HANSA-FLEX

TECHNICAL INFORMATION
FILTRATION

Technical information Filtration

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1. General

Hydraulic fluid is much more than any old operating medium, although it frequently receives less than its due share of attention in hydraulics. As an important part of the machine, it is crucially significant to the design, operation and maintenance of hydraulic systems. We often see hydraulic fluid as a necessary evil ("it's only oil").

Modern hydraulic systems are noted for shortened cycle times, higher temperatures and pressures, reduced clearance gaps between components and more compact designs, with smaller tanks and higher speeds of revolution. The requirements for the quality and cleanliness of the hydraulic oils used have therefore continually risen over recent years. Hydraulic fluids are regarded as little more than standard lubricants and are mostly bought on price or whether they satisfy the minimum DIN requirements.

Efficient oil care routines and oil condition monitoring are important strategies in the field of proactive and predictive maintenance.

Implementing effective oil maintenance opens the door to considerable economic and ecological savings potential, not least because the cleanliness of the oil in the system affects the oil change interval, machine reliability and the retained value of systems and components.

CAUSES OF OIL CONTAMINATION:

- Design 2 %
- Manufacture 6 %
- Installation 12 %
- **Maintenance and operation 80% (contaminants in the oil)**

Solids (hard or soft)

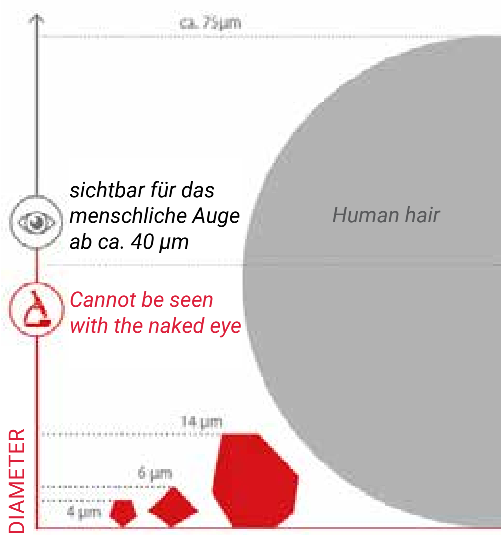
Particles are the most common cause of failures and malfunctions in an oil system. Contamination with particles cannot be avoided – only limited. The origin of the particles can be categorised as follows: inherent, introduced, arising from the machine itself or from the oil.

Sources:

Manufacture, installation, maintenance and repair, fresh oil, oil drums/storage tanks, the environment/atmosphere (process particles, dirt and dust entering through tank ventilation, defective seals, leakages), filling and replenishment processes, surface breakdown (wear, corrosion etc.), oil ageing and combustion processes (engines and motors)

About 75 % of the particles are between 1 – 5 µm in size

From the appearance of modern hydraulic systems, it is immediately clear that the technology used in them is subject to the highest requirements. For these systems to operate at this level, their components must be manufactured very precisely and to a high standard of quality. Contaminants, even though invisible to the naked eye, represent an extraordinary challenge for the narrow clearances between components in relation to wear.



If these contaminants get into the hydraulic system, they can cause the plant or equipment to stop working. Solid contaminants can even cause hydraulic hose lines to disintegrate, and thus initiate a cycle of damage. This cycle is called abrasive wear (sandblasting effect) and it adversely affects all the components in the system. The consequences include component failures and complete stoppages of whole systems. Other types of malfunctions may follow, such as stuck valves or blocked holes in the components. Maintenance personnel find these failures very difficult to investigate and rectify. More often than not, the causes of outages are found and rectified by trial and error. On top of this, there is also the possibility that adding fresh oil directly from the drum introduces contaminants into the system. Even fresh oil may be heavily contaminated. Although ISO 4406 demands a minimum cleanliness code of 21/19/16 for fresh oil, other values may also be specified in practice. A quick look at the minimum cleanliness requirements of component manufacturers reveals the range of required cleanliness codes to be very wide indeed.

Fresh oil should always be filtered before being used to fill the machine/system!

WATER IN THE SYSTEM

As well as solid contaminants, water is a very frequently occurring impurity in hydraulic fluids. It adversely affects the formation of the lubricating film and is a cause of corrosion of hydraulic systems and components.

Causes of water contamination include: fresh oil (handling, storage), ambient conditions (temperature fluctuations, condensation, water vapour), leakages and poor seals (process, coolant, rain and sea water), maintenance and repair, cleaning, operational and production-related water (e.g. paper and steel industries, marine transport vessels) and the tank ventilation and venting filters.

Water content			
10,441 ppm (1.04 %)	*2,871 ppm*	*423 ppm*	*Approx. 200 ppm (0.02 %)*

How much water (water saturation limit) and how long a specific oil can keep it in solution depends on the base oil, additives, temperature, pressure, turbulence and the contaminants in the oil. Synthetic oils (PAG, esters) and high-quality engine oils in particular can hold larger quantities of water in solution.

AIR IN THE HYDRAULIC FLUID

Mineral oil already contains approximately 9 % by volume of dissolved air.

