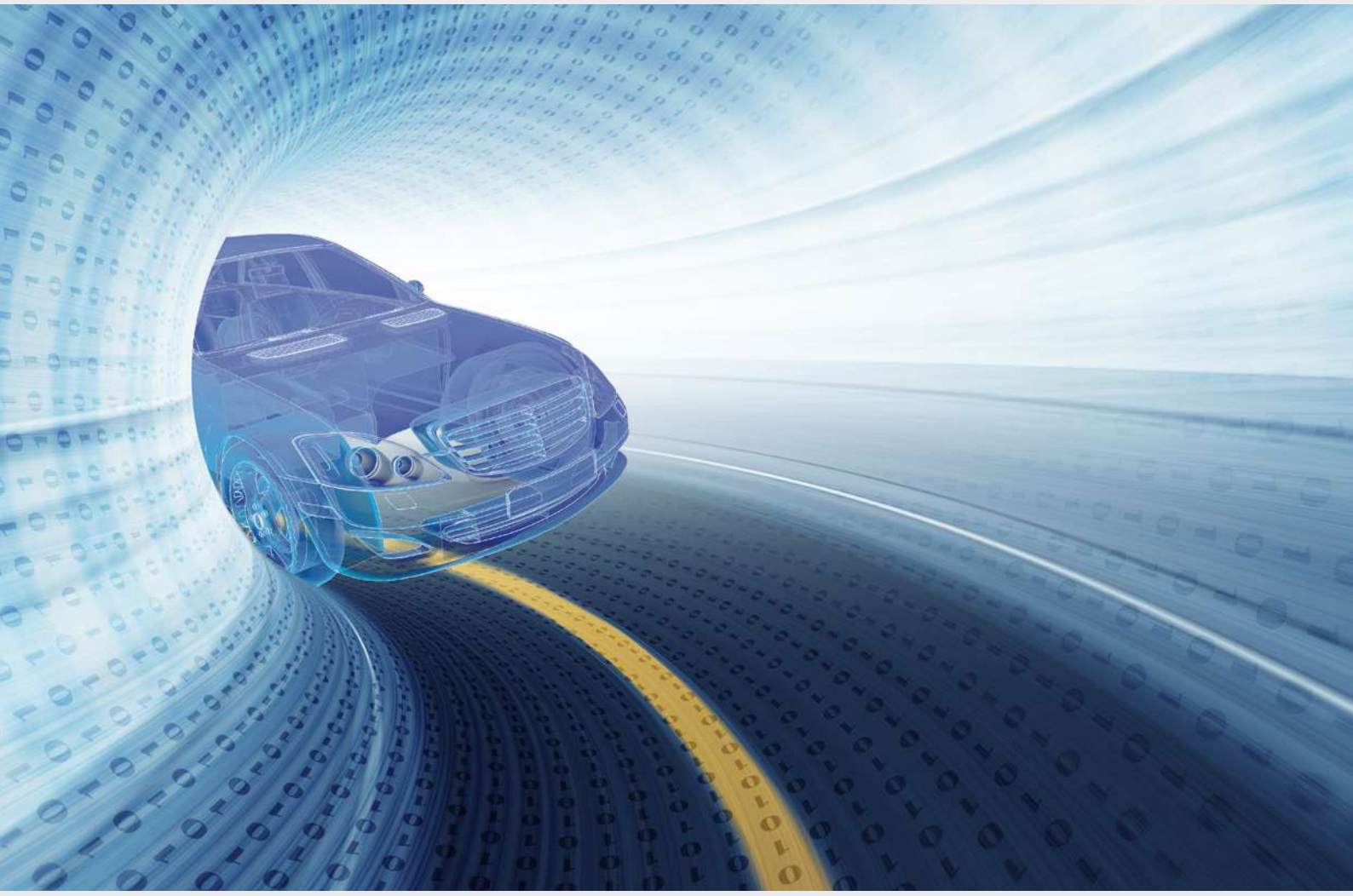
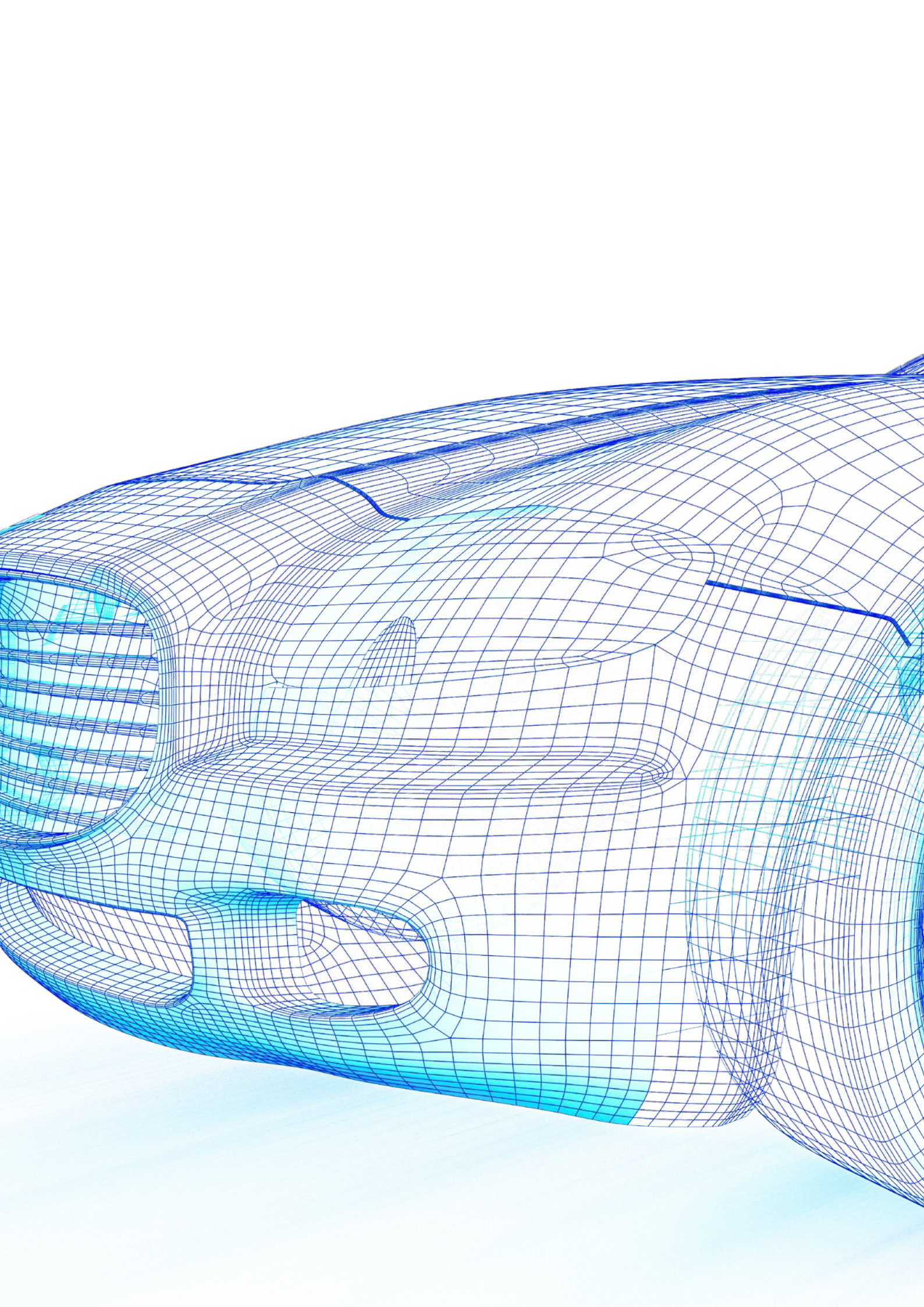
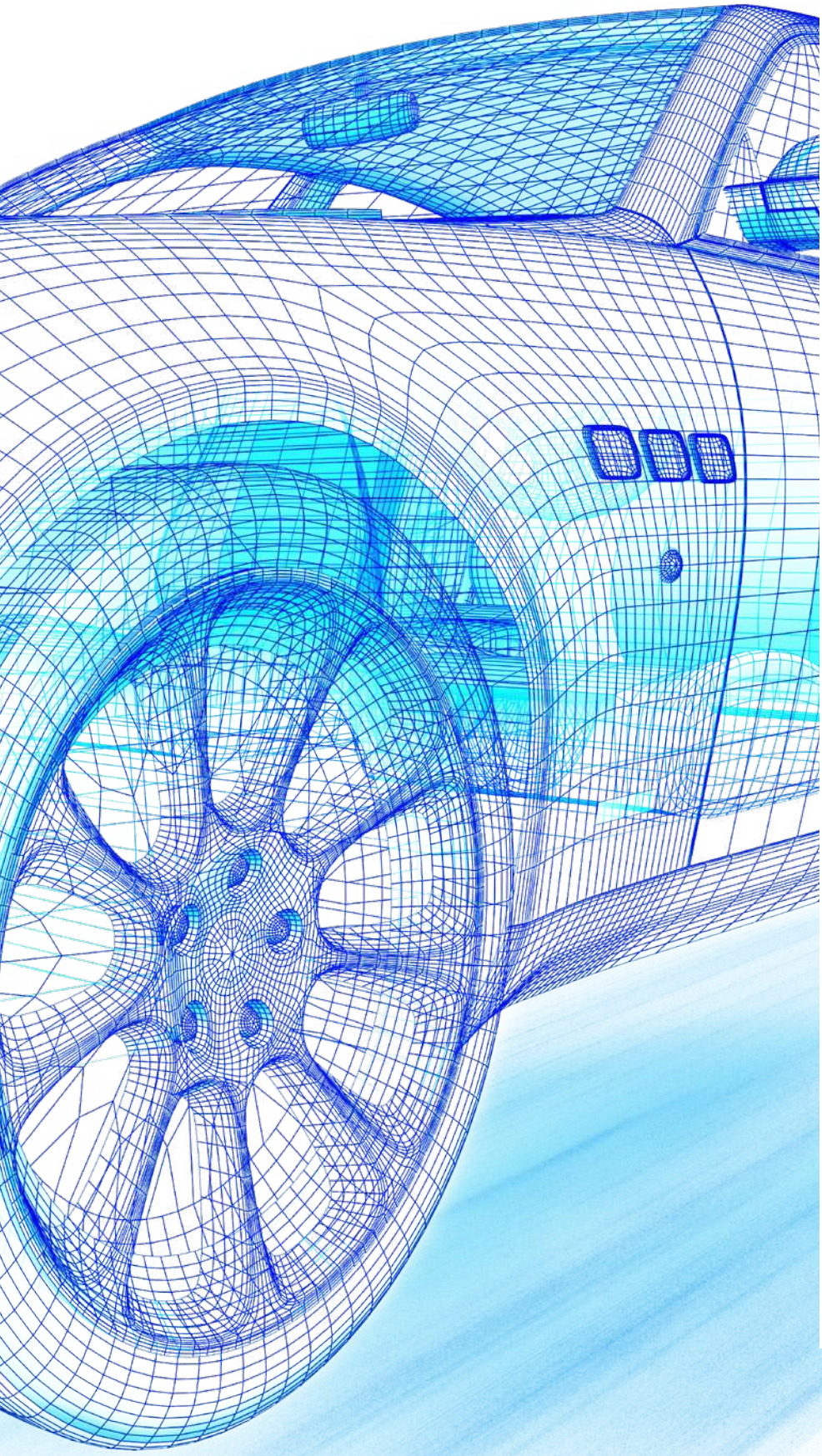
FILTER TECHNOLOGY



Automotive Filters & Components



Automotive Filters & Components



4 OUT OF 5 CARS RUN FILTER SOLUTIONS FROM GVS

This catalog is designed to provide complete information about the full range of GVS automotive filter solutions and technologies. For the sake of simplicity and clarity, the catalog is divided into two main parts.

The first section features the wide range of GVS product categories, consisting of a set of entries illustrating the general characteristics and the fields of application:

Chassis Systems (ABS - Brake filters, Solenoid valve filters, washer reservoir system);

Powertrain (Transmission, Steering, Engine Oil and Hydraulic filters);

Fuel System Management (Gasoline and Diesel Injector filters, Fuel Tank strainers and filters, Fuel Pressure Regulators, Breather filters, Diesel fuel water separators);

SCR Urea Systems (In-tank, Cartridge, Injector, Purge Management);

Ventilation (Ventilation Membrane filters, Electric power windows driver, Membranes, Sensor, Crankcase);

Air Management (Engine Air Intake, Cabin Air)

Mechanical Technology (Throttle bodies, Valves, Flaps, Metallic Shafts, Insert Molded shafts, Gears);

Racing and Extreme Sports (High Performance Fuel Management, High Performance Air Management, GVS NANO™ High Performance Fuel Filtration).

Technologies and products are accompanied by a brief description featuring the main technical specifications.

The second section covers some basic concepts about filtration and preferred materials: woven and nonwoven fabric filtration media, polymeric membrane, polymers for injection and metals for automotive applications. The goal is to clarify key aspects of filtration technology applied to the specific applications. Our Sales Engineers are always available for any further explanation. The following properties should be considered at the time of selecting the proper filter media for your application. Filters and components made by GVS cover all of the requirements of the automotive market. New made-to-order custom molds may be manufactured on request in order to satisfy special needs, producing automotive devices and articles with special dimensions, shape and purpose.

With over 300 million automotive filters manufactured per year, we let you achieve your performance needs in the most effective way

With 40 years of experience, the GVS Group has grown to become one of the leading worldwide manufacturers of micro-porous and track etched membrane and microfiltration devices for applications in Healthcare, Automotive, Life Science, Personal Protection, HVAC and Appliance industries, outdoor power equipment, powersport and on-and off highway commercial vehicle markets. Technological innovation has always had top priority on GVS' corporate agenda, as well as constant commitment and dedication to product and process quality improvement through a globalization of our services with 12 manufacturing plants around the world. That's why GVS is in an ideal position today to successfully meet the new and increasingly demanding challenges of the global market.

With 40 years of experience in injection molding with large and very large volumes (1-100 million pcs) and in high-precision mechanical processing, the GVS Group automotive division successfully meets the quality and efficiency requirements of automakers. GVS collaborates with the automotive industries' worldwide manufacturers to achieve the required performances; from the initial stages of developing the design of the product, to the creation of the prototype, right up through industrial manufacture using the most innovative production techniques. GVS is a leading supplier and innovator in the sector of in-tank fuel filters, ABS filtration component systems, low and high pressure gasoline injection systems, high pressure common rail diesel, automatic transmissions, throttle valves and fuel tanks, ventilation membranes for mechatronics applications, sensors and CPU. With factories in Brazil, Romania, US and China, GVS is a global leader in automotive filtration and a leader in the manufacture of throttle valves, gears and shafts for DBW throttle bodies.

The GVS USA operations innovated the use of the micron rated depth media strainer in the automotive fuel tank. Each new OEM product is designed and developed together with the client's technical team or in the case of innovative proprietary products, the project is completed entirely within GVS.

The GVS Group Automotive Original Equipment

GVS is the world leader in the production of injection-molded ventilation valves, with applications ranging from temperature, water and oil sensors, electronic power boxes and ABS control, electric windshield wipers, and lighting systems to innovative mechatronics. GVS produces high-volume filters for low, medium and high pressure fuel and diesel injector systems.

Highly technological and innovative design capacity allows GVS to solve all clients' steering, transmission, ABS and braking filter needs, especially for elements and special solutions with fuel tank filters that have to be inserted in limited space, therefore optimizing the performance of the final product.

By applying the GVS philosophy and investing in new technologies, GVS has become a leading firm in the manufacturing of throttle valves in aluminum, brass and special alloys. Recent investments in GVS' South America and Romania facilities, for instance, have been made for the development of a line of components for throttle bodies, shafts, drive-by-wires, air intake filters and butterfly valves for air intank systems.

While GVS experience in injection molding technology has been specialized over the years in the production of high precision automotive filters and components, gears and shaft, we are now able to solve our customers' technical needs with any other plastic components and products.

The GVS Group

Quality & Innovation

GVS has a tradition of quality, durability of the material and design technology. GVS employs a total company quality management system, capable of consistently ensuring high standards of performance, products and services. We make use of advanced design technologies, methods of error prevention, control systems and the latest in inspection technology throughout the manufacturing process to reduce the percentage of products that do not comply with specifications to near 0 ppm defect rates. GVS implements the international Quality standards expected in the relevant sectors. GVS obtained our first ISO 9001 certification in 1995 and its revision ISO 9001:2008 in 2010. Then after 8 years of certification according to QS9000 standards, in 2005 the automotive division acquired the new ISO/TS 16949: 2002 certification. In 2018 the Newest World-Wide Standard for the automotive sector is the IATF 16949 Quality Management Standard. GVS is implementing IATF 16949 at all its related facilities to ensure we maintain the highest level of Quality Management. GVS Group adheres to the UNI EN ISO 14001:2004 certification for its Environmental Management Systems (EMS).

