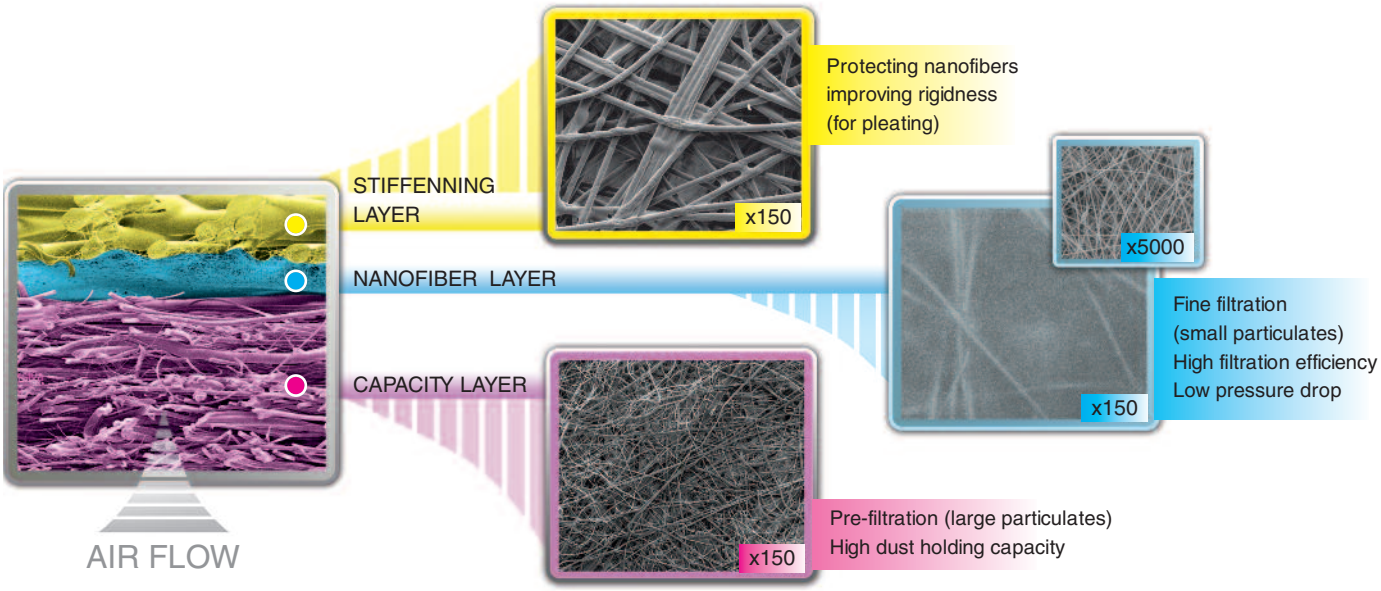
Nanofibers for depth air filtration

The evolving maturity of Elmarco's nanofiber technology enables further adoption into gradient filtration media for air filtration applications where particles load within the depth of the filter structure. Elmarco's nanofiber layer enables key performance features such as high porosity, small fiber diameter and pore size, and high specific surface area. These features enhance the overall performance of gradient filtration composite media resulting in high mechanical filter **efficiency, high dust loading capacity, and low pressure drop.** These performance advantages lower the kWh usage profile of filters in application leading to **lower system operating costs**.

Nanospider™ electrospun nanofibers in multi-layer composite media



FEATURES	BENEFITS
Low pressure drop	Reduction in energy consumption
High dust holding capacity	Longer filter life and reduction in total cost operation
High E1 filtration efficiency	Effective in capturing submicron particles
100% Synthetic media	High mechanical stability and durability
High mechanical efficiency	Does not rely on electrostatic charge to maintain filtration efficiency
Glass-free material	Not fragile and easy handling during manufacturing
Glass-free material	Does not contain Boron which causes pollution
Composite structure	Significant margin for media and filter designers to meet different performance targets

A multi-layer (stiffenning/nanofiber/capacity) composite media with a gradient structure provides high mechanical efficiency, low pressure drop and high dust loading capacity. The upstream capacity layer comprising synthetic fibers with a relatively large pore structure has three main functions; i) pre-filtering of large particulates, ii) preventing nanofiber layer from clogging, and iii) providing high dust holding capacity. The nanofiber layer which exhibits high specific surface area, interconnected pore structure, and small pore enables to reach high filtration efficiencies at relatively low pressure drops. The stiffenning substrate layer located downstream protects the nanofiber layer while improving the media rigidness. This structure features excellent pleatability of the synthetic media.