In addition, external air cannot be prevented from getting into the oil system as a result of operational or production conditions and design features.

The air present in oil may be dissolved or undissolved. Pressure and temperature affect its state. If the pressure increases, air becomes dissolved in the oil and is released again when the pressure decreases. The speed at which air present in the oil as bubbles is released is much higher than that of air in solution. This is the reason why effective air separation and the foaming behaviour of the oil are also crucially important.

Entry of air:

- Through leaky suction lines (vacuum)
- During installation and poor bleeding
- Problematic oil return flow into the tank (swirling, air mixing)

OIL AGEING

Every oil ages or oxidises – only the speed varies depending on the base oil, additives and loading from catalytic effect-causing factors: high oxygen content in the oil (fresh oil already contains 9 % by volume of air), high operating temperatures and high pressures, as well as contamination with metal particles from component wear (Cu, Fe, Al, Zn) and water.

The consequences of oil ageing for machine components and the oil:

- Valve control difficulties -> malfunctions
- Changed lubricating gap geometry (e.g. bearings) -> wear
- Corrosion -> wear
- Reduced oil cooler efficiency -> increased energy requirement
- Blocked main flow filter -> frequent filter changes
- Clogged oil lines and tanks -> system flushing
- Porous seals -> entry of contaminants -> wear
- Shortened service life of oil and components -> waste of resources

CLASSIFICATION OF OIL CLEANLINESS

ISO 4406 is a preferred method of classifying oil cleanliness (contamination by solid particles). The ISO standard uses a code that consists of a combination of three numerical values. The first value describes the number of particles larger than 4 µm present in one hundred millilitres of a sample of fluid. The second value stands for the number of particles larger than 6 µm. The third value stands for the number of particles larger than 14 µm.

ISO 4406:1999 | Table of solid contaminants in hydraulic oils		
Number of particles per 100 ml of fluid		
Larger than:	**Up to and including:**	**ISO scale number**
1,300,000,000	250,000,000	28
64,000,000	130,000,000	27
32,000,000	64,000,000	26
16,000,000	32,000,000	25
8,000,000	16,000,000	24
4,000,000	8,000,000	23
2,000,000	4,000,000	22
1,000,000	2,000,000	21
500,000	1,000,000	20
250,000	**500.000**	**19**
130,000	250,000	18
64,000	**130,000**	**17**
32,000	64,000	16
16,000	32,000	15
8,000	**16,000**	**14**
4,000	8,000	13
2,000	4,000	12
1,000	2,000	11
500	1,000	10
250	500	9
130	250	8
64	130	7
32	64	6
16	32	5

Automatic particle counting

The numbers of particles > 4 µm, > 6 µm and > 14 µm per 100 ml are determined. Numerical values - code numbers or “scale numbers” - are assigned to the three resulting particle number counts. The resulting code numbers indicate the oil cleanliness class.

For example – ISO code 19/17/14
(typical for fresh oil quality)

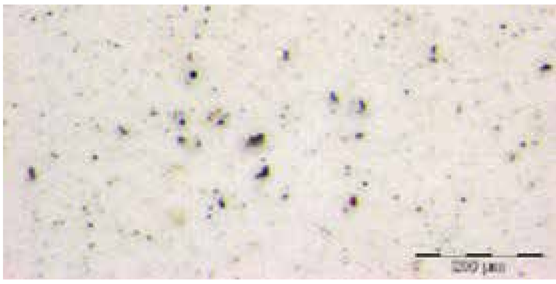
Particle size distribution in 100 ml of the tested oil:

- **250,000 to 500,000 particles > 4 µm**
- **64,000 to 130,000 particles > 6 µm**
- **8,000 to 16,000 particles > 14 µm**

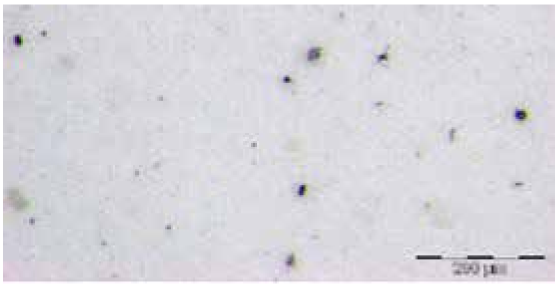
A laser particle counter is normally used to determine oil cleanliness in accordance with ISO 4406.