GVS is constantly improving its organizational setup and procedures by developing and closely monitoring its quality system and ensuring high standards of performance, products, and services. Holding periodic group meetings, GVS' 0 ppm defect rates philosophy has been successfully applied to all group controlled companies elsewhere in the world.

Materials of construction for filters & components

A variety of resins, including nylon (polyamide), acetal (POM), thermoplastic elastomers (TPE), polypropylene (PP), homopolymers, and copolymers are normally used in the production of our filter housings. A wide range of thermoplastics, elastomers and technologically advanced materials are employed to fully satisfy customer specifications. The filter media we use includes our Fortex™, Gradient Density and KussLife® Gradient Density nonwoven fabric filtration and gradient media, screens of different materials such as monofilament nylon fabric, polyester and/or metal, hydrophobic and oleophobic microporous membranes; medias with pore sizes from 0.02 to 1000 micron. GVS' insert-molding know-how and production technology make it possible to use and to work with many other materials, from brass to steel to more advanced alloys.

SUPPORT MARKETING SERVICE SATISFACTION

Research & Development

Giving you a range of components from plastic to metal that fulfill all the needs of the automotive market, GVS' Research Laboratories ensure that the company's various divisions receive all the R&D resources they need. With its pioneering tools and facilities and highly sophisticated analytic techniques, ours labs also work in close conjunction with a large number of academic bodies of international acclaim.

A strong R&D presence coupled with the GVS Group's strongly innovation-oriented policy and commitment to growth has made GVS an effective innovation leader.

Large investments in R&D have gone into the development of some of our most successful products. OEM customers are closely followed, step by step, from the design through to the industrial production, while proprietary products are fully developed inhouse or in collaboration with many universities.

GVS Global Presence

GVS' global business network ensures the Group's presence in major markets across the world. GVS is in fact strongly committed to guaranteeing our customers the best service possible, providing them with efficient and effective support and assistance at all times.

Wherever our customer is located, a GVS plant has a strategic presence in both geographic and organizational terms. GVS' presence gives us the chance to meet specific requirements in different market segments, enriching the Group's overall product experience and strengthening our business profile.

Production Capability

- 12 Production plants
- 7 Clean room class 100'000
- 2 Clean room class 10'000
- 150 Injection machines from 50 to 450 tons
- 9 Assembly dept. in clean room 10'000
- 7 Injection molding dept. in clean room 100'000
- 5 Development labs
- 3 In-house tool-shops
- 8 metrological offices
- R&D with dedicated injection equipment

Manufacturing locations

Italy (3), UK (1), Brazil (1), USA (4), China (2) and Romania (1)

Sales offices

Italy, Brazil, USA, UK, Russia, Turkey, Argentina, China and Korea

For more information, visit www.gvs.com

QUALITY IMPROVEMENT STANDARD RELIABILITY

Innovative ideas & solutions in filtration products

High technological and innovative design capacity allows us to solve all of our clients' filtering problems, especially when the elements are to be used or inserted in limited space, optimizing the performances of the final product.
In over 40 years' activity GVS has been an innovator in filtration products. The traditional use of standard filtering screens and depth medias, from 10 to 160 micron, allows us to satisfy every request, even for high-speed prototyping. While the strong cross technology that distinguishes the various areas of GVS development guarantees the use of innovative filtering material, from 0.02 to 1000 micron, and advanced design to increase the resistance of the mesh and the efficiency of our products.

GVS is a leading company in high production volumes thanks to the use of completely automatic technologies. Today, we are also highly flexible in the areas of medium and low volume programs, ensuring to our customer constant process repeatability. Environmentally controlled production areas enable GVS to ensure superior cleanliness in product units, allowing us to provide to our customers filters with cleaning certification.

GVS utilizes advanced tools to develop the right solution and provide the highest levels of product quality, durability and value. GVS has deep expertise using advanced engineering analysis tools such as 3D modeling, FEA, CFA, DVA, Moldflow analysis, rapid prototyping, D/FMEA, and filter testing.

Our product lines for the automotive industry now include chassis systems, powertrain, fuel system management, SCR Urea systems, mechatronics and motor air management. The **chassis systems** line includes brakes or ABS - antilock brakes systems, TCS - traction control, ESP - electronic stability control and solenoid filters; **powertrain** technology products consist of transmission, oil, hydraulic and power steering filters; **fuel system** application products include fuel and diesel injector filters, tank filters, fuel delivery module filters, and pressure regulators; **SCR Urea system** application products include injector filters, tank filters and purge filters; **ventilation** products include ventilation membranes, adhesive membrane patches and electric power windows driver filters; **air management** products consist of air filtration products; **mechanical technology** products include throttle bodies, valves, shafts and gears; and **racing and extreme sports** products consist of higher performance fuel and air filters.

Product Lines

Automotive Filters & Components

Chassis Systems

ABS/ESP - Brake Filters

GVS' advanced technology teams have developed advanced filter solutions for the ABS-ESC/P hydraulic circuit liquid, protecting the wheel speed sensors from metallic dust contaminant and potential failure to detect wheel slip. Our special production technology is based on innovative solutions.
With the production of very high volume co-molded personalized filters and automatic molds producing up to 100 million zero-defect filters per year, it is certainly a benchmark for every new ABS - ESC/P system, from the project development stage to the finished product.
The GVS production in class 100,000 clean rooms guarantee levels of cleanliness in line with required standards where no particles are allowed. The standard filtering materials in PE, PA and steel satisfy every production specification, while research and technological development allow new solutions to be obtained which improve the performance of the products and reduce unit production costs.
GVS has always believed in applying policies of strong technological investments and today, this means an average increase of 25% per year in production volumes.

Solenoid valve filters

Solenoid/isolation valves are used to equip the anti-lock braking system (ABS) to prevent fluid from entering the wheel brake area when ABS is used. The normally closed valve is then energized (opened) which releases pressure from the wheel causing a pressure drop across the isolation valve. The above causes the isolation valve to move closing a ball seat valve which isolates the master cylinder (pedal) from the wheel (pump, solenoid, etc.). The actual movement of the isolation valve is caused by the pressure generated by the pump. Filters in the valving system avoid contamination that could cause a valve to fail to open or close.

Washer Reservoir System Filters

The Automotive Windshield Wiper System removes water and debris from the windshield to maintain a clear view of road ahead in inclement weather. Inside the windshield wiper system is a fluid reservoir and pump that circulates washer fluid through plastic lines to the washer nozzles. These nozzles spray fluid evenly onto the windshield when activated. GVS supplies coarse filters used to filter the washer fluid and remove debris that could clog the plastic lines or nozzles.

Transmission filters

The requirements of modern automatic transmissions according to efficiency, convenience and environmental sustainability are constantly growing. These demands are met by developing new, more complex and thus more sensitive systems. Examples for new transmission conceptions are CVT´s (continuously variable transmissions) or double clutch transmissions.
As specialists for filtration systems, GVS contributes to these developments by offering modern conceptions to improve the transmission fluid cleanliness. Contaminants can enter your transmission fluid system in the manufacturing process. They can also enter the transmission through the vent, or through the dipstick and fill tube during fluid level checking/filling. Most of the time, however, contaminants are the result of normal wear. These contaminants consist of metal chips and flakes from gears and bushings and fine fibrous materials from clutch facings. Automatic transmission filters protect automatic transmissions against contaminants in the transmission fluid system. Proper filtration helps improve transmission life by minimizing wear and preventing sticking and scoring of sensitive shift control valves. In the event of a part failure, the filter also guards against secondary damage to other parts and thus helps to minimize repair costs.

TYPICAL MATERIALS USED

Stainless Steel, mesh or PET/PEEK mesh.

GVS TECHNOLOGIES APPLIED TO THIS PRODUCT

Ability to manufacture filters without use of sealing o-rings – using Co-Molding and Over-Molding of silicon or rubber elastomer seals.
Resistance to high temp: up to 160°C.
Level of cleanliness generally required is Class 19/17/14 according to ISO 4406.

Steering filters

Electric and electro-hydraulic power steering systems require mechatronic solutions expertise to reduce the steering effort of cars by using an external power source to assist in turning the wheels. GVS is in the lead in the manufacturing of ventilation membranes for these applications (see the chapter for ventilation filters).

Engine Oil filters

The requirements of modern engines require engine oil supply with high performance filtration and temperature durability. As an engine runs, the metal surfaces wear down and release tiny abrasive particles. These particles can block oil flow and damage the engine. The oil filter catches these particle, preventing potential wear and damage to the engine surfaces. GVS led the market in the development and launch of a high volume ALL Plastic Oil Filter and housing assembly for the US truck market. The assembly utilizes engineered materials to replace the traditional metal housing. This unique design leverages a durable and lightweight design with the consumer in mind for ease in service. GVS supplies traditional spin on oil filters for multiple automotive and small engine markets.

Hydraulic filters

The hydraulic systems wear differently and require filters designed for their specific needs. High pressure and high temperature call for unique filtration components and filter characteristics.
GVS is uniquely positioned to provide filtration solutions to our customers for any hydraulic application.

GVS Powertrain Test Procedures follow International Standards such as:
SAE HS- 806
SAE J 2709
ISO 16889

Gasoline and Diesel Injector Filters

The functional objectives of fuel injection systems can vary depending on a design decision for particular system optimization such as: power output fuel efficiency, emissions performance, ability to accommodate alternative fuels, durability, reliability, drivability and smooth operation, initial cost, maintenance cost, diagnostic capability, and range of environmental operation. Some combinations of these goals are conflicting, and can be challenging for a single engine control system to fully optimize all criteria simultaneously.

25 years of GVS injection systems filtration experience meets the quality requirements of the most demanding automotive manufacturers worldwide. Our injector filter technology equips high pressure Piezo direct fuel injection that, in conjunction with advanced engine management systems, is credited for delivering higher torque and improved vehicle fuel economy. This is the state-of-the-art trend for today's automotive gasoline engines.

Starting from the research stage and design of the product on an experimental level, right up to large-scale production, GVS has acquired vast experience in injection technology needs and has become a leading firm at the international level in the construction of very high-volume injector filters for low, medium and high pressure fuel and diesel injector systems.

The quality and experience acquired in this sector enables GVS to offer innovative solutions and patented design which make it possible to increase the filter surface, even in extremely small spaces, respecting the specifications or increasing the performance of the product up to 30%. The entire production phase takes place in class 100,000 clean rooms with fully automatic equipment, with a production capacity reaching over 25 million filters per year for each mold.

GVS covers a wide range of **injector system filtration** needs, starting with standard products such as diesel, low pressure, direct injection, methane, piezo, and conical gpl with stainless steel mesh, and including OEM solutions for more sophisticated systems and technologies. Filter materials used range between 8 and 100 micron and the screens in PA, PE, PPS and stainless steel offer different flow capacities according to the specifications required by the final product.

Piezo injector for the gasoline direct injection from Bosch

Fuel Tank Filters

(In-Tank Pump Strainers / Filters, Pressure Side (Fine) Filters and In-Line Housed Filters)

Fuel filters are incorporated in the automotive fuel tank to protect the fuel pump from debris and contaminants present in the fuel. Electric fuel pumps are placed directly inside the fuel tank to supply the engine with controlled fuel flow and injection pressure. Fuel filters are key in reducing wear on the fuel system components and ensuring consistent fuel flow can be maintained to the engine. Today's engines require more fuel flow and cleaner fuel to achieve higher standards in emissions control and fuel economy and engine performance. GVS is the premier supplier to the fuel system manufacturers, supplying innovative filtration technologies that provided enhanced performance and protection to the fuel system and the engine.

Since innovating automotive fuel filtration with depth media over 25 years ago, GVS Technology has continued to introduce new filtration solutions and considerably improved the standards in the fuel tank filters application sector. Highly innovative designs allow GVS to solve a wide range of different filtration challenges put forth by the clients, especially by providing special solutions with compact design for intricate installations, and optimizing the performances of the complete system.
The use of a wide range of filtration media, (ranging from 7 to 300 micron), enables GVS to satisfy all requests for filtration protection. GVS provides design solutions fast with customized high-speed prototyping. The strong cross technology that has always distinguished the various areas of development enables GVS to propose filtration media and innovative designs to increase performances and reduce the costs of their final products.

As the leader in high production volumes with fully automatic insert-molding processes, GVS today is highly flexible in applications of medium and low volumes, exploiting the new potentials offered by the new production plants in developing countries.

Filter Testing

GVS Filtration has extensive and proven knowledge in Automotive Filter Testing and evaluation of the interrelationship between the filter media and filter performance. GVS leverages this expertise to provide filters that maximize system performance and meet or exceed the customer's requirements. GVS provides product testing and technical support from concept development through product validation and manufacturing.

DEPTH MEDIA - THE ORIGINAL GRADIENT FILTRATION MATERIAL

GVS developed the first innovative Gradient Density filtration media for In-Tank Fuel Filtration, ensuring the high performances and cost benefits. R&D Laboratory test results show excellent barrier properties to protect parts from damage caused by contaminants; enabling improvements and sustainability in pressure drop, efficiency and durability:

- **Superior capacity.** Multi-layer media and tri-dimensional filtration surface increases retention capacity.
- **Higher Efficiency.** Customized Filtration media provides the particle size efficiency needs without negative affects on pressure drop or filter life.
- **Extended durability.** Proprietary material construction and fuel durable materials provide longer filter life.
- **Extreme Flexibility.** Contamination retention spectrum can be tailored according to different needs. Flexible filters can be designed to fit into complex locations and complex shapes for optimal filter media area.
- Wide filtration range availability and compatibility with new fuel types.

Fuel system management

APPLICATIONS
- Fuel Delivery Modules
- Fuel Tanks.
- Diesel Fuel Systems.
- Saddle Tanks.
- In tank electrical fuel suction pump

ADDITIONAL PRODUCT FEATURES AVAILABLE
- Shapes and Sizes to maximize wicking and dust capacity
- Bent Filters for maximum area usage
- Reduced System Components
- Molded-In System interfaces (snaps, anti-rotation, wiper lips, retention, tabs)
- Housing and Pressure vessels
- Integrated Noise/Vibration Dampening
- ESD Static management
- Exceptional Fuel Handling and sloshing performance in Low Fuel conditions
- Serviceability
- Diesel Cold Start Management

TYPICAL MATERIALS USED

Plastic: POM, PA 6 and PA6.6

Media: PET for non-alcohol applications

PA6/PA66 for gasoline, diesel and gasohol application

Fortex™, Gradient Density and KussLife® Depth Media for Dirty environments, long life and superior contamination capture and fuel handling

GVS TECHNOLOGIES APPLIED TO THIS PRODUCT
- Fortex™, KussLife® and Gradient Density Depth Medias.
- High Cavity Molding operations for reduced cycle time and cost
- Internal Cut and Mold
- Innovative In-Mold Filter Forming
- 3D printing for Low Volume Manufacturing
- Fuel Delivery Module Capacity Testing for Multiple Filter Performance Balancing

TYPICAL TESTS AND GVS TEST CAPABILITIES
- Fuel Flow versus Pressure Drop (flow x pressure)
- Micron size retention efficiency (%)
- Dust (Contaminants) Holding Capacity (DHC)
- Tensile Strength
- Collapse Strength
- Burst Strength
- Cleanliness
- Fuel Permeability
- Air Inclusion and Suction Performance
- Water Separation
- Temperature Aging
- Fuel Aging
- Fuel Delivery Module System Dust Holding Capacity

GVS Test Procedures follow International Standards such as:
- SAE J 1985
- SAE J 905
- ISO 19438
- ISO 4020
- ISO 4548-12
- JIS D1608

Summary of GVS capacities in In-Tank Filters manufacturing
- Filtering Media used: PA6, PA6.6, PET, PP open Mesh; Non-Woven and woven;
- Production Technologies: insert-molding, over-molding, two step molding, in-mold pleating, ultrasonic welding, Insert cutting with laser technology
- In-House filtration Test Laboratory
- Design optimization to improve performance
- 3D Prototyping
- High-Speed Prototyping

Fuel Pressure Regulators

Fuel pressure regulator devices are connected to the fuel rail to balance and keep the pressure in the fuel system. This keeps the injectors at a constant pressure through a spring-loaded membrane which allows the opening of the return-flow channel. The valve uncovers a fuel line that returns excess fuel to the fuel tank when it is opened by excessive pressure in the fuel lines. If the pressure of the fuel is less than the membrane pressure, the excess fuel flows back to the fuel tank increasing the fuel pressure at the injector. If the pressure of the fuel supplied exceeds the spring-loaded membrane, the diaphragm retracts the valve to discharge the excess fuel and thus reduce the fuel pressure at the injector. As the pressure difference between the two sides of the injectors are balanced and constant, the amount of fuel injected depends solely on the opening time of the injectors.

