

Smart Filtration Ensures Long-Term Automatic Transmissions Performance

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The ability of automatic transmissions to operate reliably over many years is critically dependent on the purity of the transmission fluid employed. Integral filters which remove small to ultra-small particles from the oil flow in a closed loop have become essential.

Sensitive hydraulic transmission parts need to be protected from foreign matter and other impurities

Demands for enhanced transmission performance, superior shifting convenience and improved environmental compatibility are the core challenges faced by the makers of automatic and semi-automatic transmissions today. Transmission developers respond to these needs by introducing new and, specifically, easily recyclable materials, more efficiently sized designs, increasingly sophisticated control systems and, last but not least, innovative transmission solutions.

Examples of the latter include continuously variable transmissions, like Audi's Multitronic® system, or dual-clutch transmissions, like VW's DSG. In addition, there is



Figure 1: Structure of a CombiMedia™ suction filter from top to bottom: filter housing upper cover, full-flow screen mesh, rib tray as spacer, partial-flow fine filter medium, and filter housing bottom pan

a trend for the number of speed steps in automatic transmissions to increase as exemplified by Daimler's 7G-Tronic.

Unlike manual shift gearboxes, automatic transmissions have an oil circuit which, apart from lubricating and cooling the various components, supplies the fluid medium for the specific hydraulic transmission control system. The latter comprises highly sensitive parts which need to be protected from foreign matter contamination and other impurities. This is ensured by means of fil-

ter systems designed to maintain the transmission in its proper operating state throughout its service life.

Filter system manufacturers have had to adapt their products to satisfy new parameters. Their products must not only withstand higher operating temperatures and more aggressive oil types, they should also occupy the least space possible in performing their functions. This is in addition to other requirements: first, the system must cause less differential pressure; second, it

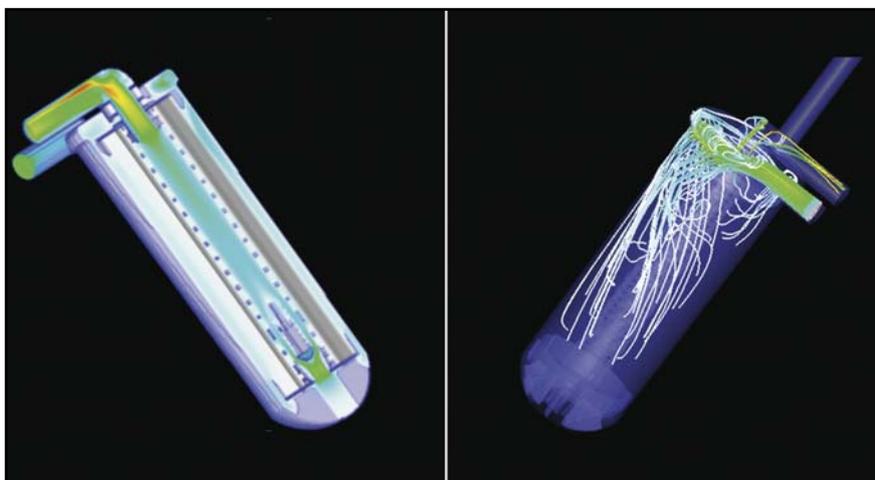


Figure 2: View of the velocity distribution (left) and streamlines (right) inside a pressure filter

should provide enhanced absorption capacity; and, third, it should deliver maximum separation efficiency. IBS Filtran has devised new filter concepts that offer advantages in all three areas.

Space and cost-saving combination of filter media

In the past, filtration relied exclusively on suction oil filters.

These operated as full-flow filters upstream of the pump in the oil circuit, requiring the use of a fairly open-pored filter material to ensure adequate oil supply even at very low temperatures. Today, additional pressure oil filters are employed to achieve higher oil purity ratings. Such filters are arranged in a partial flow in the oil circuit, typically in the cooler line, and are common-

ly equipped with a bypass valve. As the differential pressure across the filter is of secondary importance here, a highly efficient filter medium can be selected.