Typically recommended oil cleanliness code specifications for hydraulic components							
Component	**Typical specification**						
Servo valve	■	■	■				
Proportional valve		■	■	■			
Variable displacement pumps			■	■	■		
Cartridge valve				■	■	■	
Piston pump				■	■	■	
Vane pump					■	■	■
Pressure relief valve					■	■	■
Solenoid-operated directional control valve					■	■	■
ISO 4406:1999 CODE	**14/12/9**	**15/13/10**	**16/14/11**	**17/15/12**	**18/16/13**	**19/17/14**	**20/18/15**
Recommended filter fineness (absolute)	**3 µm**		**6 µm**		**10 µm**		**> 10 µm**

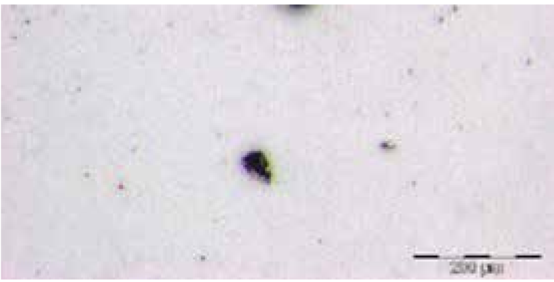
EXAMPLES OF ISO 4406 CLEANLINESS CODES



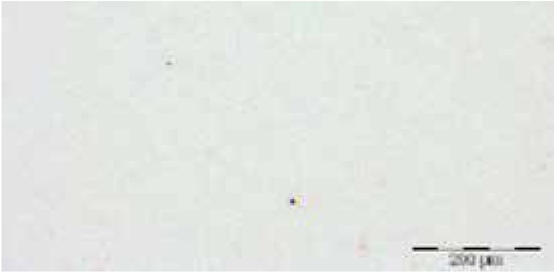
ISO code 21/19/16 – minimum requirement for fresh oil supplied in accordance with DIN 51524



ISO code 19/17/14 – requirement for electromagnetic control valves (s/w hydraulics)



ISO code 16/14/11 – requirement for proportional valves



ISO code 15/13/10 – requirement for servo valves

OIL CARE

Monitoring of the fluid condition and the use of filtering sufficient to meet the requirements of the application (if necessary dewatering and degassing) are indispensable in retaining the performance characteristics and ensuring a long service life for hydraulic fluids and system components.

The demands of monitoring increase with unfavourable operating conditions, increased loads on the hydraulic system and high expectations of availability and service life.

When the machinery or equipment is brought into first use, it should be noted that the required minimum cleanliness code can usually only be achieved by flushing the system. In cases of high initial contamination, it may be necessary to change the fluid or filters after only a short period of operation (< 50 operating hours).

Filtration

Filtration is the key to reliability and effective contamination control! The choice of the optimum filtration solution makes a considerable contribution to achieving these goals. Filters prevent malfunctions, extend the operating life of important and expensive system components, prolong system availability and significantly increase productivity.

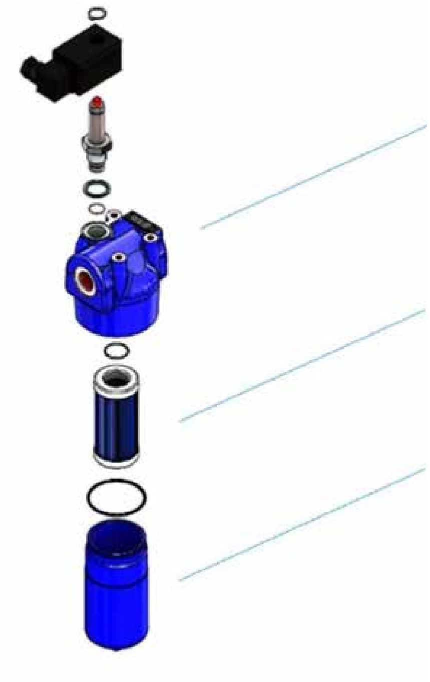
General requirements for filters

To allow the filter to work effectively and efficiently, it must meet certain requirements such as:

- Low cost
- Easily recycled elements
- High effectiveness
- Guaranteed cleanliness codes

- High dirt holding capacity
- Resistance to chemicals
- Pulsation resistant
- Long service intervals
- Ease of maintenance

Construction of a hydraulic filter



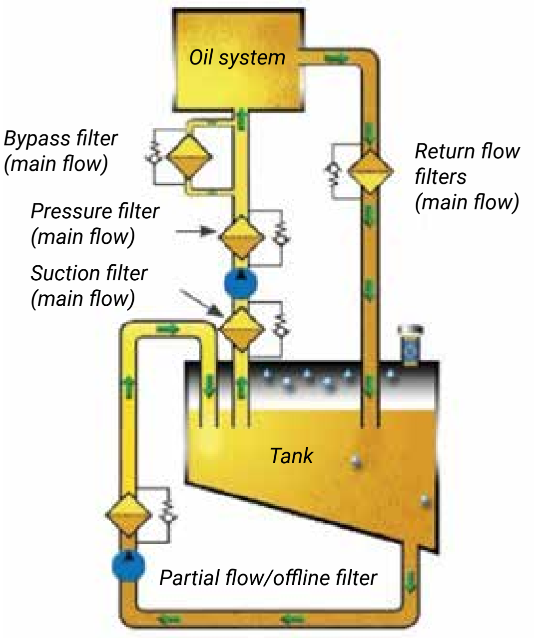
They consist of the filter element, a housing and additional fittings, depending on the type of use (e.g. bypass valve, maintenance indicator, reversing valve)

The housing consists of a head and a bowl.