Breather Filters

Gas Cap Breather filters

Traditional Vehicle Gas caps function in multiple ways to protect and seal off the fuel tank system. The gas cap screws into the top of the filler neck and seals to keep out debris and block fuel vapor leakage. A filter can be incorporated into the gas cap for air venting during use. The filter aids to block debris from entering the tank during cap removal and to allow for controlled escape path for air pressure when opening the tank. This controlled pre-release of air reduces the possibility of any fuel expulsion from the tank towards the consumer.

Filler Neck filters

A newer trend is the use of filters in the fuel line of the filler neck. This seeks to reduce and remove debris from the fuel before it enters the fuel tank. A filter can be incorporated into the end of the filler neck with or without venting.

Tank Breather filters

The air pressure and volume changes internal to the fuel tank require compensation with air from outside. This compensated air needs filtered to remove contaminant present in the incoming air. The breather filter can be directly attached to the fuel tank or as a component to the carbon canister.

GVS provides unique Air Filters for tank breathers and carbon canisters that utilize filtration media designed to block water and humidity in the air from entering into the system. Water vapor can affect fuel quality and carbon canister function.

Diesel fuel water separators

The presence of water in Diesel fuel causes multiple failure modes in the fuel system and its components. Water and solid contaminants affect the diesel fuel's lubrication of high precision injection components. This can result in excessive wear, erosion, surface pitting and pressure loss of the diesel high pressure fuel system. Fuel Water Separators are used to remove debris and water from the fuel prior to the fuel flow to the fuel systems. These filters use specialized filtration medias and membranes to coalesce and capture the water present in the Diesel fuel. The Fuel Water Separators remove water from the fuel before the fuel reaches the fuel pump and injectors. This prevents the major causes of diesel fuel injection system failure and prolongs system life.

Tank Filters (In-Tank Strainers, Filters, Inline Filters and Housed Assemblies)

Selective Catalytic Reduction (SCR) systems are used in diesel engine applications to meet the world's increasingly stringent NOx emissions standards. Aqueous Urea Solution, Urea, AdBlue and DEF are terms used for the fluid used in the SCR systems. This fluid is added to, "dosed" into, the exhaust of the diesel engine vehicles and a chemical reaction reduces the harmful fumes exiting into the environment.

Filtration of the Dosing fluid is needed to remove contaminants before dosing occurs. GVS leveraged its extensive and proven knowledge in automotive fuel systems to develop patented high performance Dosing filters for the SCR tank system to maximize system performance.

Over the years GVS technology has introduced new solutions and considerably improved the standards of reference in the SCR tank filters application sector. Highly innovative design skills allow GVS to solve a wide range of different filtration problems put forth by the clients, especially by providing special solutions with compact design for intricate installations, and optimizing the performances of the final product.

SCR Urea Systems

ADDITIONAL PRODUCT FEATURES AVAILABLE

- Shapes and Sizes to maximize wicking and dust capacity
- Bent Filters for maximum area usage
- Reduced System Components
- Molded-In System interfaces (snaps, anti rotation, wiper lips, retention, tabs)
- Housing and Pressure vessels
- Fuel Handling
- Freeze, Thaw and Purge management through unique filter designs
- Serviceability
- Cold Start Management

TYPICAL MATERIALS USED

- Plastic: POM and Nylon 6
- Media: Nylon PA6/PA66 and Gradient Density Depth Media for maximum performance in a compact filter

GVS TECHNOLOGIES APPLIED TO THIS PRODUCT

- KussLife® and Gradient Density Depth Medias.
- Innovative In-Mold Filter Forming
- 3D printing for Low Volume Manufacturing
-

TYPICAL TESTS AND GVS TEST CAPABILITIES

- GVS has developed special Testing protocols for the SCR application
- Low Flow Test stands
- Climate Chambers for Freeze/Thaw Testing
- Flow versus Pressure Drop (flow x pressure)
- Micron size retention efficiency (%)
- Dust (Contaminants) Holding Capacity (DHC)

SCR injector filters

GVS utilized its vast expertise in injection technology for the fuel system to apply to the application of injector filters in the SCR system. Common to both systems, in the SCR there are injector nozzles used to spray the Dosing Fluid into the exhaust stream. Without fluid filters the nozzle may become clogged with debris. The SCR injector filter is designed to remove this debris before the dosing fluid flows to the nozzle.

Ventilation Membrane Filters

With a production exceeding 5 billion pieces manufactured in the last 10 years and more than 800 million ventilation filters manufactured in 2018, GVS is the world leader in the production of injection molded ventilation valves for electronics packaging and waterproof ventilation filters for window motors, and wipers, and membranes for air, temperature or pressure sensors.

Retaining water and simultaneously allowing air to pass freely through the filter media, vent filters enable continuous exchange of gases and vapors. This provides pressure equalization within the auto parts enclosures that are often exposed to fast temperature fluctuations, causing extreme changes in internal pressure, and reducing condensation, protecting electrical parts from pollution and liquid.

Vented closures prevent housing distortion due to:

- Product off-gassing
- Oxygen scavenging/product migration
- Changes in temperature
- Changes in altitude
- Dispensing

The applications range from temperature, water and oil sensors, electronic power boxes and ABS control, electric windscreen and lighting systems to the whole innovative mechatronics with IP specifications.

More than 60 different types of membranes allow GVS clients to choose the best solution in terms of performance, quality and price.
GVS' experience of industrial production in the membrane sector dates back 28 years, when major technological investments and a wide range of innovative patents allowed them to confront the leaders of the sector with confidence. Today GVS has become the market's main point of reference for very high volume productions.

HYDROPHOBIC / OLEOPHOBIC MOLDED VENTILATION PRODUCTS

GVS microporous membranes range in pore size from 0.2 to 1.2 micron, covering lifetime needs for water intrusion resistance and air permeability. Our proprietary surface treatments enhance the hydro-repellency and oleo-repellency of the membrane.

- Horn Filters
- Insert molded ventilation valves for ECU, ABS, Power-train and Window anti-trap unit, Climate control units.
- Insert molded ventilation filters for window motors, wipers, air sensors, oil temp. pressure sensors, water temperature and mechatronics, head-lamps, fog-lamps.
- Patches and Adhesive membranes

VENTILATION

Electric power windows driver

Original lifting mechanisms making car windows go up and down, were first introduced in the 1940's. They have been extensively developed during the past few decades with several additional features such as automatic up/down, window control from outside and courtesy power-on function. It's driven by a small electric engine attached to a gear reduction system with a self-locking feature allowing it to lift and affix to the window glass.

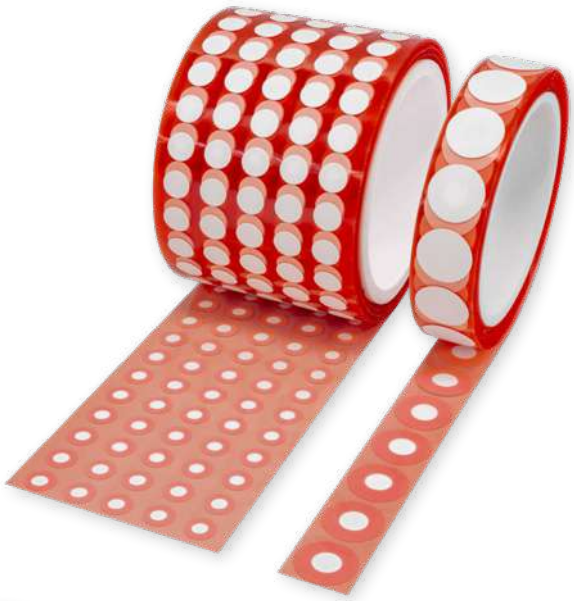
The powering motor can be switched by a control panel and distributed by two side contacts allowing the windows to run in different directions when selected. The window control is usually integrated in the door along with power-mirror, power-lock and power-seat controls.. An integrated relay is charged to transmit the power to the window control.

An **electric power window driver** is one of the traditional applications for the GVS membrane filter designed to meet different requirements for the latest compact, quieter and lighter generation of car window drives. Actual power window rotor and gearbox materials now enable us to develop extremely high-tech devices, characterized by a significant simplification thanks to a reduction in the number of components compared to the past.
By separating different housings for electronic controls and regulating systems, avoiding moisture contact, allowing developing water vapor to leave the system and preventing rain water to enter through the membrane, GVS electric power window driver filters now equip many power window systems used by the most important manufacturers in the world.

Engine crankcase ventilation

The crankcase ventilation system (CVS) is a one way passage for the blow-by gases to escape in a controlled and filtered manner from the crankcase of a combustion engine. Crankcase blow-by gases are sources of particulate emissions loss of lubricating oil and cause fouling of external surfaces and unregulated emissions.

GVS carries the expertise to design and manufacture open and closed crankcase ventilation systems required to meet the stringent emission regulations for motorcycles, automotive and commercial vehicles along with off highway constructions, forestry, agriculture and recreational vehicles.



Air Management

GVS is a global leader in the design, development and manufacture of Air filters for the transportation industry.

Engine air filters for intake and maximum engine performance

Air filters are a key component of the vehicle and are used to clean the air that goes into the engine as required for effective combustion. The air filter removes abrasive particles from the entry air ensuring combustion occurs in the best possible conditions and maintaining optimal fuel efficiency of the vehicle. Without the proper combustion, fuel mileage and power are both reduced.

GVS provides air filters that meet the manufacturer's specification exeeding the market standards, and providing optimal performance and particle blocking power. The GVS cleanable air filter line targets high flow needs for the high performance passenger car and truck aftermarket. The reusable filter can be washed and reused with guaranteed continued filter performance; eliminating expense of frequent filter replacement or use of recharge oiling kits.

Cabin Air filters for optimal clean and breathable air

Each of todays' modern vehicles include a cabin air filter designed to catch dust particles and pollen outside the vehicle and prevents them from entering the car. These filters are important for keeping the air inside the car clean and breathable no matter the external environmental conditions. GVS designs cabin air filters for passenger and agricultural vehicle interior cabins to protect the driver and passengers from potential environmental hazards. Cabin air filters can include carbon inside the filter to reduce odors present in the entering air.

APPLICATIONS
Engine Air intake
Emission System Air intake
Cabin Air and A/C Air filtration

ADDITIONAL PRODUCT FEATURES AVAILABLE
Reduced System Components
System interfaces (snaps, anti-rotation, wiper lips, retention, tabs)
Integrated Noise/Vibration Dampening
Serviceability
UL for Flammability resistance and flame retardancy
Water repellency
Washable without added treatments
Carbon additives for odor absorption

TYPICAL MATERIALS USED
Plastic frames
Urethane flexible frames
Adhesive-free Paper to Plastic bonding
Filtration Medias, including Cellulose, synthetics, laminate multi-layer, flame retardant, water resistant

GVS TECHNOLOGIES APPLIED TO THIS PRODUCT
GVS® NANO filtration media
KussLife® A120 Air Filtration media
Pleating
Urethane Molding
High Speed embedding

TYPICAL TESTS AND GVS TEST CAPABILITIES
Fuel Flow versus Pressure Drop (flow x pressure)
Micron size retention efficiency (%)
Dust (Contaminates) Holding Capacity (DHC)
Flammability
Wet Strength and Collapse
Dust Swirl
Water Holdout
Backfire
Heat Soak
Compression Set
Fractional Efficiency
Dynamic Vibration

GVS Test Procedures follow International Standards such as:
ISO 5011
GMW 3232 Flammability
ISO/TS 11155-1
ISO/TS 19713
JIS D1612

Mechanical Technology

Investing heavily in new technologies, GVS has become a leading firm worldwide for high-precision mechanical processing with large and very large volumes (1-100 million pcs) in the manufacturing of throttle bodies, valves, shafts and gears in plastics, aluminum, brass and special alloys.

Valves

Regulating the air/fuel mix by increasing or decreasing the volume of incoming air, throttle body system butterfly valves can be mechanical, electromotive or fully electronic (drive-by-wire).

Valves can be mechanically linked to the accelerator pedal or can be controlled through a combination of accelerator pedal and ECU or exclusively through electronic signals from the engine management system.

With more than 30 years of experience in valves and many tens of millions units released, GVS Automotive has been specializing in the production of butterfly valves. GVS caught up to today's levels of precision allowing us to claim our world-wide technological and market-share leadership.

These results have been achieved thanks to unique process propositions allowing to obtain customers' confidence and market differentiation. For example:

- A wide range of available diameter sizes, from 34mm to over 64mm, ensure important time and cost reduction.
- GVS' experience in the internal design of the production systems and Italian CNC high precision lathe technology
- enables us to maintain the high precision required by the valves (+/- 4 micron) at an industrial production level.
- In order to guarantee the requested tolerances, humidity and temperature in the production areas are constantly controlled to cut down heat expansion, which would otherwise lead to an increase in the working tolerances.
- GVS' environmentally controlled production areas along with skilled working people's awareness of every single micron part importance enable us to ensure superior cleaning in our products.
- Thanks to GVS longstanding experience in advanced design technologies, methods of error prevention and control systems throughout the whole manufacturing process, our 0 PPM system comes out of constantly working in critical sectors such as medical, ABS brake systems and fuel injectors.
- Aluminum, brass and special alloy properties knowledge and experience ensure GVS to succeed in matching high quality level and price to satisfy every demand in performance and cost while developing valves for throttle bodies with innovative materials such as plastic, plastic and metal combinations with toothed co-molded sector for DBW, as well as other innovative solutions.
- A Metrological area with instruments for highly sophisticated working programs.
- The quality control for valves can be assured by experienced technicians working with GVS for more than 20 years. Our technicians are specialized in the complicated field of metrology for valves and gears. This helps to avoid first timer (rookie) programming errors, mistakes in measuring particular units characterized by different angle sizes and surface measurements that could easily generate serious problems if not measured correctly.
- For customers looking for particular work on the diameter, GVS also offers a post process allowing external angles to soften, therefore avoiding estate compromising but guaranteeing a better and immediate valve functionality by eliminating the traditional culvert adaptation period.
- Extensive presence in the markets of reference finally allows GVS to follow you in every market, nationalizing your local projects.

Metallic shafts & insert molded shafts

GVS forged the need for high technology products, as a heavy user of metallic shafts for the throttle body. Difficulty in securing high quality precision products in the market led GVS in 2019 to integrate processes into their own operations. These processes could be tailored to the stamping process and utilize high precision stamps common to GVS. Thanks to the experience development in shaft utilization, the extensive knowledge concerning production process weaknesses, and the decades of experience in working with valves, GVS invested heavily to integrate these processes in house and has become a leading manufacturer with a integrated automatic CNC (computer numerical control) center.

GVS' high precision machine tools can produce work with a 5 micron margin. Highly skilled staff allow us to realize every kind of requested shaft respecting a high process effectiveness and the highest degree of precision. This automatic line has been completed with a high capacity induction hardening that guarantees an additional advantage to the line: the continuity of the production cycle through a stiff flow allowing related advantages such as quality, economizations and manufacturing organization. In the classic shaft production process, units are produced separately and then sent to be hardened externally. They are then returned inside to be reworked.
The whole line is automatically monitored by sensors constantly verifying the quality of the product. This guarantees process stability and repeatability, allowing controls that are not dependent upon human interventions (typically more than 20). This eliminates the extreme fragmentation of the process. Like any other product line, GVS distinguishes itself from other traditional producers thanks to a contamination controlled atmosphere and the awareness of its operating staff that perfectly understands cleanliness, precision, and the non-defective state requirements demanded during the next step of the process: the injection molding or the assembly phase in the throttle body. Both of these processes requires zero errors.
The materials used can vary from stainless steels with a low carbon percentage to stainless steels characterized by high corrosion resistance that typically include:

- AISI 420C
- SAE 12L14
- DIN 9SMnPb28K

The highly skilled staff at GVS, thanks to the complete in-house laboratory equipped with metallographic cutting machine, metallographic inserting device, polishing device, and microdurometer is able to quickly supply a statement on the quality and capacity produced from the line.