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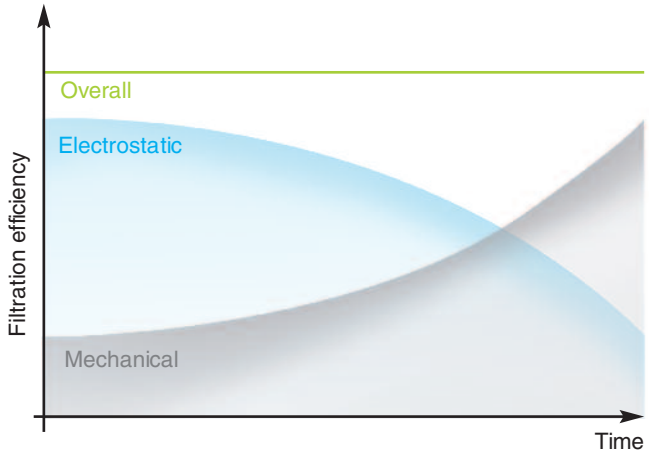
Mechanical type filtration

Four different collection mechanisms govern particulate air filter performance: inertial impaction, interception, diffusion, and electrostatic attraction. The first three of these mechanisms apply mainly to mechanical filters and are influenced by particle size.



As mechanical filters load with particles over time, their collection efficiency and pressure drop typically increase. Conversely, electrostatic filters, which are composed of polarized fibers, may lose their collection efficiency over time or when exposed to certain chemicals, aerosols, or high relative humidities.

Pleating the filter media

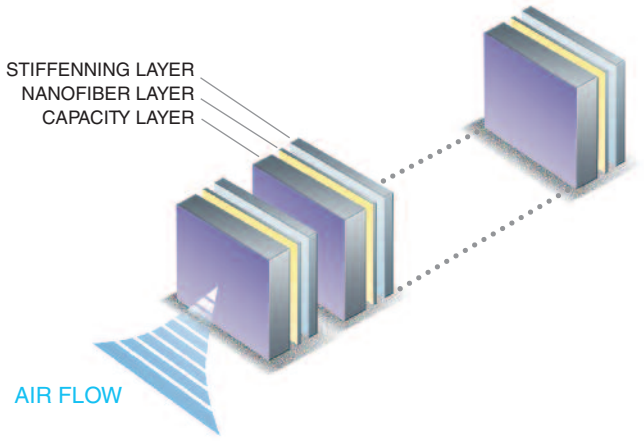
Pleating filter media extends effective surface area thereby reducing the air velocity through the filter media. This enables the filter to increase the collection efficiency for a given pressure drop as well as reducing energy consumption. Filters with increased surface area will often have an increased lifetime between replacements. Pleat density and geometry has to be optimized to provide the desired efficiency at the least possible pressure drop. Synthetic media typically lacks rigidity to maintain pleat shape. In the past nanofiber web structures have been too lacking in durability to withstand pleating processes. Elmarco's reference filter contains composite nanofiber media that is sufficiently rigid for self supporting pleat elements and sufficiently durable to withstand pleating processes.

Proven concept

Feasibility of the concept was proven by reference filter project in all necessary design and manufacturing steps. The multi-layer composite media concept offers designers by numerous design parameters to optimize their final filter design.

Composite design flexibility

A multi-layered composite structure allows producer to design each layer independently in order to reach different filtration characteristics. A wide range of performance targets are achievable by optimizing the basis weight, fiber diameter and porosity of each layer. In addition to performance flexibility the fully synthetic composite allows process flexibility. Synthetic fibers are robust and responsive to downstream converting equipment.



Support for designers

Designers can benefit from Elmarco's large in-house R&D and nanofiber sampling capacity in order to optimize final nanofiber media design quickly. Elmarco's R&D scientist are able to utilize the Nanospider™ technology to provide exceptional uniformity and a high degree of design flexibility. While Elmarco does not manufacture media or filters we have extensive experience in working with customers to design nanofiber layers that enable composite media to match performance targets for each application. Based on customer performance targets we can fine tune fiber diameters and web porosity to meet the optimal balance between efficiency and resistance.

Applications

As multi-layer composite media concept meets all industry requirements and standards, it opens up a potential for nanofiber introduction into wide range of filter types:

- HVAC filters (hospitals, schools, universities, commercial buildings, airports, hotels, manufacturing and research facilities, etc.)
- Automotive cabin air filters
- Automotive engine intake filters