Filter types

Filtration involves main and partial flow filters
The following filter types are used:

- Suction filters
- Pressure filters
- Return flow filters
- Tank venting/breather filters
- Partial flow/offline filters
- Bypass filters



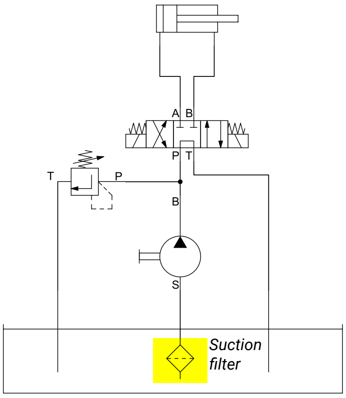
2. Safety instructions

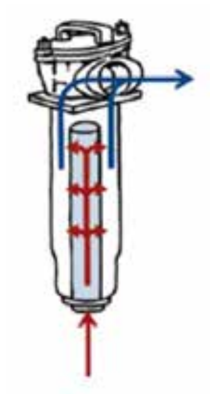
When replacing filters, always take into account the rate of decay of pressure, scalding risk from hot hydraulic oil, preventing the entry of dirt and water, condition of seals and system venting.

3. Technical information

3.1 Suction filters

The suction filter is located in the main flow before the system pump. It acts as a screen and protects the pump from being damaged by coarse particles. The filter fineness is typically > 25 µm because of the risk of cavitation in the pump. It is not suitable for providing the protection to components necessary to ensure the efficient operation of the system. Furthermore, so that it protects the pump against cavitation, it also does not remove water. These elements are replaced after the specified service interval or when prompted by the clogging indicator.





Advantages

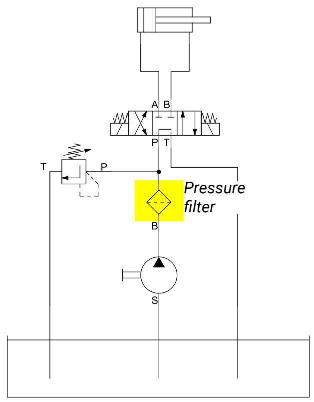
- Protects the pump from coarse contaminants

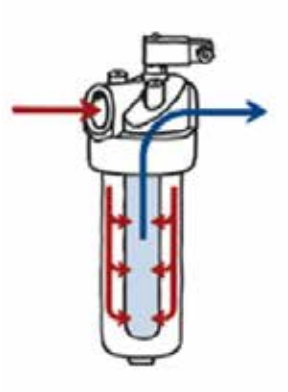
Points to note:

- Microfiltration is not possible
- The pump must be protected against cavitation (vacuum switch)
- Risk of cavitation, particularly at low temperatures (cold start)
- Additional filters must be installed to ensure the system is protected against wear

3.2 Pressure filters

The pressure filter is located in the main flow after the system pump and protects the machine and its components against wear due to solid particles from the oil tank and the pump. These filters are designed for use as full or partial flow filters and for low-pressures (up to 60 bar), medium pressures (up to 210 bar) and high-pressures (up to 420 bar). Pressure filters may be designed as line filters, flanged filters or replaceable filters (screw-on cartridges, spin on filters). We recommend that this type of filter is positioned directly before components that are particularly susceptible to dirt, such as servo and proportional valves. However, in these circumstances, it is particularly important to consider the high dynamics in the control circuits. The filter fineness lies typically in the range 10–15 µm. High operating pressure, strongly fluctuating pressure surges (start-stop operation) and high volumetric flows lead to extreme loading with material fatigue and the destruction of the filter's pore structure. Frequent filter changes involving very expensive elements are therefore to be expected. In addition, energy costs rise with finer filtration because additional pressure must be built up upstream of the filter. Pressure filters should always be fitted with a clogging indicator. Only a line filter without a bypass valve should be used before particularly critical components. These types of filter must be fitted with a filter element that can resist differential pressure loadings without incurring damage. These elements are replaced after the specified service interval or when prompted by the clogging indicator.





Advantages

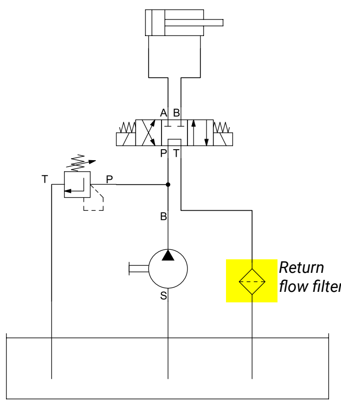
- Filtration takes place directly before the components to be protected
- The required cleanliness code is guaranteed

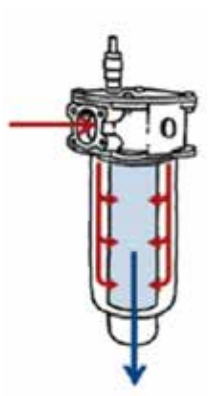
Points to note:

- Expensive filter housing and element due to the pressure loadings
- Complex element design due to the need for resistance to differential pressure
- Does not provide protection for the pump
- In the case of single filters, the system must be shut down for element replacement.