The key element of quality for shaft production is the centering technique points in the shaft used for the overmolding process. If correctly developed, they guarantee 0 defects in the finished product for the final user. This is the important GVS know how that, thanks to the deep knowledge of these techniques, can easily succeed to perfectly produce shafts with respect to the insert-molding requirements, ensuring the required quality from the beginning to the end of the process. With respect to all these points, GVS guarantees a strong process and a resulting product that is in compliance with the final customer requirements.

Air Management

Gears

With the philosophy in mind to give full service to our customers, in 2001 we developed our first full plastic gear line to be used in automotive applications. Today plastic molded gears are showing new potentials and new advantages that can be exploited, since they can be easily used for applications that cannot be served by metal gears. Inspection equipment is now capable of measuring these unique parts with great precision.

The Double Flank Gear Rolling test is used to determine and validate process control, simulating gear working conditions and assuring consistency of the molded part in production. Roll testing can give an indication of shrinkage tolerances by detecting/measuring center distance deviation and looking at the total effect of gear errors, but it cannot calculate the amount of error or correction needed. It is usually used to assure that the same gear sizes are molded consistently during the production process.
The Double Flank Rolling Test consists of the following parameter evaluations:
Fi" - Total composite error (TCE) or Double Flank Rotational Deviation: this represents the difference between the biggest and the smallest center distance during one revolution of the part. Gear quality can be judged from here and when values are out of tolerance, it is possible to easily identify problems and correct them.
fi" - Tooth to Tooth error: Represents the quality of the teeth of the gear. It is revealed as a variation in the working center.
Fr" - Runout error: Reveals eccentricity errors.
Aa" - Average center Distance: Checks the gear size during a rolling test.
Master gears are brought into contact with the work gear for testing. Their material and profile quality has to be better than the tested gear, while speed has to be slow enough to guarantee correct movement of the measurement. This depends on the diameter, width and weight of the gear, avoiding the center distance change between the master and tested gear. Also, the measuring force must be correct since it can easily influence test results preventing typical test errors such as profile error, deviation of the outer flank, tooth thickness variations, pitch errors or profile waviness.

By measuring the complete gear, the rolling test allows GVS total quality (100% check) control production for several kinds of gears in plastic as well as metal shafts with toothed co-molded sector for DBW (Drive by-wire), middle gears and pinion gear technologies for automotive.
All of these and many others are the controls applied by GVS during production. Through an innovative Machine, we are able to give you a fully automatic 100% inspection. Our great experience in different polymers can help our customer in choosing the best plastic for their specific applications.

High performance fuel management

The GVS high performance line of G-Force™ fuel filters were designed to improve fuel system performance by providing excellent filtration and fluid flow at high flow rates and extreme conditions and G-forces. Proper filter design allows for constant flow of fuel to the fuel system and engine and reduces contaminants present in the fuel to allow the fuel to be combusted more efficiently.

GVS Filter media outperforms other media during extreme fuel pick up conditions. Our proprietary media seals the filter surface with fuel to ensure a continued supply of fuel without introducing air into the fuel lines. Air in the fuel system can result in hesitation, stalling or poor engine performance.

Made to perform in extreme conditions: hard cornering, banking, acceleration and deceleration, low fuel, high inclines, high fuel flow and extreme climbs and dives.

Filter shapes and sizes can be specially designed to match the insides of the fuel delivery module or hug the surfaces of the fuel tank to enhance fuel pickup during extreme conditions.

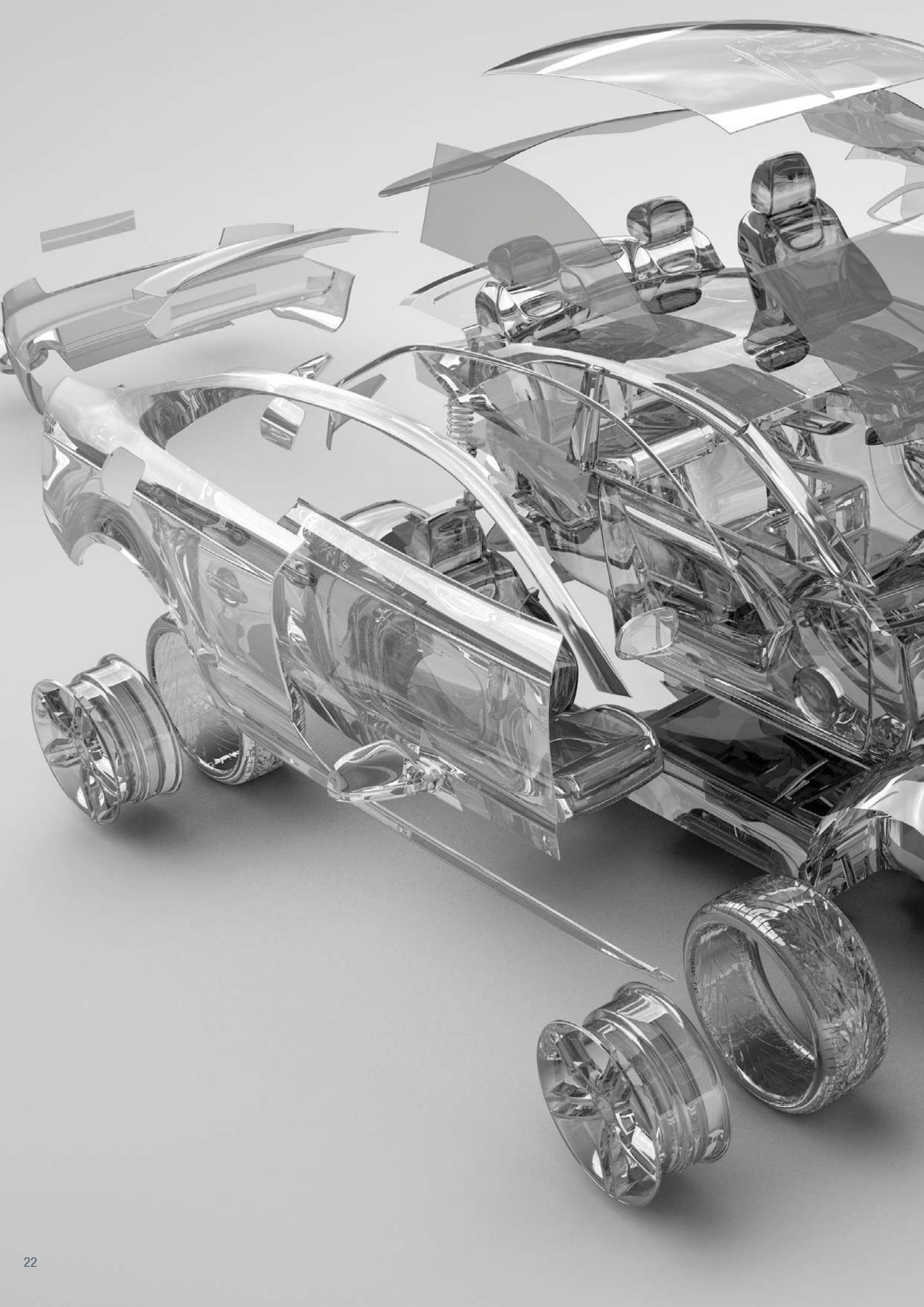
High performance air intake

Replace restrictive factory air intake system filters with a filter designed for high-performance without compromising engine efficiency. GVS makes specialty filters using innovative media like hydrophobic, dry washable, polyester blend, cellulose blend and engineered textile.

High Performance Air intake systems are designed to eliminate the major sources of air flow restriction that your vehicle experiences from the factory intake system. With more air flow the Engine can produce more horsepower for your toughest extreme sport. Get More Power without sacrificing filter protection. High Performance filters provide the 99%+ dust capturing technology needed to protect your engine components.

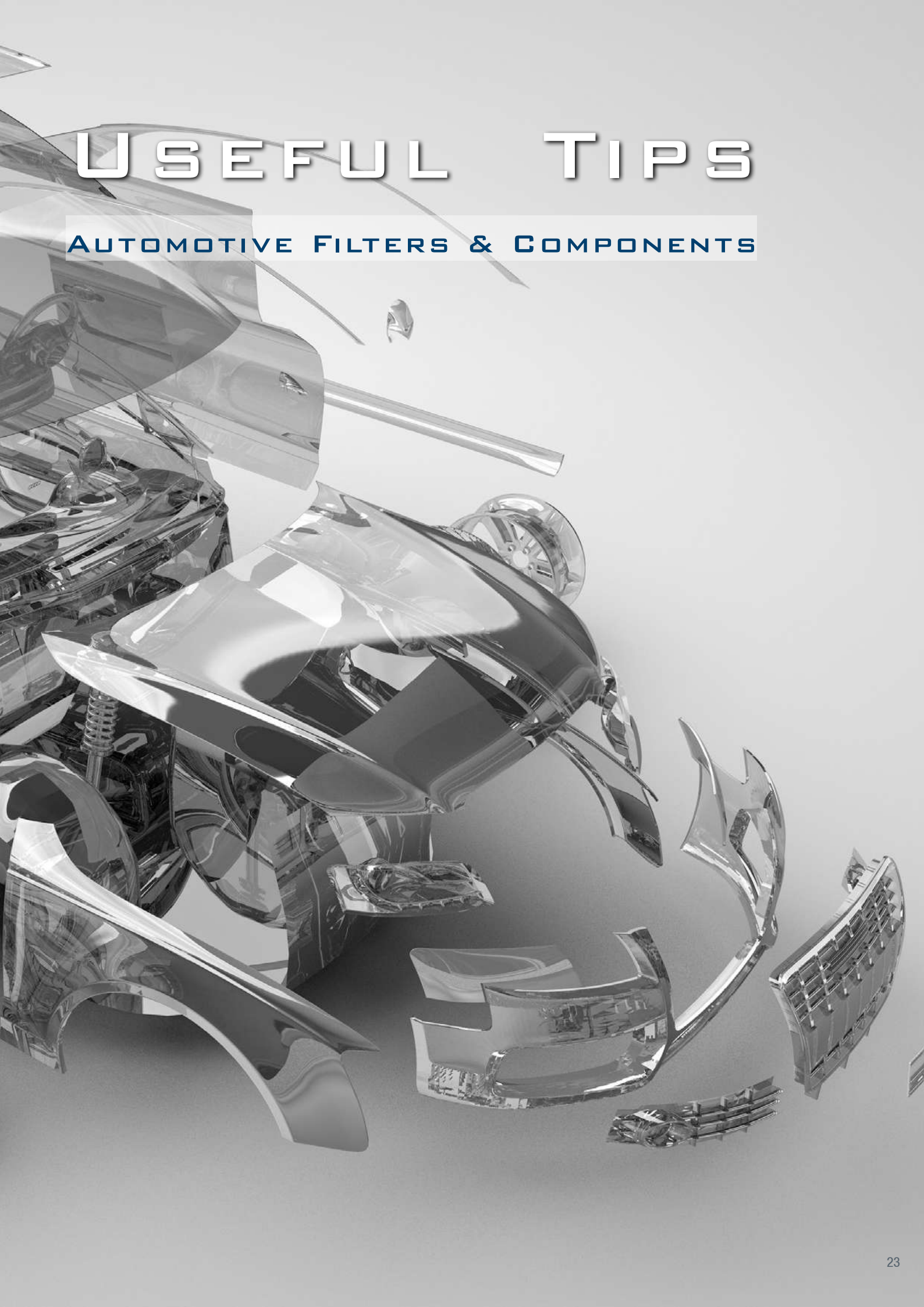
- Gain Horsepower
- Engineered for Specific Vehicle Design
- High-Flow Air Intake Systems
- Available for Many Popular Automotive, Motorcycle, ATV and RV Applications

GVS NANO MEDIA



Useful Tips

Automotive Filters & Components



Woven fabric Filtration media

Precision and maximum performance screens for excellent filter solutions

Filtration through wire and synthetic meshes is mechanical filtration. Mesh is specified by its mesh size, which is just one of the several key characteristics.

The monofilament precision woven fabric used by GVS for automotive filters is manufactured with uniform weave and accurate open-mesh structure, which guarantees to achieve any contamination reduction needs through a wide range of opening sizes, a precise pore size and square shape geometry, high throughput and flow rates.

Types of Weave

- **Plain weave**

This wire is produced by the constantly alternating over and under threading of the warp and weft wires. This mesh has square openings and where wire sizes that are the same in warp and weft. It is the simplest, the best known and the most commonly used type of weave, producing particularly accurate mesh sizes.

- **Twill weave**

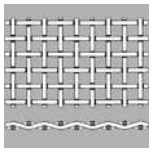
Special Mesh where weft wire passes alternatively over and under two warp wires, and has been created to compensate for the diagonal distortion of twill weaves. This weave is suitable if relatively small mesh sizes are required with relatively heavy-gauge wires.

- **Plain Dutch weave / Reverse Dutch weave**

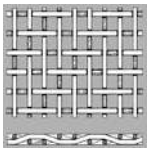
Similar to a plain weave, but the warp wires have greater diameter than the weft wires. The proximity of the weft wires to each other results in a so-called ‘closed mesh’. Its particular advantages lie in its efficient through-flow capacity and uniform apertures.

- **Twill Dutch weave**

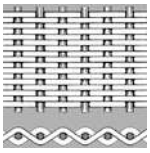
This weave shows a combination of twill and dutch weave. One heavier warp wire is woven over multiple lighter weft wires, that are the double the weft wires by comparison with a plain braid. The advantages lie in its smooth surface and ultra-fine filtration.



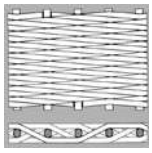
Plain weave



Twill weave

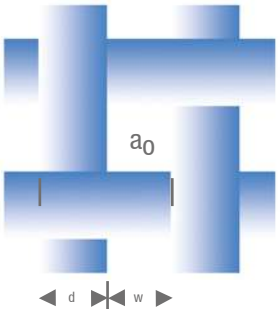


Plain Dutch weave



Twill Dutch weave

Mesh characteristics



a_o = Open Area
d = Thread Diameter
w = Mesh Opening

- **Raw materials**

GVS open mesh fabrics offer you the greatest design flexibility. Common raw materials used for the monofilament are polyamide (PA6.6), polyester (PET) and polypropylene (PP) in particular, but other materials such as high performance filter materials (PEEK) and fluorinated polymers (ETFE) or metals (Al, Cu, Ag, Au, Cu-Al, Ti and Ni) are also available upon request.

- **Mesh opening**

This is the size (micron) of any window or opening.
Open area (% open area)
This is a percentage (%) of the total mesh area which is "open" to let the flow go through. It's important to have high open area percentage to reduce flow restriction. This is also tested by electronic analysis image systems during production.

- **Mesh count**

This is the quantity of threads per cm (n/cm) or per inch (n/in).
Thread diameter
This is the diameter (micron) of the filament.

- **Weight of the mesh**

The mass to area ratio of material. It is important to qualify the quality of the mesh, (g/m2) or (oz/yd2)
Thickness of the mesh
Thickness is expressed in microns (µm) and its stability is very important to achieve the proper handling of the mesh during production.

- **Effective Filtration Area (EFA)**

This is the actual filtration area in a device that is subject to filtration. For instance, in a tubular filter, the frame (socket, two ribs and top cover) made by plastics should be eliminated from the calculations of the device EFA. In mesh filters you should only eliminate the seal area.
Micron Retention
The diameter of the largest round particles which can pass through a filter. Since absolute Micron Retention can change during filtration, aperture size can be determined by Bubble Point and Glass Bead Tests methods.

- **Warp**

The direction of thread filament running the length of the mesh (main)

- **Weft**

The direction of thread filament running the width of the mesh (weave)

- **Wicking**

The ability of the mesh, through capillary action, to hold liquid across the surface when only a portion of the mesh is submerged in the liquid and the remaining is exposed to air. Can be affected by the orientation of the warp and weft.

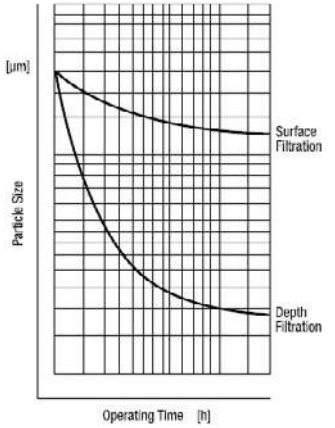
- **Bubble Point Test**

The pressure required to force air bubbles through a wetted mesh. These tests are typically performed with water; however, test can be conducted on mesh using test liquids other than water. The BP is an indication of the pore size. The average size can then be calculated by taking into account surface tension, liquid density, temperature and immersion depth.