Oil cleanliness levels achievable with the IBS Filtran CombiMedia™ are markedly higher and eliminate the need for an pressure oil filter

Space is at a premium at the filter mounting site – below the automatic transmission's control valve housing – so suction oil filters must be of a flat design. The filter medium, which is typically a needle-punched non-woven fabric, will usually be a single-layer type, configured into a bag-shaped or planar pleated element. As a deep filtration material, needle-punched non-wovens offer service life gains over mere surface filtration media such as woven fabrics. Pressure oil filters, on the other hand, are usually designed as a round filter element comprising the filter medium in the form of a zigzag folded, pleated strip (pleat star).

New developments by IBS Filtran include the CombiMedia™ suction filter which combines different filter media in one filter housing (see Figure 1). Compared to conventional suction oil filters, the oil cleanliness levels achievable with this product are markedly higher, so that in some applications the need for an additional pressure oil filter is eliminated altogether. This, in turn, saves mounting space while reducing the number of components and hence, overall cost.



Figure 3: Composite suction filter with laser welded suction tube and the newly developed V-Pore™ 97

IBS Filtran Kunststoff-/Metallerzeugnisse GmbH
a medium-sized German-American joint venture

Leading manufacturer of filter system solutions for the automotive industry

The Filtran group supplies filter system solutions for automatic transmissions to all automotive and transmission manufacturers.

Due to further research & development centers and production plants in the US and China, we can come up to all global customer requirements. An example is the worldwide first series-production application of a plastic oil pan with integrated suction oil filter.



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Design and rating of automatic transmission filters

The demand for high separation efficiency (to achieve high oil purity and a small critical particle size), high dirt absorption capacity (to extend the maintenance intervals and filter service life) and high functional reliability at low differential pressures play a key role in filter rating and design. While separation efficiency and absorption capacity are dependent mainly on the choice of filter medium, the differential pressure produced by a given filter is directly contingent on the design of the filter housing. This makes it mandatory to optimise the fluid dynamic properties of the housing.

Using the SuFiS™ computational fluid dynamics (CFD) software developed by IBS Filtran, it has been possible to generate a meshed 3D model of each filter that can be used to render internal flow conditions quickly and easily visible as a function of diverse parameters (Fig.

2). The design and rating of the filter can thus be optimised at a very early stage in the engineering process. As a result, the development cycle for a new filtration system can be shortened significantly.

PC-based modeling not only provides a visualisation of flow conditions, it also enables the user to calculate the differential pressure drop as a function of the volumetric flow rate and hence, to optimise filter effectiveness. Already, IBS Filtran, in co-operation with the Fraunhofer Institute Techno and Wirtschaftsmathematik (ITWM), is working on a refined and upgraded version of the SuFiS that will enable simulation and monitoring of the filter efficiency and dirt retention performance parameters.

Although CFD simulations will not be able to replace practical filter tests altogether, they provide IBS Filtran with an exceedingly useful development tool that facilitates the time and cost efficient design and rating of advanced filter systems for

automatic transmissions of all design sizes and performance categories.

Filtran's exclusive flow simulation software enables the design and rating of a filter to be optimised early on, shortening the development cycle

About IBS Filtran

IBS Filtran Kunststoff-/Metallerzeugnisse is a joint venture between SPX Filtran and the Fritz Brocke family. The company ranks among the leading producers of automotive filter systems. Since 1986, it has been supplying filter systems for automatic transmissions to car and transmission manufacturers worldwide. Plastic oil pans with integral suction filter, designed (see Figure 4) were developed in close co-operation with the customer and have been used in volume production applications since 2001.

In addition, the company has developed a laser welding process for plastics (see Figure 3) which is likewise tailored for volume production lines, as well as an exclusive software for simulating flow processes inside the filter. Innovative filter media and systems round out IBS Filtran's portfolio. ■

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Figure 4: Full plastic oil pan with integrated suction filter and filling system