3.3 Return flow filters

The return flow filter or in-tank filter is located, if possible, in the main flow in the return flow line or integrated into the tank. A fine filter fineness (small mesh size) can be used. The filter retains particles before they reach the oil tank. Coarse filters may be required – in particular with hydraulic systems because the flow in the return line is as much as 2 or 3 times larger than the pump delivery flow (pressure-induced flow). Return flow filters are usually fitted with a bypass valve to avoid dangerous failures of the hydraulic components caused by excessive pressure build-up in the return flow line. To avoid any possible foaming of the fluid in the tank, it must be ensured that the fluid coming out of the filter is always discharged beneath the level of the fluid in the tank under all operating conditions. This may even need a pipe or flow diffuser to be installed in the filter outlet. Take note that the distance between the tank floor and the end of the pipe must not be less than two or three times the pipe diameter. In the case of filter elements with little pressure strength, pulsating pressures can lead to fatigue wear and destruction of the pore structure. These elements are replaced after the specified service interval or when prompted by the clogging indicator.





Advantages

- All the return-flow fluid is filtered
- No contamination originating in the system enters the tank
- Inexpensive filter housing and element

Points to note:

- An additional filter in the form of a pressure filter must be installed at high-value components
- Installation of a bypass valve is advisable
- In the case of elements with little differential pressure strength, multiple pulsations may destroy the element
- In the case of single filters, the system must be shut down for element replacement
- Large filters are required for high volumetric flows (area ratio for differential cylinders)

3.4 Spin-on filters

Spin-on filters can be used as suction filters, return flow filters or line filters, depending on their design. They are used as working filters, or as protective filters for hydraulic pumps and sensitive components.

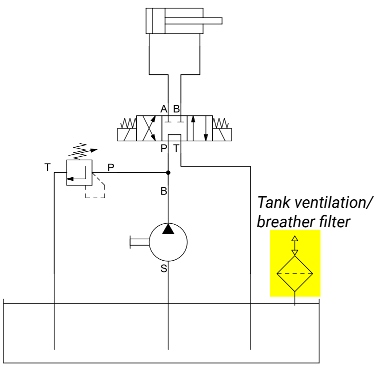
The spin-on filter consists of two basic components: a die-cast aluminium filter head and a robust sheet metal filter cartridge, which screws onto the filter head. The filter elements are integrated into the single-use filter cartridges. These cartridges are disposed of in one piece when the element is replaced. A non-return valve integrated into the cartridge prevents the unintentional escape of hydraulic fluid when the element is replaced.

The simple design of the filter means that the product has a particularly high cost-benefit ratio. In addition, the straightforward filter element replacement reduces system downtime during maintenance. Spin-on filters are used in both static and mobile equipment.

TANK VENTILATION/BREATHER FILTERS / TANK VENTILATION DRYERS (ADSORBER)

While the tank ventilation filter is an important part of the filtration strategy, it is often neglected. As a result of temperature changes and the use of cylinders or pressure accumulators, the oil level in the tanks of hydraulic and lubrication systems fluctuates continually. The resulting pressure differences from atmospheric pressure are equalised by inward or outward flows of air, which allows dirt or dust in the ambient air to enter the tank. The entry of these contaminants can be prevented by a ventilation filter. Ideally the ventilation filter should have the same filter fineness as the system filter in the hydraulic circuit. In view of the considerable amount of dirt and dust that can enter the hydraulic system through an unsuitable tank vent, these ventilation filters are indispensable. Tank ventilation filters should be replaced annually.

A more effective variant is the tank ventilation dryer (adsorber). Adsorber filters can bind with and remove humidity from the incoming ambient air and so reduce the moisture contamination of the hydraulic oil. The water in the air is taken into the pores of the adsorber (desiccant). This results in no change in volume, only the weight increases. The maximum water adsorption capacity is approx. 35 % by weight. In the adsorption process, the incoming air is dried, while the outgoing dry air enables a cyclic regeneration of the adsorber. The adsorber should be replaced if the desiccant (silica gel) has completely changed its colour (this can differ depending on the manufacturer).



Advantages

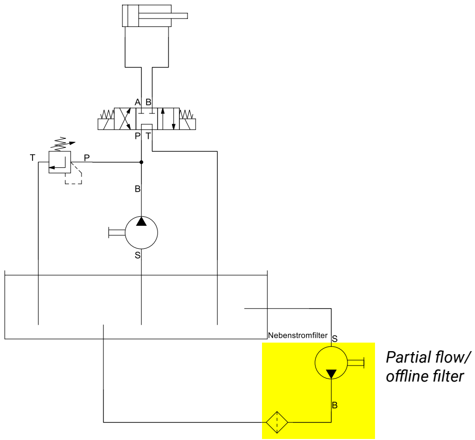
- Relieves the system filter by preventing dust and dirt from entering through the tank vent
- High air throughput
- Cost-effective
- Environmentally friendly

Points to note:

- If the filter is not properly designed, it can lead to damage to the tank and pumps.