- **Glass Bead Test**

A mixture containing glass beads is passed through the mesh, the diameter of the largest bead passing through is considered as the absolute micron retention.

$$E_x = \frac{\beta_x - 1}{\beta x} \cdot 100 \quad [\%]$$



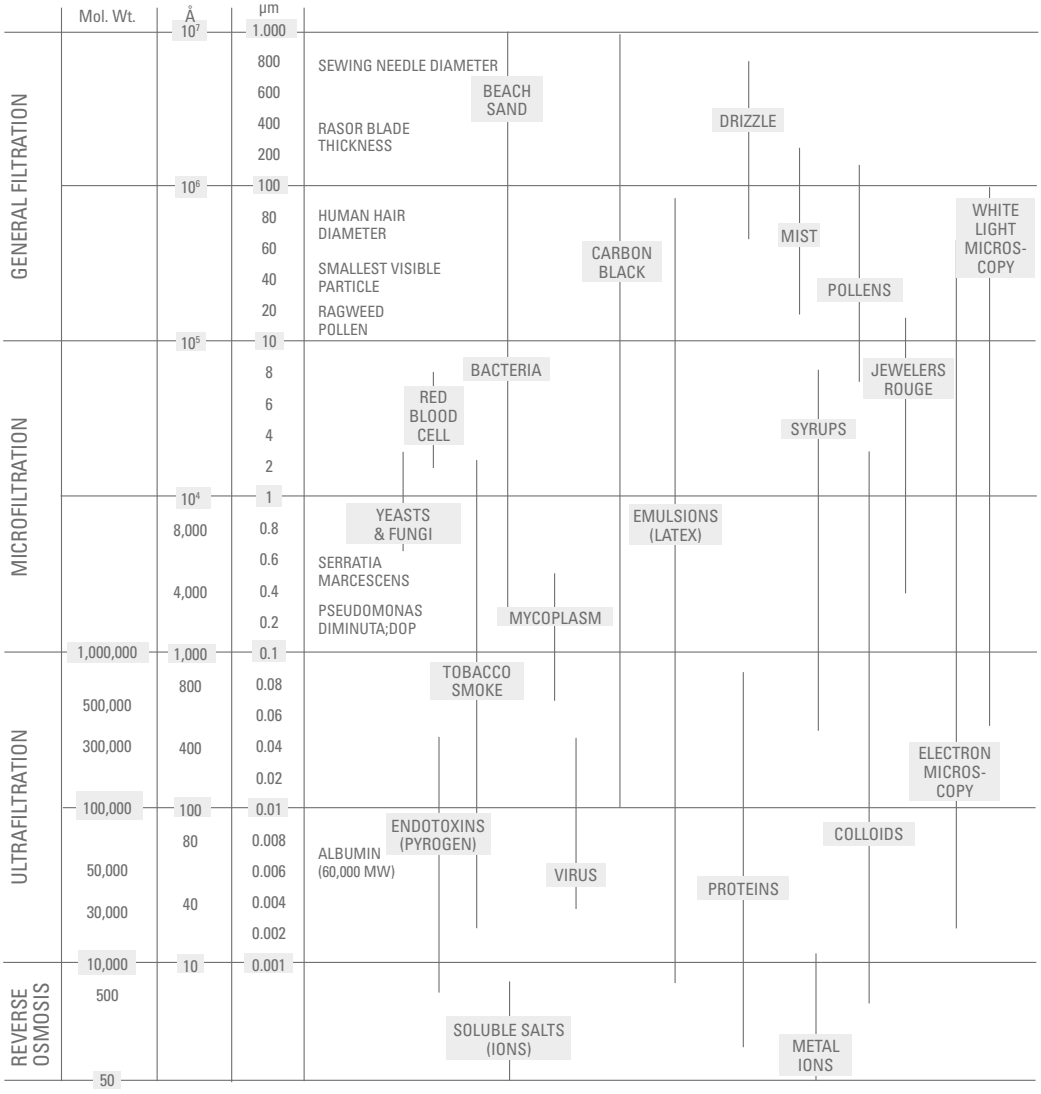
ß-value	Efficency %
1	0.00
2	50.00
20	95.00
50	98.00
100	99.00
1000	99.90
10000	99.99 %

Relationship between ß-value and efficency

Filter Efficiency (FE)

This is the quantity of particulate retained compared to the total quantity of particulate to which the filter is challenged. It is expressed in % and refers to a specific size of particles. The filter efficiency is determined by a pass test which allows the measurement of the percentage of particles which are removed by the filter. It is expressed by a beta rating representing the effectiveness of the filter
that can be calculated as follows:

RELATIVE SIZE OF SMALL PARTICLES



Å, ANGSTROM = 10^8 cm µm, MICROMETER (MICRON) = 10^4Å 1 mil = 0,001 inch = 25,4 µm

Differential pressure increases with reduced micron ratings; dirt holding capacity and relative flow rates decrease with reduced micron ratings

Nonwoven fabric Filtration media

Excellent barrier properties to protect your parts from liquids and dust

Nonwovens are typically manufactured by putting fibers together in the form of a sheet or web, and then binding them either mechanically, with an adhesive or thermally. They have a porous structure throughout the cross-section and are able to remove particulate from liquid or gaseous streams.
Typically, nonwoven filtration media are characterized by pores in the range from 1 to 500 micron, by high dirt holding capacity, high flow rates, and low pressure drop. Nonwoven fabrics are manufactured from many grades of cellulose and most natural and synthetic fibers such as polyester, polypropylene, acrylics, fluoropolymers, polyamide and glass. In the 1 to 20 micron mean flow pore range, the cost of nonwovens are much less than membranes and the dirt holding capacity is generally far superior.

Several automotive parts are actually made with today's engineered nonwoven fabrics. Typical GVS applications include fuel, urea, oil, and air filtration. Special fabric post-treatments, such as hydro-repellent and oleo-repellent treatments can yield treated nonwoven gradient media having characteristics which improve filtration efficiencies and/or flow rates. Advantages of nonwoven fabrics include their versatility, diverse functionality, and low price-performance ratio. Many filtration and separation applications require stiffness, minimal flex, and rigidity or even low stretch. Therefore, it is evident that filter design engineers make their media selections based on performance trade-offs. This is routinely studied at GVS.

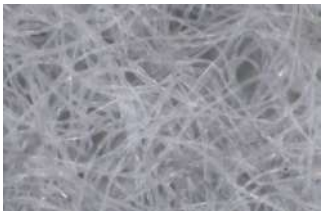
Typical nonwovens

Wet-laid, Spunbond and Meltblown nonwovens
Nonwoven fabrics are prepared by a polymer melt process, where fibers are created in a wet slurry or spinning operation and cast on a moving belt forming a continuous web. Fiber diameters are controllable and measured in microns. Recently nanotechnology permits the preparation of sub-micron diameter polymeric fibers. Glass fibers have been available for many years below 1 micron in diameter and are commonly utilized in HEPA (High Efficiency Particulate Air) and ULPA (Ultra Low Penetration Air) gas filtration.

Wet-laid filtration media have more controlled micron retention and are characterized by narrow pore size distribution.

Spunbond fabrics serve in applications needing a nominal pore size above 5 micron. They are not as micron retention controlled as wet laid materials.

Meltblown nonwovens have extremely fine fiber diameters, but are not strong fabrics by themselves. These materials are often layered with stronger spunbond fabrics for added strength. As used as filter media meltblown nonwovens are able to capture very fine particles and have excellent dirt holding capacity. They are formed by fibers in the 1-10 micron diameter size range and are characterized by lower pore size (as low as 1-3 micron).



Nonwoven outside wall

Nonwoven cross section

Test methods terminology for evaluation of filtration media

Standard Test Dust
Natural Arizona ground mineral test dusts are available in the following grades: A.C. Fine (ISO 12103 Pt1 A2 FINE) and A.C. Coarse (ISO 12103 Pt1 A4 COARSE).

Beta Ratio
Ratio of particles present upstream to particles present downstream the filter.

Dead end filtration
The stream to be filtered flows perpendicularly through the filtration media.

Depth Filtration
The filter captures contaminants on the surface and into the cross-section (the porous part) of the filter media.

Filter Efficiency
Is the percentage of particles of a specific size retained by a filter. It is calculated by [1-(particles in filtrate)/(particles in feed)]

Filter Capacity
It is indicative of the filter's life. It is expressed as the amount of standard test dust required to increase the pressure drop of the filter to a predetermined level, at least 3 times of its initial pressure drop. It is typically expressed in g/cm2.

Flow Rate
The quantity of liquid or gas which flows through the filter at a given temperature and pressure. It is expressed in l/min.

Flux
The quantity of liquid or gas which flows through the unit area of a filter at a given temperature and pressure. It is expressed in l/min m2.

Frazier Permeability
It is the air flow in CFM which passes through one square foot of filtration medium at 0.5 inch differential water pressure.

Gurley Permeability
It is the time required for a fixed volume of air to pass through a filter medium placed within a specific apparatus

HEPA
An air filter or filtration medium which can reject 99.97% of particles when challenged with DOP 0.3 micron particles under specific conditions.

Multi-pass system
Standard test dust is prepared in slurry form, mixed with the testing fluid in the system main tank and circulated through the test filter. The dust not retained by the filter is recycled to the main tank.

Pressure Drop (∆P)
Difference in pressure between upstream and downstream of the filtration medium.

Single-pass system
Standard test dust is prepared in slurry form, mixed with the testing fluid in the system main tank and circulated through the test filter. The dust not retained by the filter is not recycled to the main tank.

SULPA (Super ULPA)
An air filter or filtration medium which can reject 99.9999% of particles when challenged with DOP 0.3 micron particles under specific conditions.

Tangential (Crossflow) Filtration
The stream to be filtered flows tangentially to the filtration media, part is filtrated and part is recycled. (crossflow)

ULPA
An air filter or filtration medium which can reject 99.999% of particles when challenged with DOP 0.3 micron particles under specific conditions.

Polymeric membrane filtration

Filtration through a membrane allows for continuous exchange of gases and vapors, providing pressure equalization within the auto parts enclosures that are often exposed to rapid temperature fluctuations, causing extreme changes in internal pressure and creating a vacuum that puts stress on the seals.

Hydrophobic & Oleophobic membranes

Microporous hydrophobic & oleophobic membranes allow air to pass freely through the filter media, equalizing the pressure differential between the enclosure and the ambient temperature. Small pore size reduces liquid penetration speed through the filter due to slow airflow, while larger pore size lets liquids pass through faster and easily reduces retention performance. Oleophobic membranes are post-treated to repel low surface tension fluids such as oils and alcohols. Key properties and pore size (ranging from 0.02 to 10 µm), particular environmental conditions and specific surface tension of a fluid should be considered before choosing the proper filter media for a given application.

Membrane Specifications

- **Pore size**

Pore size is determined by the size of the particle that is expected to be retained with a defined degree of efficiency. Pore size is typically stated in micrometers or microns (µm), and should clearly be designated as either nominal or absolute.

- **Nominal pore size**

Is the ability to retain a majority (60% - 98%) of particles having a specific dimension.
Absolute pore size is the ability to retain the 99,999% of particles of a specific dimension under defined test conditions (particle size, challenge pressure, concentration, detection method).

- **Retention capacity**

Retention efficiency is also dependant on such process conditions as concentration, operating pressure etc. Rating parameters can vary among manufacturers. When the pore size, or retention, is "nominal", it should be stated as a particle size and a percent, i.e., 99.97% retention of 0.3 µm particles.

- **Chemical compatibility**

This is the ability of the membrane to resist to chemicals without mechanical or chemical damage from chemical exposure. Information about the liquid used with a specific filter material should be outlined before application to determine compatibility, GVS can assist customers in choosing the proper filter (and housing) materials.

- **Extractables**

Extractables are contaminants (typically chemicals) that elute from the filter which might affect quality of the effluent. Wetting agents (surfactants), and manufacturing residuals are the main causes of undesired extractables.

- **Binding**

This is the property of substances to be filtered having affinity with membranes. This could be a positive effect in some circumstances, but most of the time it can create adverse effects. Particularly it could lead to loss of active components of the liquid to be filtered reducing its beneficial effect.

- **Water Breakthrough (WBT)**

The pressure at which aqueous solutions will pass through a hydrophobic membrane is called the water breakthrough (WBT) or water intrusion pressure (WIP).

- **Air Flow (AF)**

It is the amount of air that passes through a fixed surface of membrane with a specific applied pressure.

- **Filter Efficiency (FE)**

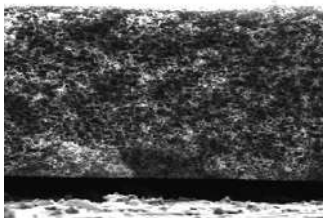
Quantity of particulate retained compared to the total quantity of particulate to which the filter is challenged. It is expressed in % and referred to a specific size of particles.

- **Effective Filtration Area (EFA)**

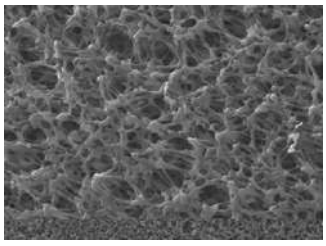
This is the actual filtration area in a device that is subject to filtration. For instance, whereas a 25 mm device may start out with a disc of filter media that is cut to 25 mm, the sealing surfaces should be eliminated from the calculations of the device EFA.

- **Contact Angle Measurement**

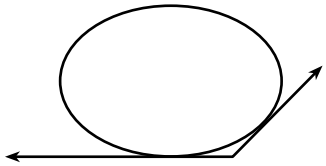
The measure of the angle between a drop of liquid and a surface of a solid is used to determine the surface hydrophobicities or oleophobicities of membranes and to assess their separation potential.



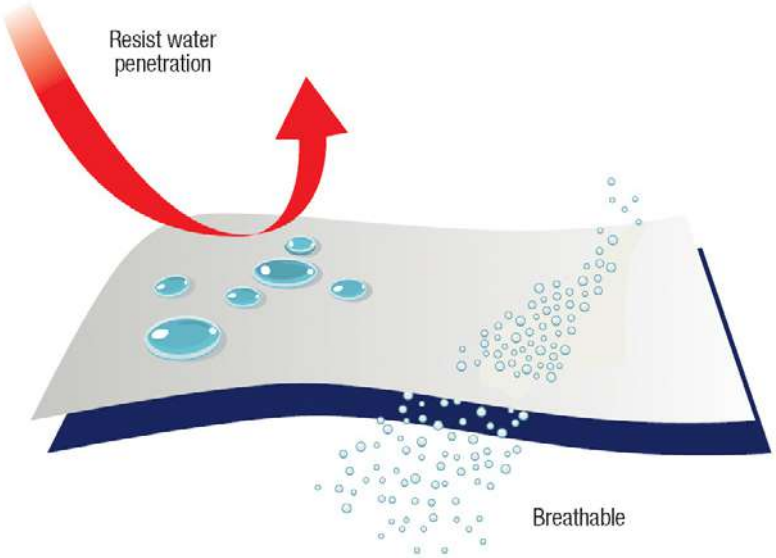
Membrane cross section

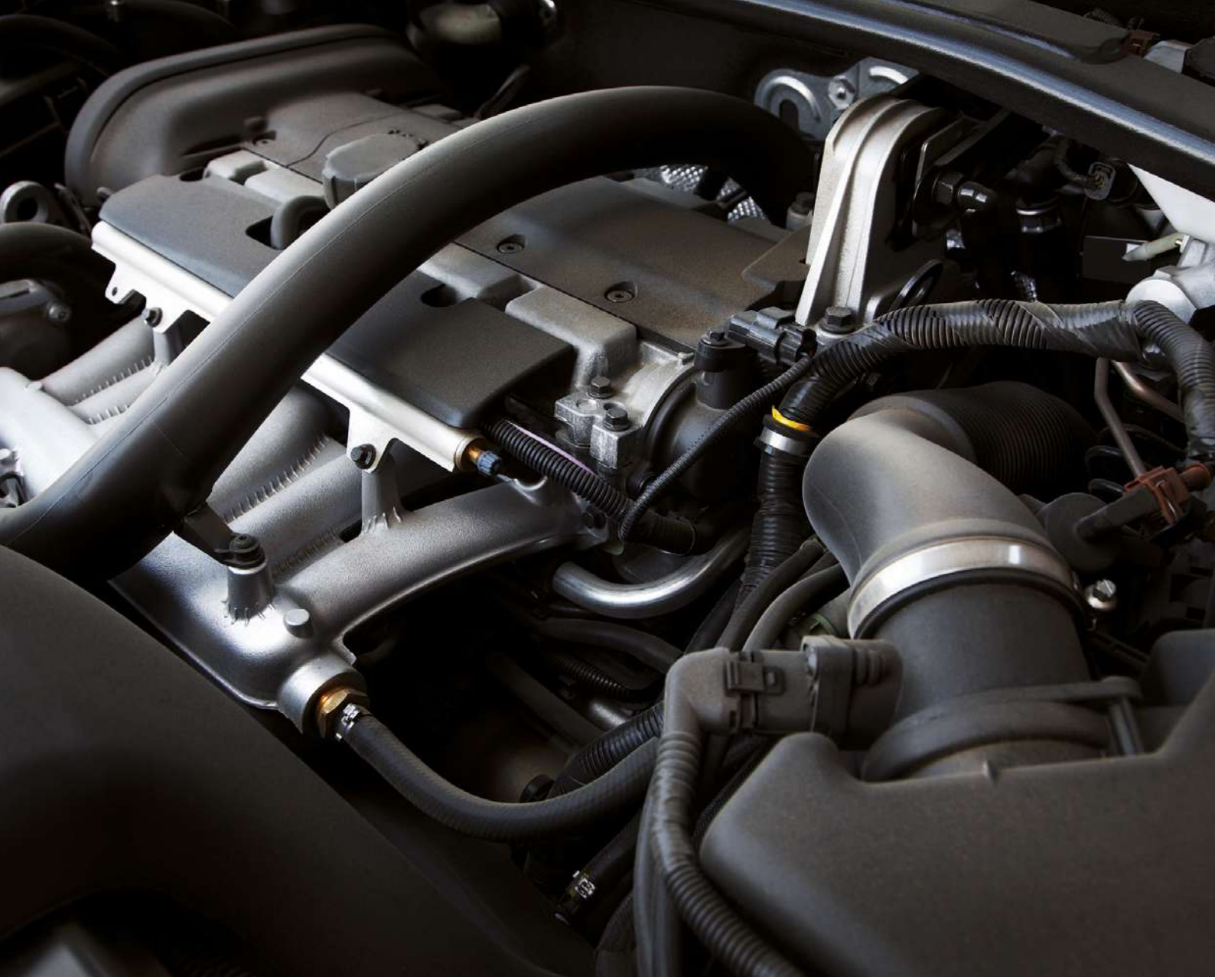


Membrane outside wall



Contact Angle





Polymers for injection

The automotive industry is the largest consumer of plastic materials since their properties meet requirements for a large variety of automotive applications. They are widely used in original equipment and after-market sectors.
Usually, thermoplastic polymers are supplied in the form of pellets, which often contain additives to enhance processing or to provide necessary characteristics in the finished product (e.g., color, conductivity, etc.). The temperature service range of thermoplastics is limited by their loss of physical strength and eventual melting at elevated temperatures.
GVS typically uses Nylon or Acetal in under the hood applications exposed to fuels especially for in-tank filters for their excellent chemical resistance, good stress-crack resistance, moldability and good wear and abrasion resistance.

Main Thermoplastic resin used in Automotive Applications

Nylon (Polyamide, PA) - comprises the largest family of engineering plastics with a very wide range of applications. Typically Nylon - especially if glass fiber reinforced - can replace metal in many applications due to its good resistance to wear and abrasion, good mechanical properties even at elevated temperatures, low permeability to gases and good chemical resistance. GVS typically uses PA for powertrain applications such as fuel injector, fuel pumps filters and filters in transmission applications.

Nylon Generics
Nylon 66 – Housings, Filters, fuel exposure
Nylon 6 – Connectors, fuel exposure
PPA - Gears
Nylon 12
Nylon 66/6 – Fuel filters
Nylon 612

Typical Nylon Automotive Applications
Automotive Under the Hood

Advantages of Nylon
Heat Stabilized
Lubricated
Chemical Resistance
Good Dimensional Stability Flame Retardant
Impact Modified
Good Toughness
Heat Resistance

Disadvantages of Nylon
High moisture pick-up with related dimensional instability
Requires UV stabilization
High shrinkage in molded sections
High moisture absorptivity degrades electrical and mechanical properties

Acetal (POM) - A thermoplastic produced by the addition of polymerization of an aldehyde through the carbonyl function, yielding unbranched polyoxymethylene chains of great length. The Acetal resins are among the strongest and stiffest of all thermoplastics, and are characterized by good fatigue life, low moisture sensitivity, high resistance to solvents and chemicals, and good electrical properties. Because of these properties, acetals often compete with nylons for many of the same applications. GVS typically uses POM in fuel in tank filters for its good static dissipation properties, fuel resistance and design flexibility.

Acetal Generics
Acetal (POM) Copoly
Acetal (POM) Homopoly
Acetal (POM) Copoly Alloy

Typical Acetal Automotive Applications
Fuel system filters
Gears
Actuators

Advantages of Acetal
Chemical Resistance
Creep Resistance
Dimensional Stability
Fatigue Resistant
Lubricated
Wear Resistance

Disadvantages of Acetal
Low Poor resistance to acids
UV sensitive
Flammable

Thermoplastic resin ADDITIVES for Improved Performance
The latest developments in THERMOPLASTIC RESIN technology provide for the ability to enhance the performance and durability of the base resin. These can enhance the thermal and chemical properties of the plastic and change the hardness, strength and flexibility of the material.

Some of the additive technology currently used in Automotive products include:
Impact Modifiers for balancing stiffness, strength and impact
Carbon and stainless steel additives for Static Discharge and Conductivity
Glass and mineral additives for Improved Rigidity and Hardness
UV stabilizers for enhanced UV Resistance
Additives to Improve Resistance to Environmental and Chemical Exposure
Additives for improved Thermal Conductivity

Polymers for injection

Thermoplastic Elastomers (TPE) - TPEs are a family of polymers that can be repeatedly stretched without permanently deforming the shape of the part. Unlike rubber-like elastomers, they do not require curing or vulcanization, as they are true thermoplastics. There are six main thermoplastic elastomer groups found commercially; styrenic block copolymers, polyolefin blends (TPOs), elastomeric alloys, thermoplastic polyurethanes (TPUs), thermoplastic copolyesters and thermoplastic polyamides. GVS uses TPEs especially for automotive vent applications.

TPE Generics
TPE
TPO (POE)
SEBS
TPV
SBS
EPDM
TPEE
PEBA

Typical TPE Automotive Applications
Seals
Vents
Gaskets

Advantages of TPE
TPE
TPO (POE)
SEBS
TPV
SBS
EPDM
TPEE
PEBA

Disadvantages of TPE
Degraded by UV
Flammable, but retarded grades available
Attacked by chlorinated solvents and aromatics
Difficult to bond
Several metals accelerate oxidative degrading
Low temperature impact strength is poor

Polypropylene (PP) - This polyolefin is readily formed by polymerizing propylene with suitable catalysts, generally aluminum alkyl and titanium tetrachloride. Polypropylene properties vary according to molecular weight, method of production, and the copolymers involved. Two main families of PP are:
Homopolymers, which have high heat resistance and good rigidity, making them suitable for a vast range of applications;
Copolymers, which are made by incorporating different monomers, are extremely resilient materials and have wide uses in automotive and industrial applications; GVS typically uses PP in non-fuel applications under the hood especially for reservoir-filters for its excellent chemical resistance, good stress-crack resistance, transparency and good resistance to heat (with peaks up to 120°C).

PP Generics
PP Homopoly
PP
PP Copoly
PP Impact Copoly
PP Random Copoly
PP, High Crystal
PP+EPDM
Etc...

Typical PP Applications
Automotive Applications, such as reservoirs,
Unspecified parts under the hood and headlight housings
Household Goods
Appliances
Containers
Packaging
Furniture
Electrical/Electronic Applications

Advantages of PP
Homopolymer
Good Processability
Good Stiffness
Good Impact Resistance
Copolymer
High Impact Resistance
Flow, High Chemically Coupled

Disadvantages of PP
Degraded by UV
Flammable, but retarded grades available
Attacked by chlorinated solvents and aromatics
Difficult to bond
Several metals accelerate oxidative degrading
Low temperature impact strength is poor

Polyphenylene Sulfide (PPS) - Engineering thermoplastic resins having a symmetrical, rigid backbone chain consisting of recurring p-substituted benzene rings and sulfur atoms, Polyphenylene Sulfide exhibits excellent heat resistance, thermal and dimensionally stability, as well as outstanding chemical resistance, high stiffness and good retention of mechanical properties at elevated temperatures. The major use for Polyphenylene sulfide is in automotive parts and electrical/ electronic parts. GVS typically uses PPS for motor air management applications such as plastic valves and insert molded shafts.

PPS Generics
PPS
PPS+PPE
PPS Alloy
PPS+Nylon

Typical PPS Applications
Automotive Applications
Electrical/Electronic Applications
Pump Parts
Compounding
Metal Replacement
Coating Applications
General Purpose
Housings
Industrial Applications

Advantages of PPS
Lubricated
Good Chemical Resistance
Flame Retardant
Electrically Conductive
High Heat Resistance
Linear Polymer Structure
Good Thermal Stability
High Strength
Good Flow

Disadvantages of PPS
Difficult to process (high melt temperature)
Comparatively high cost
Fillers required to get good impact strength
Subject to warpage and brittleness

Polybutylene Terephthalate (PBT) - It is a semi-crystalline polymer combining excellent mechanical and electrical properties with robust chemical resistance. The PBT - based resins deliver high flow and rapid crystallization. This makes them fast-cycling. The PBT product range includes a wide variety of reinforced, filled, impact-modified and flame-retardant grades which are great for injection moulding. The combination of high mechanical and electrical properties, good thermal stability and superior chemical resistance creates many automotive application opportunities and GVS typical example include fuel pressure regulator devices.

Advantages of PBT
High strength
Excellent stiffness-to-weight ratio
Good toughness
Low moisture absorption
Very high electrical insulation properties
Low dielectric loss
Broad chemical resistance
High temperature capability
Good overall environmental resistance
Flame retardancy
Good moldability with fast cycles

Typical PBT Applications
Automotive Applications:
Windshield wiper covers, mirror housings, cowl vents, handles, fans, fuel system, components, connectors, sensor housings, fuse boxes, actuator cases, power relays, switches, motor components and ignition system components

MATERIAL ABBREVIATIONS
PLASTICS
ABS Acrylonitrile-butadiene-styrene
HDPE High-density polyethylene
LDPE Low-density polyethylene
PA Polyamide (Nylon)
PC Polycarbonate
PP Polypropylene
POM Polyoxymethylene (Acetal)
PS Polystyrene
PUT Polyurethane Terephthalate
PVC Polyvinyl chloride
SAN Styrene acrylonitrile copolymer
SEBS Styrene-Ethylene-Butylene-Styrene
TPE Thermoplastic elastomer
TPO Thermoplastic Polyolefin

MESH / MEMBRANE
PA 6 / PA 6.6 Polyamide (Nylon)
PET Polyester
PP Polypropylene
PES Polyethersulfone
PTFE Polytetrafluoroethylene
AC Acrylic
PVDF Polyvinylidene fluoride
PE Polyester

Metals for automotive applications

The high competence of GVS in mold manufacturing technology also means that inserts of any metal may be used and produced, including brass, steel and the most advanced alloys (Al, Cu, Ag, Au, Cu-Al, Ti and Ni).

Copper (Cu)

Copper and its alloys are essential components of many of the latest parts in the modern automotive industry. It is malleable and ductile and it can be hammered and molded into several shapes, or drawn into wire. New technological advances in copper are proven to produce more durable and higher quality parts in automotive applications for the future. It's density of 8.92 g/cm^3 (Kilogram per cubic meter) is slightly superior to steel and its melting point is 1084.62°C (1984.32°F).

Copper's advantages:

- Superior thermal and electrical conductivity
- High resistance to corrosion
- Easy to work in manufacturing and refining

Many copper alloys exist, representing the third most used metal worldwide after stainless steel and aluminum. There are close to 400 different Copper and Copper-alloy compositions, grouped into different categories. UNS Classification identifies two kinds of copper: wrought alloys and cast alloys.

Wrought alloys

Name	UNS Classification	Composition
Coppers	C10100 – C15760	> 99% Cu
High-copper alloys	C16200 – C19600	> 96% Cu
Brasses	C20500 – C28580	Cu-Zn
Leaded brasses	C31200 – C38590	Cu-Zn-Pb
Tin brasses	C40400 – C49080	Cu-Zn-Sn-Pb
Phosphor bronzes	C50100 – C52400	Cu-Sn-P
Leaded phosphor bronzes	C53200 – C54800	Cu-Sn-Pb-P
Copper-phosphorus and Copper-silver-phosphorus alloys	C55180 – C55284	Cu-P-Ag
Aluminum bronzes	C60600 – C64400	Cu-Al-Ni-Fe-Si-Sn
Silicon bronzes	C64700 – C66100	Cu-Si-Sn
Other copper-zinc alloys	C66400 – C69900	Cu-Zn
Copper-nickels	C70000 – C79900	Cu-Ni-Fe
Nickel silvers	C73200 – C79900	Cu-Ni-Zn

Cast Alloys

Name	UNS Classification	Composition
Coppers	C80100 – C81100	> 99% Cu
High-copper alloys	C81300 – C82800	> 99% Cu
Red and leaded red brasses	C83300 – C85800	Cu-Zn-Sn-Pb (75-89% Cu)
Yellow and leaded yellow brasses	C85200 – C85800	Cu-Zn-Sn-Pb (57-74% Cu)
Manganese bronzes and Leaded manganese bronzes	C86100 – C86800	Cu-Zn-Mn-Fe-Pb
Silicon bronzes, silicon brasses	C87300 – C87900	Cu-Zn-Si
Tin bronzes and leaded tin bronzes	C90200 – C94500	Cu-Sn-Zn-Pb
Nickel-tin bronzes	C94700 – C94900	Cu-Ni-Sn-Zn-Pb
Aluminum bronzes	C95200 – C95810	Cu-Al-Fe-Ni
Copper-nickels	C96200 – C96800	Cu-Ni-Fe
Nickel silvers	C97300 – C97800	Cu-Ni-Zn-Pb-Sn
Leaded coppers	C98200 – C98800	Cu-Pb
Special alloys	C99300 - C99750	-

Metals for automotive applications

Brass

Copper and its alloys are essential components of many of the latest parts in the modern automotive industry. It is malleable and ductile and it can be hammered and molded into several shapes, or drawn into wire. New technological advances in copper are proven to produce more durable and higher quality parts in automotive applications for the future. It's density of 8.73 g/cm^3 (Kilogram per cubic meter) is slightly superior to steel.

Copper's advantages:

- Superior thermal and electrical conductivity
- High resistance to corrosion
- Easy to work in manufacturing and refining

Many copper alloys exist, representing the third most used metal worldwide after stainless steel and aluminum. There are close to 400 different Copper and Copper-alloy compositions, grouped into different categories. UNS Classification identifies two kinds of copper: wrought alloys and cast alloys.

Brass mechanical properties

Alloy (ASTM)	Chemical Composition	Traction Resistance Limit (MPa)	Lenthening Limit	Lengthening (%)	Hardness Brinell (HB)	Work Resistance Limit (MPa)
C210	95Cu 5Zn	270-550	100-380	45-3	65-120	-
C220	90Cu 10 Zn	270-570	90-420	50-4	55-125	70-160
C230	85Cu 15Zn	310-600	100-420	50-4	60-135	105-170
C240	80Cu 20Zn	310-640	120-480	52-3	65-155	100-185
C260	70Cu30Zn	330-850	120-540	62-3	65-160	75-200
C268, C270	66Cu 34 Zn 65Cu35Zn	340-860	130-550	60-3	65-165	85-155
C272	64Cu 36Zn	340-860	130-550	56-5	65-165	95-210
C280	60Cu 40Zn	380-600	160-450	40-4	85-145	110-130
C340	65Cu34Zn1Pb	330-550	120-460	45-8	65-135	-
C353	62Cu36Zn2Pb	340-700	150-460	45-2	70-125	100-195
C360	61Cu36Zn3Pb	360-520	150-450	40-12	75-135	140
C370	61Cu38Zn1Pb	380-580	180-520	40-8	80-150	-
C442	71Cu28Zn1Sn	340-400	130-180	65-50	65-85	160-185
C464	61Cu38Zn1Sn	395	160-390	40-20	90-145	150-230

Heat treatments and recrystallization methods allow you to control not only the desired hardness but also the desired strength, ductility and toughness of brass and brass alloys, influencing the evolution of the material microstructure and its mechanical properties. Heat treatments serve several purposes such as annealing, stress relieving, homogenizing and precipitation hardening.