3.5 Partial flow filters

A partial flow or offline filter works in a separate circuit whether or not the machine is operating (24/7 filtration) and at a low pressure (max. 2 bar). Its own pump sucks up unclean oil from the lowest part of the tank. The filtered oil is returned to the tank close to the system pump. The volumetric flow can be set such as to allow the use of depth filter cartridges with a filter fineness of 3 µm absolute and a retention rate of up to 1 µm. Depth filter cartridges are notable for their extraordinarily high dirt holding capacity and filtration efficiency. The cost of removing 1 gram of dirt from the oil is lowest if this is done in a partial flow (offline) arrangement. The machine does not require to be shut down for filter replacement or maintenance. Partial flow filters are generally low-maintenance and robust. They protect the expensive main flow filters and extend their replacement intervals. Sampling is easy because the system is almost free of pressure. Partial flow filters can be fitted with preheaters, coolers, prefilters and oil sensors for condition monitoring. Partial flow filter systems have proved capable of achieving and maintaining excellent levels of oil cleanliness.



Advantages

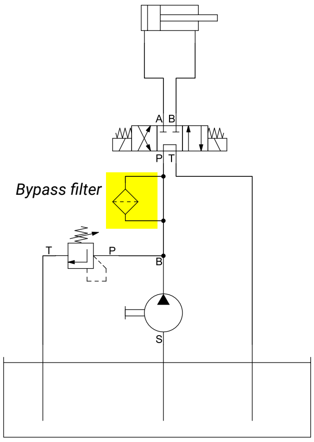
- Outstanding cleanliness codes
- System-independent filtration
- High dirt holding capacity of the filter elements due to low, pulsation-free and constant fluid flow through the filter elements
- Element replacement can be done without shutting down the machine
- Cost savings from lower material costs
- Less maintenance time
- Less downtime
- Cost-effective filter elements
- Hydraulic system replenishment possible
- Easily retrofitted to systems with inadequate filtration
- Fluid dewatering possible
- Service life of the fluid in the system is extended

In general, partial flow filters should always be present

- If high levels of dirt entry is anticipated, such as on production test benches, large systems in dusty environments, cleaning systems
- When installing a separate cooling circuit
- Where strongly fluctuating volumetric flows occur in the system

3.6 Bypass filters

Bypass filters work in a secondary circuit, not the main circuit carrying most of the fluid. The filter fineness is typically about 3 µm. In every case, this type of filter takes and filters only a small proportion of the main volumetric flow.



Advantages

- Very efficient filtration performance in bypass mode
- Compact and easy-to-maintain filter unit
- Suitable for water-absorbing filtration
- High water and dirt holding capacity

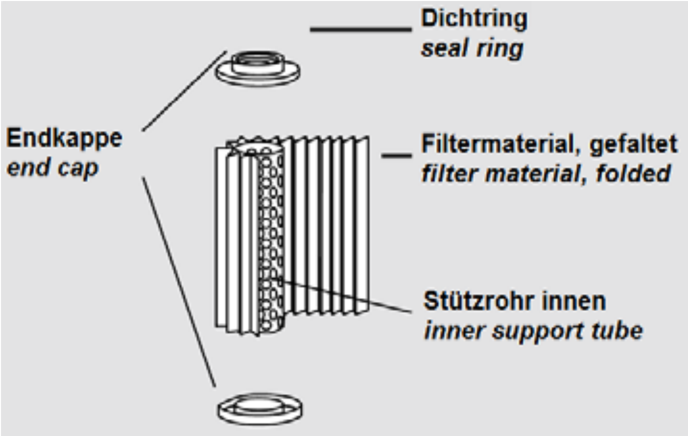
3.7 Filter design

The design of filters basically depends on the following system parameters:

- Flow volume
- Max. working pressure
- Required cleanliness code in the system or the filter fineness specified by the component manufacturer
- The type of hydraulic system (large-scale systems with many piston rods and consumers, medium, small systems)
- Operating medium
- Operating temperature
- Start-up temperature
- Filter construction (housing + element + options)

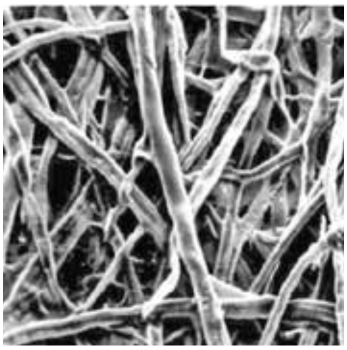
3.8 Filter elements

The filter element performs the actual filtration with its permeable material structure. The filter element consists of the inner support tube, the folded-star filter material and the end caps. With only a few exceptions, the direction of flow through the filter is usually from outside to inside.