Annealing - By heating cold metal to a high temperature until recrystallization occurs, it is possible to soften or anneal it. If maximum softening is desired, by heating well above the recrystallization temperature to cause grain growth. Light annealing is performed at a temperature slightly above the recrystallization temperature, while soft annealing is performed several hundred degrees higher.

Stress Relieving - Stress relieving is aimed to reduce or eliminate residual stress, thereby reducing the likelihood that the part will fail by cracking or corrosion fatigue in service. Parts are stress-relieved at temperatures below the normal annealing range that do not cause recrystallization and consequently soften the metal.

Homogenizing - Homogenizing is applied to dissolve and absorb segregation and coring found in some cast and hot worked materials, chiefly those containing tin and nickel. Diffusion and homogenization are slower and more difficult in tin bronzes, silicon bronzes and copper nickels than in most other copper alloys.

Precipitation Hardening - High strength in most copper alloys is achieved by cold working. Solution treating and precipitation hardening is applied to strengthen special types of copper alloys.

Aluminum

It is one of most versatile engineering and construction material and it is the second most used material in new automotive applications. Aluminum is a soft, very light weight metal. It is malleable, ductile and can be easily molded since its mass is roughly one-third of iron and copper. It is found primarily in bauxite ore and it is extracted by electrolysis. It has high structural and excellent corrosion resistance and durability and it is a good thermal and electrical conductor (third best after silver and copper).
However aluminum alloys have a high coefficient of thermal expansion which makes them unsuitable for high temperature applications.
Aluminum products include rolled, extruded, cast and forged forms, offering the possibility to cover a wide range of automotive applications requirements such as Brake Calipers, Bumpers, Chassis, Cradles, Closure Panels, Control Arms, Engine parts and Suspension parts.

Metals for automotive applications

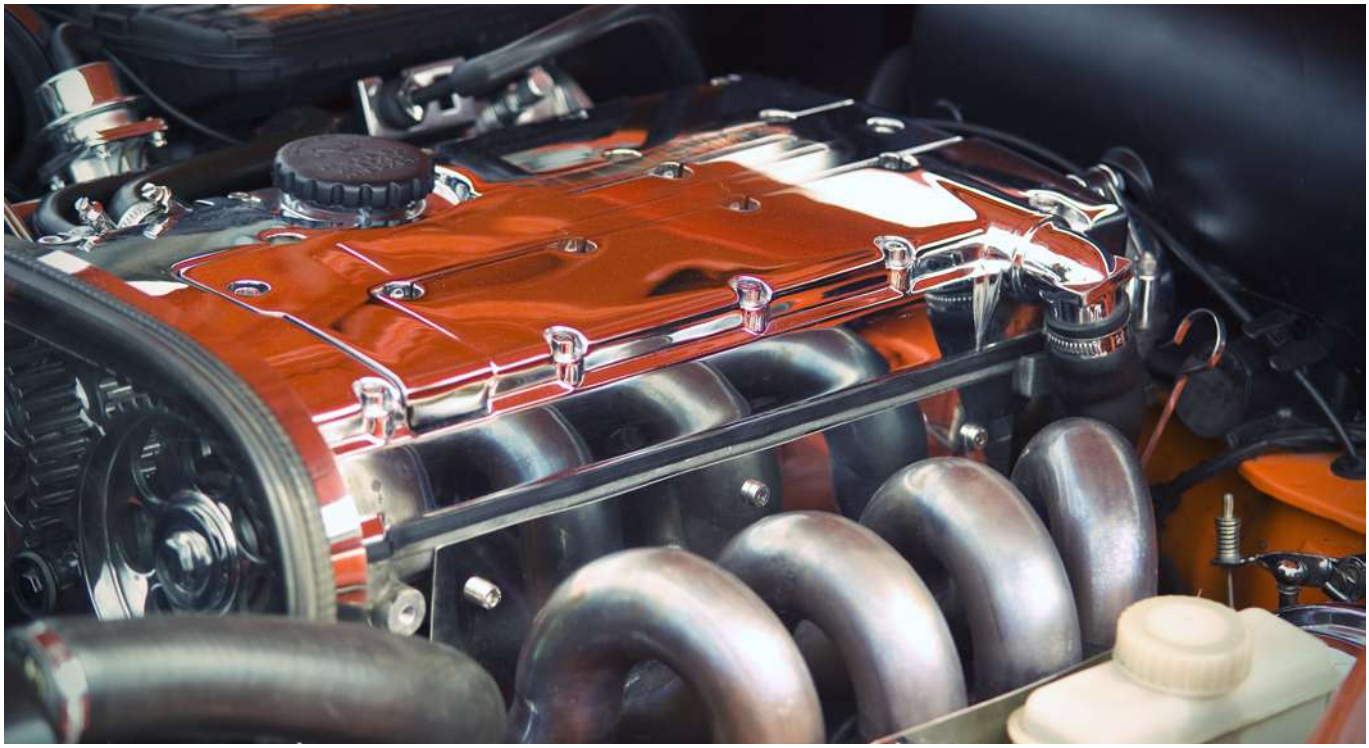
Comparison of Terminology for Pure Aluminum (Aluminium), and Aluminum Alloys*								
International		Canada	France	Germany		GB	Italy	Japan
International Registration Record (AA) U.S.A. Specs	ISO R209	Alcan Abbreviation	Abbreviation, as per NF A02-004	DIN Abbreviated, as per DIN 1700	Material Number, as per DIN 17007	Abbreviation, as per BS, BS-L, DTD	Conventional Abbreviation, as per UNI	Conventional Abbreviation, as per JIS
1050A	Al99,5	1S	A-5	Al99,5	3.0255	1B	P-Al99,5	.
1070A	Al99,7	99.70	A-7	Al99,7	3.0275	.	P-Al99,7	.
1080A	Al99,8	99.80	A-8	Al99,8	2.0285	1A	P-Al99,8	.
(1199)	.	99.99	A-99	Al99,98 R	3.0385	1	.	.
1200	Al99	2S	A-4	Al99	3.0205	1C	P-Al99,0	.
2007	.	.	A-U4Pb	AlCuMgPb	3.1645	.	.	.
2011	Al-Cu6BiPb	28S	A-U5PbBi	AlCuBiPb	3.1655	FC1	P-AlCu5,5PbBi	.
2014	Al-Cu4SiMg	.	A-U4SG	AlCuSiMn	3.1255	H15	P-AlCu4,4SiMnMg	.
2017A	Al-Cu4Mg	17S	A-U4G	AlCuMg1	3.1325	H14	P-AlCu4MgMn	A2017
2024	Al-Cu4Mg1	24S	A-U4G1	AlCuMg2	3.1355	2L97/98	P-AlCu4,5MgMn	.
2117	Al-Cu2Mg	16S	A-U2G	AlCu2,5Mg0,5	3.1305	2L69	P-AlCu2,5MgSi	.
3003	Al-Mn1Cu	D3S	A-M1	AlMnCu	3.0517	.	P-AlMn1,2Cu	.
3004	.	4S; D4S	A-M1G	AlMn1Mg1	3.0526	.	P-AlMn1,2Mg	.
3005	.	.	A-MG0,5	AlMn1Mg0,5	3.0525	.	.	.
3103	Al-Mn1	3S	.	AlMn1	3.0515	N3	P-AlMn1,2	.
3105	.	4S; D4S	.	AlMn0,5Mg0,5	3.0505	N31	.	.
5005A	Al-Mg1	B57S	A-G0,6	AlMg1	3.3315	N41	P-AlMg0,9	.
5049	.	B4S	A-G2,5MC	AlMg2Mn0,8	3.3527	.	.	.
5050B	Al-Mg1,5	A57S	A-G1,5	AlMg1,5	3.3316	.	P-AlMg1,5	.
5052	Al-Mg2,5	57S	(5052)	AlMg2,5	3.3523	.	P-AlMg2,5	A5052
5056A	Al-Mg5	56S; A56S	.	AlMg5	3.3355	N6	P-AlMg5	A5056
5082	Al-Mg4	.	.	AlMg4,5	3.3345	.	P-AlMg4,4	.
5083	Al-Mg4,5Mn	D54S	A-G4,5MC	AlMg4,5Mn	3.3547	N8	P-AlMg4,5	.
5086	.	B54S	A-G4MC	AlMg4Mn	3.3545	(N5/6)	P-AlMg4,4	.
5251	Al-Mg2	M57S	A-G2M	AlMg2Mn0,3	3.3525	N4	P-AlMg2Mn	.
5454	Al-Mg3Mn	B53S	A-G3MC	AlMg2,7Mn	3.3537	N51	P-AlMg2,7Mn	.
5754	Al-Mg3	53S	A-G3M	AlMg3	3.3535	.	(P-AlMg3,5)	.
6005A	(Al-SiMg)	(51S)	A-SG0,5	AlMgSi0,7	3.3210	(H10)	.	.
6012	.	.	A-SGPb	AlMgSiPb	3.0615	.	P-AlSiMgMn	.
6060	Al-MgSi	50S	A-GS	AlMgSi0,5	3.3206	H9	P-AlMgSi	.
6061	Al-Mg1SiCu	65S; CS5S	(6061)	AlMg1SiCu	3.3211	H20	P-AlMg1SiCu	.
6082	Al-Si1Mg	B51S	A-SGM0,7	AlMgSi1	3.2315	H30	P-AlMgSi	.
7020	Al-Zn4,5Mg1	D74S	A-Z5G	AlZn4,5Mg1	3.4335	.	P-AlZn4,5Mg	.
7022	.	79S	A-Z4GU	AlZnMgCu0,5	3.4345	.	.	.
7075	Al-Zn6MgCu	75S	A-Z5GU	AlZnMgCu1,5	3.4365	2L95/96	P-AlZn5,8MgCu	A7075

* The International Registration Record is operated by the Aluminum Association (AA), in Washington, DC. All western European countries are now using this system to replace those formerly used in Belgium, Canada, France, Great Britain, Australia and Japan. All standards not bracketed will be found under DIN 1725, part 1.

Heat Treatment

The four digit designation of aluminum alloys is usually accompanied by any of the following four letters:
F for fabricated (forgings and castings prior to heat treatment), O for annealed, W for solution heat treated, and T for heat treated to stabilize temper conditions other than O or F. The following temper designations are commonly used:
T3 - solution heat treated,cold worked and naturally aged.
T4 - solution heat treated and naturally aged.
T6 - solution heat treated and artificially aged.
T7 - solution heat treated and overaged.
T8 - solution heat treated, cold worked and artificially aged.
In addition to these heat treatments, a heat treat condition number can have additional numerical information like T7xx, where the xx describes either a stress relieving treatment done to the alloy or the extent of aging.

Aluminum alloys usually have a 4-digit designation. The first digit designates purity or alloy type. The second digit indicates modifications of the alloy. Only in 1xxx series the third and fourth digits indicate the purity. In the other series, the third and fourth digits identify different alloys.
1xxx - Aluminum (at least 99.0% pure) - Very high corrosion resistance, high electrical and thermal conductivity, good formability, low strength and not heat treatable.
2xxx - Aluminum-Copper alloy - High strength-to-weight ratio, low corrosion resistance and heat treatable.
3xxx - Aluminum-Manganese alloy - Good formability, moderate strength and not heat treatable.
4xxx - Aluminum-Silicon alloy - Lower melting point than normal and not heat treatable.
5xxx - Aluminum-Magnesium alloy - Good corrosion resistance, easy to weld, moderate to high strength and not heat treatable.
6xxx - Aluminum-Magnesium-Silicon alloy - Medium strength, good formability, machinability and weldability, corrosion resistant, heat treatable.
7xxx - Aluminum-Zinc alloy - Moderate to very high strength, heat treatable and prone to fatigue.
Aluminum-Lithium alloy (no numerical designation) - 10% lighter and 10% stiffer than other aluminum alloys and superior fatigue performance. Aluminum-Iron-Molybdenum-Zirconium alloy (no numerical designation) - High temperature tolerance, of 600°F.



Stainless Steel

Stainless steel is the term used for a large number of steels showing an excellent corrosion-resistance in a large number of conditions, due to their 10.5% mass minimum percentage of chromium and a 1.2% maximum of carbon content. It is protected by a very thin chromium-rich oxide film, which prevents further direct contact between the metal and its environment.
Stainless steel's different mechanical and physical properties are mainly determined by solution characteristics and combination with chromium since nickel, molybdenum, titanium, niobium and other elements may also be present. There are several types of stainless steel: Ferritic, Martensitic, Austenitic and Duplex.

Ferritic steels are magnetic, have a low carbon content and contain chromium as the main alloying element, typically at the 11-17% levels.
Martensitic steels are the most used group of stainless steels by GVS. They are magnetic and they typically contain 12-18% chromium and a moderate carbon content (0,10%). They have high strength and rather low ductility (or formability).
The **Austenitic** steels are non-magnetic and can be easily welded, containing 7-20% nickel, which increases their corrosion resistance, in addition to the 17-25% level of chromium. Austenitic steels have lower strength and high ductility.
Duplex steels are used where combinations of higher strength and corrosion resistance are needed. Super austenitic grades and recipitation hardened grades of steel are also available. Duplex and ferritic steels occupy an intermediate yield strength and ductility position.

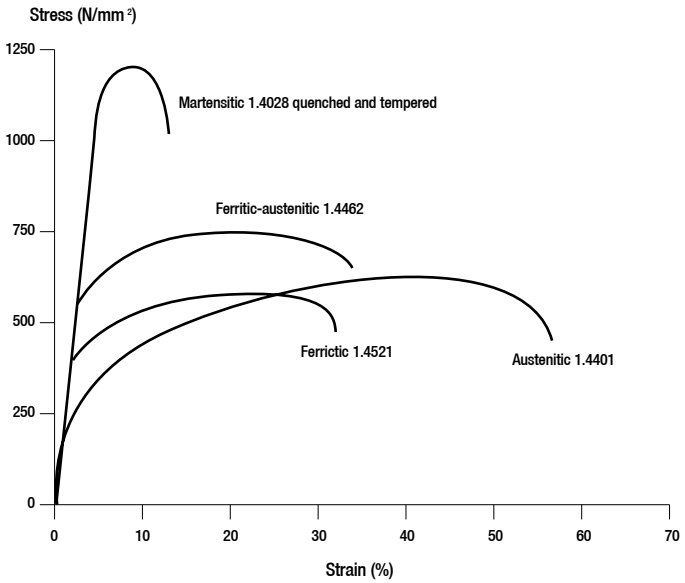
Curve illustrated in the figure indicates how much energy the material absorbs before it breaks. The material's mechanical properties depend on:

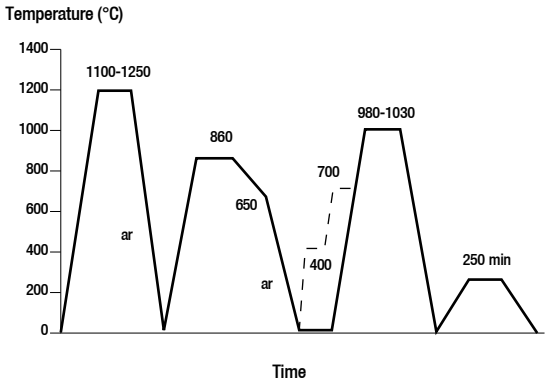
- chemical composition
- heat treatment (for martensitic stainless steels)
- cold working (for austenitic and duplex stainless steels)

Martensitic steels provide the highest strengths, since mainly carbon, but also manganese, silicon, chromium, molybdenum, boron, vanadium, and nickel are used in various combinations to increase hardenability. High levels of strength can be reached by cold working stainless steels. Cold worked austenitic and duplex stainless steels generally offer an interesting combination of strength and formability, in terms of weight-saving potential.
Sheet or tube formed steels can be used in the automotive sector for auto body, closure, suspensions, wheels, bumpers, fuel tanks, bars and rods. Alloy steels are usually designated by distinct AISI (American Iron and Steel Institute) mainly four-digit numbers. The first two digits indicate the leading alloying elements, while the last two digits give the nominal carbon content of the alloy in hundredths of a percent. Occasionally it is possible to find five-digit designations where the last three digits tell that the carbon is actually over 1%.