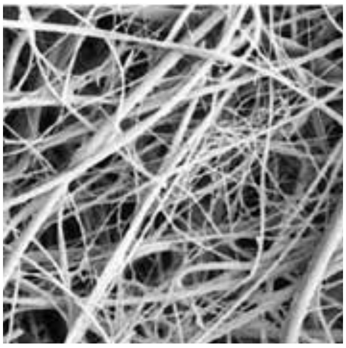


3.9 Filter materials

Wire mesh
- *10/25/40/60/100 µm*
- *Regeneratable (e.g. in an ultrasound bath)*



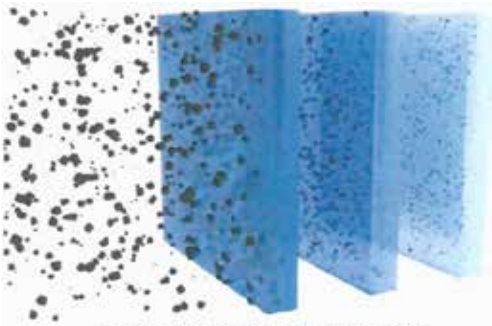
Paper / cellulose
- *6/10/25 µm*
- *Organic*



Fibreglass
- *3/6/10/16/25 µm*
- *Inorganic*

DEPTH FILTRATION

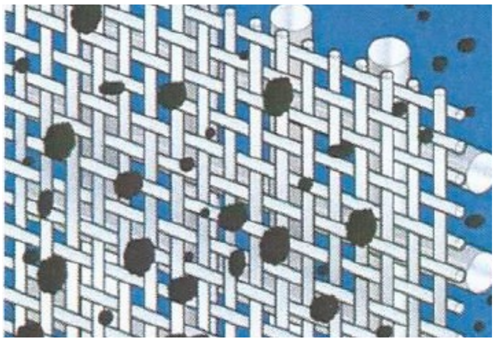
In depth filters, the elements consist of cellulose and glassfibre. Filtration takes place inside the filter material and the retained particles are kept between and within the various filtration layers. Elements that have reached their full dirt holding capacity therefore appear to be only very slightly soiled at first sight from the outside.



Schematic representation of depth filtration

SURFACE FILTRATION

Wire mesh elements are surface filters. The particles of dirt are separated directly at the surface of the wire mesh, which means the dirt holding capacity is less than that of a depth filter. Some of the dirt retained by these filter elements is evident on the outside.



Schematic representation of surface filtration

DEFINITION OF B VALUE AND SEPARATION RATE

The ßx value is the measure of the efficiency of a filter. It expresses the ratio of the number of particles before and after passing through the filter.

In hydraulics, people speak of filter fineness x (in µm) if the filter element meets the requirements of the multipass test in accordance with ISO 16889. The beta value, e.g. ß10 (C) >= 200, must also be given.

ISO 16889 cannot be used for filter finenesses > = 40 µm.

$$\beta x = \frac{\text{Number of particles larger than x µm before the filter}}{\text{Number of particles larger than x µm after the filter}}$$

The separation rate (retention rate) thus has the following direct relationship with the β value. The separation rate or the filtration efficiency is expressed as a percentage (%).

Example:

$$\varepsilon = \frac{\text{(Particles larger than x before the filter - particles larger than x after the filter)}}{\text{Particles larger than x before the filter}} \text{ x 100}$$

ε=99 %

Number of particles > 3 µm before the filter: 5,000,000 particles

Number of particles > 3 µm after the filter: 50,000 particles

Beta value β3: 99 %

In this example, ß3 = 99 means that 50,000 of 5,000,000 articles > 3 µm pass through the filter, the separation rate or the filtration efficiency is 99 %, 1 % of the particles > 3 µm are not retained.

The cumulative separation rate is determined because it indicates how many of the separated particles are > a specific particle size x.

ABSOLUTE AND NOMINAL FILTER FINENESS

The terms absolute and nominal filter fineness come from the US Army's MIL specifications and are not defined in any German standard. The glass bead test forms one part of the MIL specifications.

The absolute filter fineness describes the maximum particle size in micrometres that is almost completely retained (more than 99.98 %) by a filter medium. The expression "absolute filter" means that, for example, in the case of a 10 µm absolute filter, no glass beads > 10 µm diameter are allowed to pass through the filter.

Since solid contaminants are not round like a glass bead, it is also not possible to filter out all particles. For a nominal filter fineness, the filter medium would retain only a proportion (e.g. 70 %) of the particles relating to the particle size.

In relation to the β value, the following assumption applies:

β value = 1,000 (99.9 %): Absolute filter

β value < 75 (98.6 %): Nominal filter

- Filter made from inorganic glassfibre material
  Filter fineness 10 µm = 10 µm absolute

- Filter made from paper material (cellulose)
  Filter fineness 10 µm = 10 µm nominal = 30-40 µm absolute

ACCESSORIES

Filters can be used at their optimum economic efficiency only if their dirt holding capacity can be fully exploited. Therefore filters must be fitted with the device that indicates when the filter must be serviced (see DIN EN ISO 4413, Section 5.4.5.3.2.2). These clogging indicators must be clearly visible to the operating and maintenance personnel (see DIN EN ISO 4413, Section 5.4.8.5). Their mechanical or electrical sensors react to changes in the pressure ratios at the filter element.

Depending on the design, the clogging state is signalled on a pressure gauge or optically/opto-electrically by a switch. The switching point is chosen such that there is still a specific amount of reserve dirt holding capacity in the filter.

If clogging indicators cannot be used, then filter maintenance intervals must be specified.

4. MAINTENANCE

4.1 Maintenance indicators

There are various types of maintenance indicators:

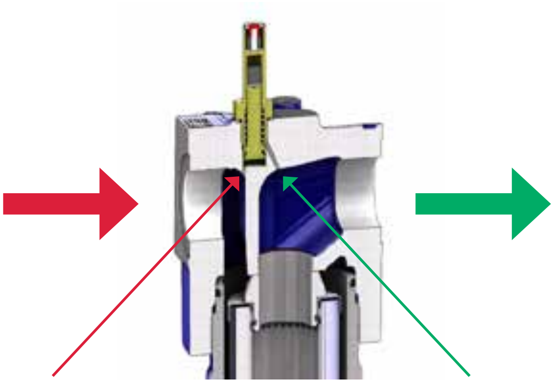
- Differential pressure indicator
- Back pressure indicator / pressure switch / gauge / sensor
- Vacuum switch / indicator / gauge / sensor

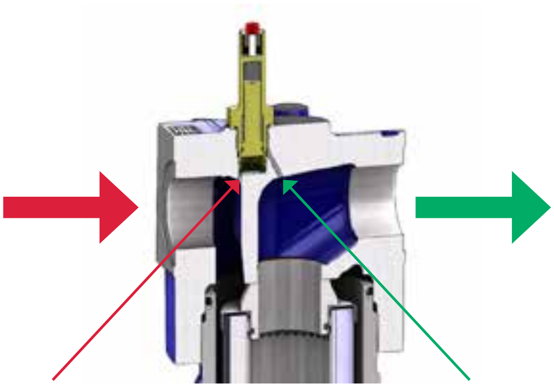




Advantages:

- Lower maintenance costs
- Prevents sudden collapse of the element
- Full use of the dirt holding capacity





MAINTENANCE IN THE CASE OF TANK VENTING DRYERS (ADSORBERS)

The saturation and the necessary replacement of the adsorbent is indicated by a change in colour from orange to green. HANSA-FLEX Xdry with heavy metal-free pH indicators (organic pigments) is used in the adsorber filters. These are substances whose colour depends on the pH value of the solution.

HANSA-FLEX Xdry and the pH indicators used are not classified as a hazardous substance according to the legislation of the European Union (EC Directive No. 1272/2008). It is not subject to mandatory labelling according to EC Guidelines (67/548/EEC and 1999/45/EC) and the corresponding national laws. The adsorbents used are therefore not substances harmful to health or the environment.

4.2 Information on HANSA-FLEX services

HANSA-FLEX Fluid Service is the tried and tested means of effective oil maintenance. It is the reliable way to avoid the costly consequences of heavily contaminated oil.

We provide advice and assistance for:

- Preventative maintenance
- Consulting, selecting and optimising hydraulic systems, hydraulic fluids and transmission fluids
- Fluid service provision for mobile and industrial hydraulics
- Conversion from mineral oil to bio-oil
- Oil mixing
- Contaminated oil
- Water in oil
- Detection of damage to components, e.g.: pump damage, damage to hydraulic systems, motors and cylinders, hose lines, hydraulic filters etc.

4.3. Links to website

Suction filter:
https://shop.hansa-flex.de/de_DE/filtration/filter/saugfilter/c/webcat_HF_FIL_0390_1820

Tank venting and filler filters:
https://shop.hansa-flex.co.uk/en_GB/hydraulic-components/tanks/general-accessories-for-hydraulic-tanks/tank-venting-and-filler-filters/c/webcat_HF_HKO_0550_2240_5760

Adsorber filters:
https://shop.hansa-flex.co.uk/en_GB/filtration/filters/adsorber-filters/c/webcat_HF_FIL_0390_1790

Return flow filters complete:
https://shop.hansa-flex.co.uk/en_GB/filtration/filters/return-flow-filters/return-flow-filters-complete/c/webcat_HF_FIL_0390_1810_4830

Spin-on filters complete:
https://shop.hansa-flex.co.uk/en_GB/filtration/filters/spin-on-filters/spin-on-filters-complete/c/webcat_HF_FIL_0390_1830_4850

Pressure filter complete:
https://shop.hansa-flex.co.uk/en_GB/filtration/filters/pressure-filters/pressure-filter-complete/c/webcat_HF_FIL_0390_1800_4810

Partial flow filter systems:
https://shop.hansa-flex.co.uk/en_GB/filtration/filtration/partial-flow-filter-systems/c/webcat_HF_FIL_0400_1840

Clogging indicators:
https://shop.hansa-flex.co.uk/en_GB/filtration/filters/accessories/c/webcat_HF_FIL_0390_1240

5. Disposal information

Filter elements, hydraulic oil, hose lines and components may not be thoughtlessly placed in ordinary refuse; they must be collected and disposed of in accordance with the applicable waste disposal regulations. The national requirements of the respective country and, if appropriate, the information given in the safety data sheets must be observed.

Spent adsorber filters can be disposed of with ordinary refuse, provided that they have not come into contact with oil.