Typical processing sequences

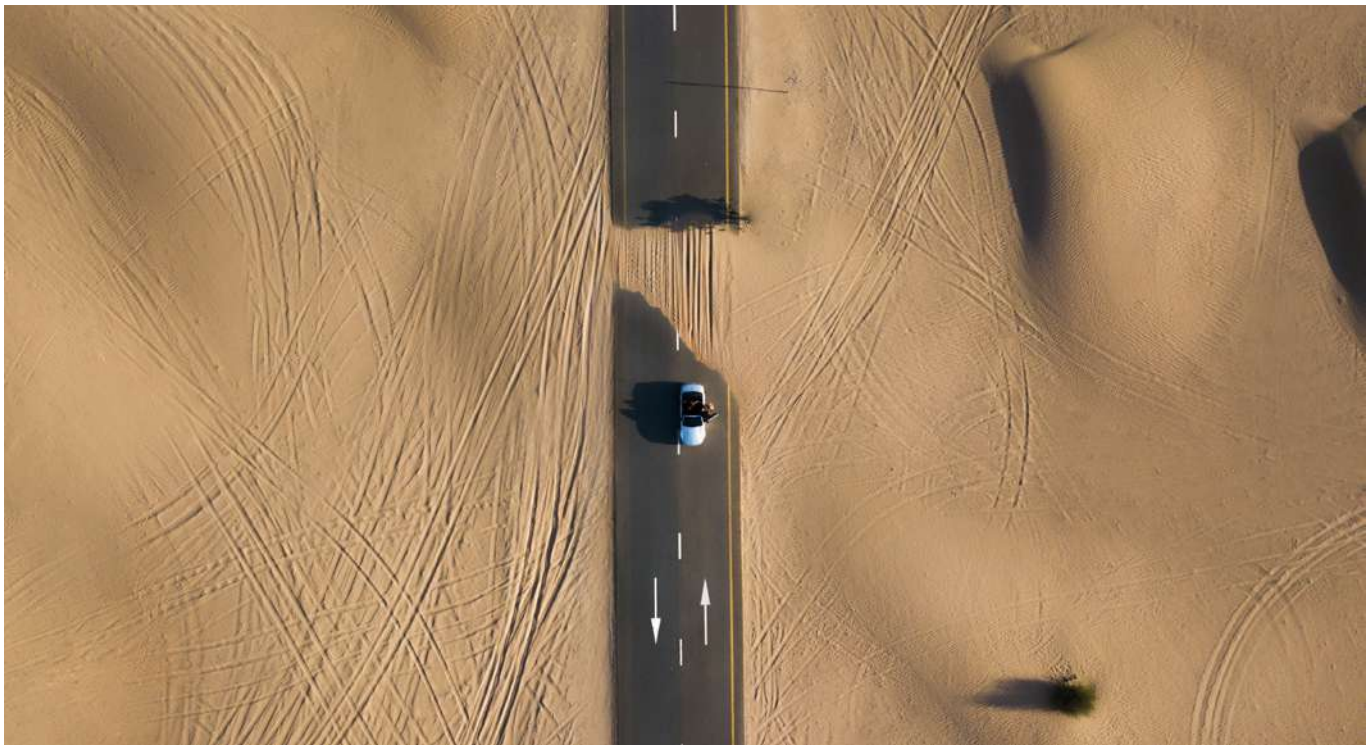
Stress-Strain curves for different types of stainless steel





Martensitic temperated stainless steel chemical composition in compliance with aisi specifications

AISI	C max.	Mn max	Si max	P max	S	Cr	Ni	Other Elements
03	0.15	1.00	0.50	0.040	0.030 max	11.50 - 13.00	-	-
405	0.08	1.00	1.00	0.040	0.030 max	11.50 - 14.50	0,60 máx.	Al: 0,10 - 0,30
409	0.08	1.00	1.00	0.045	0.045 max	10.50 - 11.75	0,50 máx.	Ti + 6_C < 0,75
410	0.15	1.00	1.00	0.040	0.030 max	11.50 - 13.50	0,75 máx.	-
410 S	0.08	1.00	1.00	0.040	0.030 max	11.50 - 13.50	0,60 máx.	-
414	0.15	1.00	1.00	0.040	0.030 max	11.50 - 13.50	1,25 - 2,50	-
416	0.15	1.25	1.00	0.060	0.15 min	12.00 - 14.00	-	-
416 Se	0.15	1.25	1.00	0.060	0.060 max	12.00 - 14.00	-	Se: 0,15 mín.
420	0.15 min	1.00	1.00	0.040	0.030 max	12.00 - 14.00	-	-
420 F	0.15 min	1.25	1.00	0.060	0.15 min	12.00 - 14.00	-	-
420 Se	0.30 - 0.40	1.25	1.00	0.040	0.060 max	12.00 - 14.00	-	Se: 0,15 mín.
430	0.12	1.00	1.00	0.040	0.030 max	16.00 - 18.00	0.75 max	-
430 F	0.12	1.25	1.00	0040	0.15 min	16.00 - 18.00	-	-
431	0.20	1.00	1.00	0.040	0.030 max	15.00 - 17.00	1,25 - 2,50	-
440 A	0.60 - 0.75	1.00	1.00	0.040	0.030 max	16.00 - 18.00	-	Mo: 0,75 max.
440 B	0.75 - 0.95	1.00	1.00	0.040	0.030 max	16.00 - 18.00	-	Mo: 0,75 max.
440 C	0.95 - 1.20	1.00	1.00	0.040	0.030 max	16.00 - 18.00	-	Mo: 0,75 max.
440 F	0.95 - 1.20	1.25	1.00	0.040	0.15 min	16.00 - 18.00	0.75	Mo: 0,60 máx.
440 Se	0.95 - 1.20	1.25	1.00	0.040	0.030 max	16.00 - 18.00	-	Se: 0,15 mín.
501	0.10 min	1.00	1.00	0.040	0.030 max	4.00 - 6.00	-	Mo: 0,40 - 0,65
502	0.10	1.00	1.00	0.040	0.030 max	4.00 - 6.00	-	Mo: 0,40 - 0,65



Global Presence

EUROPE

Italy - Headquarters Office
GVS S.p.A
Via Roma 50 - 40069 Zola Predosa
(BO) - Italy
tel. +39 051 6176311
gvs@gvs.com

United Kingdom
GVS Filter Technology UK
Mellishaw Lane, Morecambe
Lancashire LA3 3EN
tel. +44 (0) 1524 847600
gvsuk@gvs.com

Russia
GVS Russia LLC.
Profsoyuznaya Street,
25-A, office 102
117418, Moscow
Russian Federation (Russia)
tel. +7 495 0045077
gvsrussia@gvs.com

Romania
GVS Microfiltrazione
Str. Principala 320 ET.1,
Ciorani De Jos
Ciorani, Romania
tel. +40 244 463044
gvsro@gvs.com

Turkey
GVS Türkiye
Cevizli mah. Zuhal cad. Ritim
Istanbul no:44 A-1 Blok D.371
Maltepe / Istanbul
tel. +90 216 504 47 67
gvsturkey@gvs.com

AMERICA

U.S.A.
GVS Filtration Inc.
2150 Industrial Drive
Findlay, OH 45840 - USA
tel. +1 419 423 9040
gvsfiltration@gvs.com

GVS Filtration Inc.
2200 W. 20th Ave.
Bloomer, WI 54724 - USA
tel. +1 715 568 5944
gvsfiltration@gvs.com

GVS North America
63 Community Drive
Sanford, ME 04073 - USA
tel. +1 866 7361250
gvsusa@gvs.com

ASIA

Brazil
GVS do Brasil Ltda.
Rodovia Conego Cyriaco
Scaranello Pires 251
Jd. Progresso, CEP 13190-000
Monte Mor (SP) - Brasil
tel. +55 19 38797200
gvs@gvs.com.br

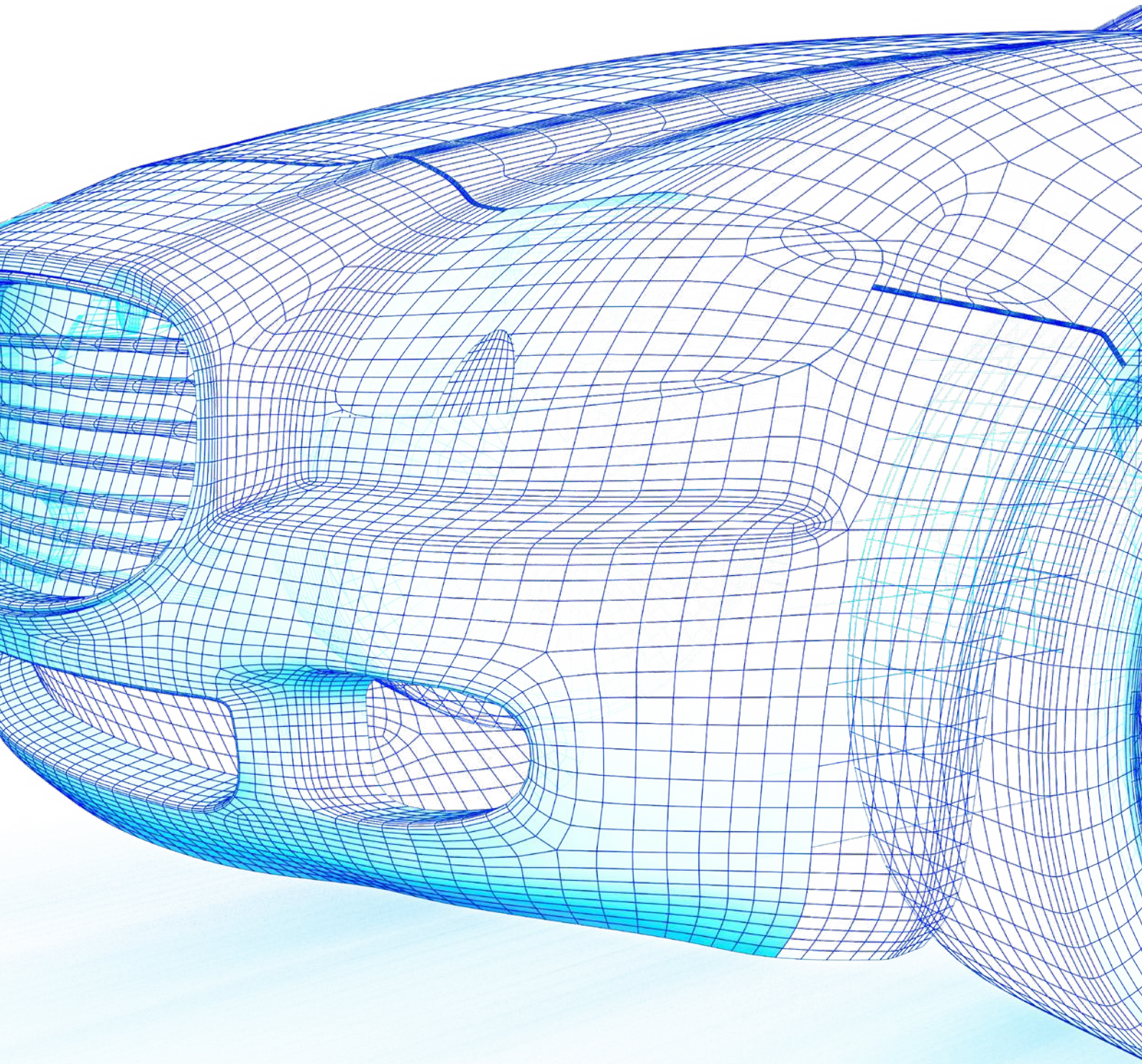
Argentina
GVS Argentina S.A.
Francisco Acuña de Figueroa 719
Piso:11 Of: 57
1416 Buenos Aires - Argentina
tel. +54 11 48614750
gvsarg@gvs.com

México
Universal No. 550, Vynmsa
Aeropuerto Apodaca Industrial Park,
Ciudad Apodaca, Nuevo León, C.P.
66626 México
tel. +52 81 2282 9003
e-mail: gvsmex@gvs.com

China
GVS China Automotive
Fengqiao Civil-Run Sci-Tech Park,
602 Changjiang Road,S.N.D.
Suzhou, China 215129
tel. +86 512 6661 9880
gvschina@gvs.com

Korea
GVS Korea Ltd
#315 Bricks Tower
368 Gyungchun-ro(Gaun-dong),
Namyangju-si, Gyunggi-do,
Tel: +82 31 563 9873
gvskorea@gvs.com

Japan
GVS Japan K.K.
KKD Building 4F, 7-10-12
Nishishinjuku
Shinjuku-ku, Tokyo 160-0023
Japan
tel. +81 3 5937 1447
gvsjapan@gvs.com

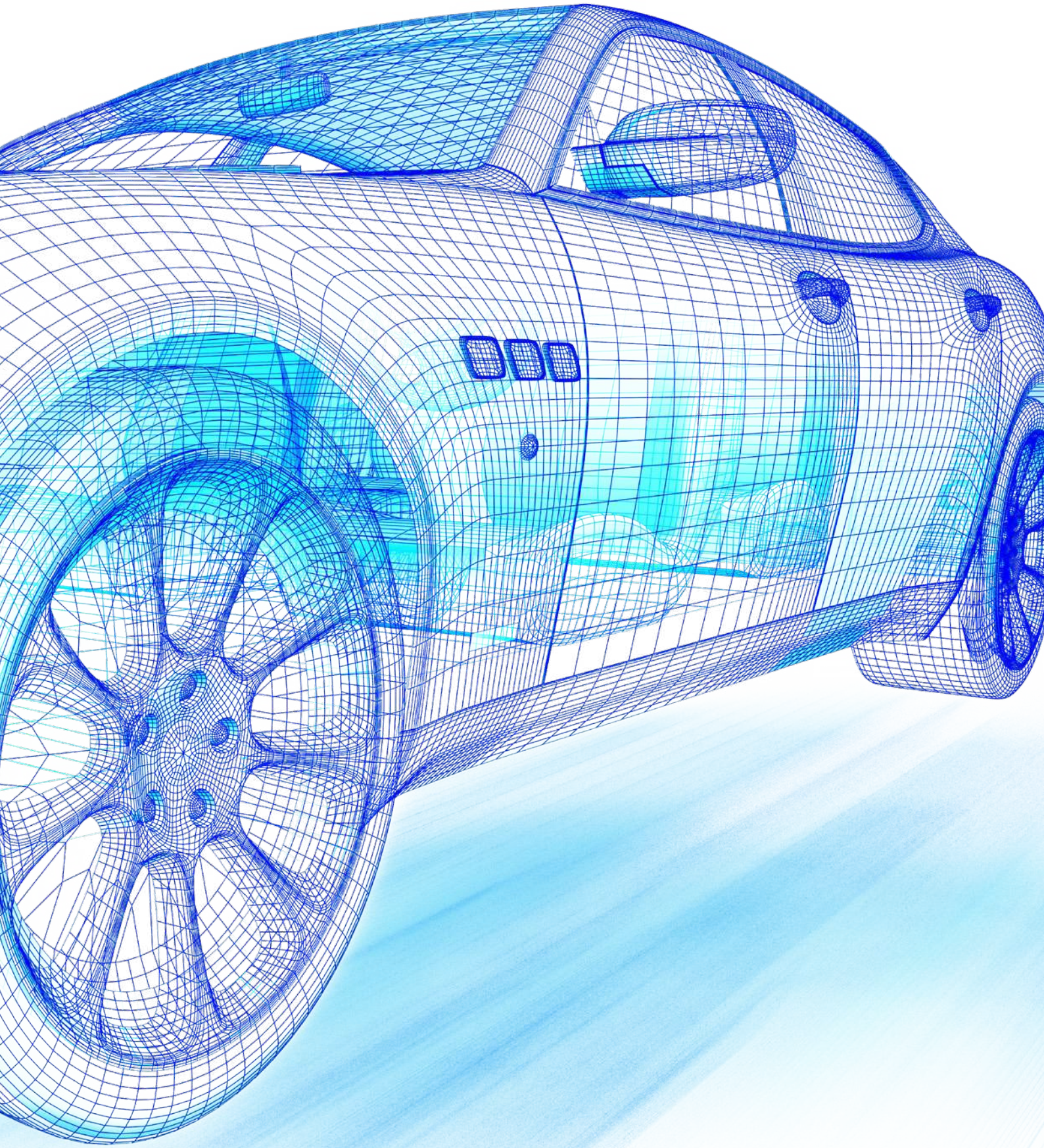


Disclaimer

GVS reserves the right to make changes to this catalog without notice.
Results in specific applications of GVS products may vary according to the conditions and applications.
GVS assumes no responsibility for damage resulting from incorrect use of our products.

Automotive Catalog GVS

Version 20190419



FILTER TECHNOLOGY

WWW.GVS.COM