

Filtration in Hydropower Plants



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Your competent partner for optimum fluid conditioning

With over 9,000 employees worldwide, HYDAC is one of the leading suppliers of fluid power, hydraulic and electronic equipment.

More than 50 subsidiaries and over 500 sales and service partners guarantee competent on-site service – wherever you need our support. Our wide range of products, combined with our expertise in development, manufacturing, sales and service, allows HYDAC to provide comprehensive fluid conditioning concepts – from individual filter components to the complete system.

The operating fluids

HYDAC offers solutions for stationary, mobile and portable fluid conditioning systems for filtration, dewatering, degassing and conditioning of almost all operating fluids, such as:

- Hydraulic fluids
- Synthetic fluids
- Lubricating fluids
- Rapidly biodegradable fluids
- Transmission oils
- Water-in-oil emulsions
- Turbine oils
- Oil-in-water emulsions
- Mineral oils
- Water:
- Diesel
- cooling water, sealing water and extinguishing water

Our solutions

- Filtering out of solid particles, water, oil degradation products and gases
- Stationary, mobile and portable units
- With integrated or retrofittable fluid sensors
- Filter element technologies made specially for a range of applications:
 - High contamination retention capacity
 - High filtration efficiency

Your benefits

- Increased machine availability
- Improved service life for components and system filters
- Longer oil change intervals
- Reduced life cycle cost
- Improved energy efficiency

Trust us to maintain your system – we have the expertise and knowledge for your fluids!

Impurities in your system:

- Corundum
- Water and many others
- Tinder
- Aluminium
- Rust particles
- Laminated fabrics
- Iron
- Seal abrasion
- Steel
- Rubber particles from hoses
- Brass
- Paint or varnish particles
- Bronze
- Oxidation debris from hydraulic fluids

Note

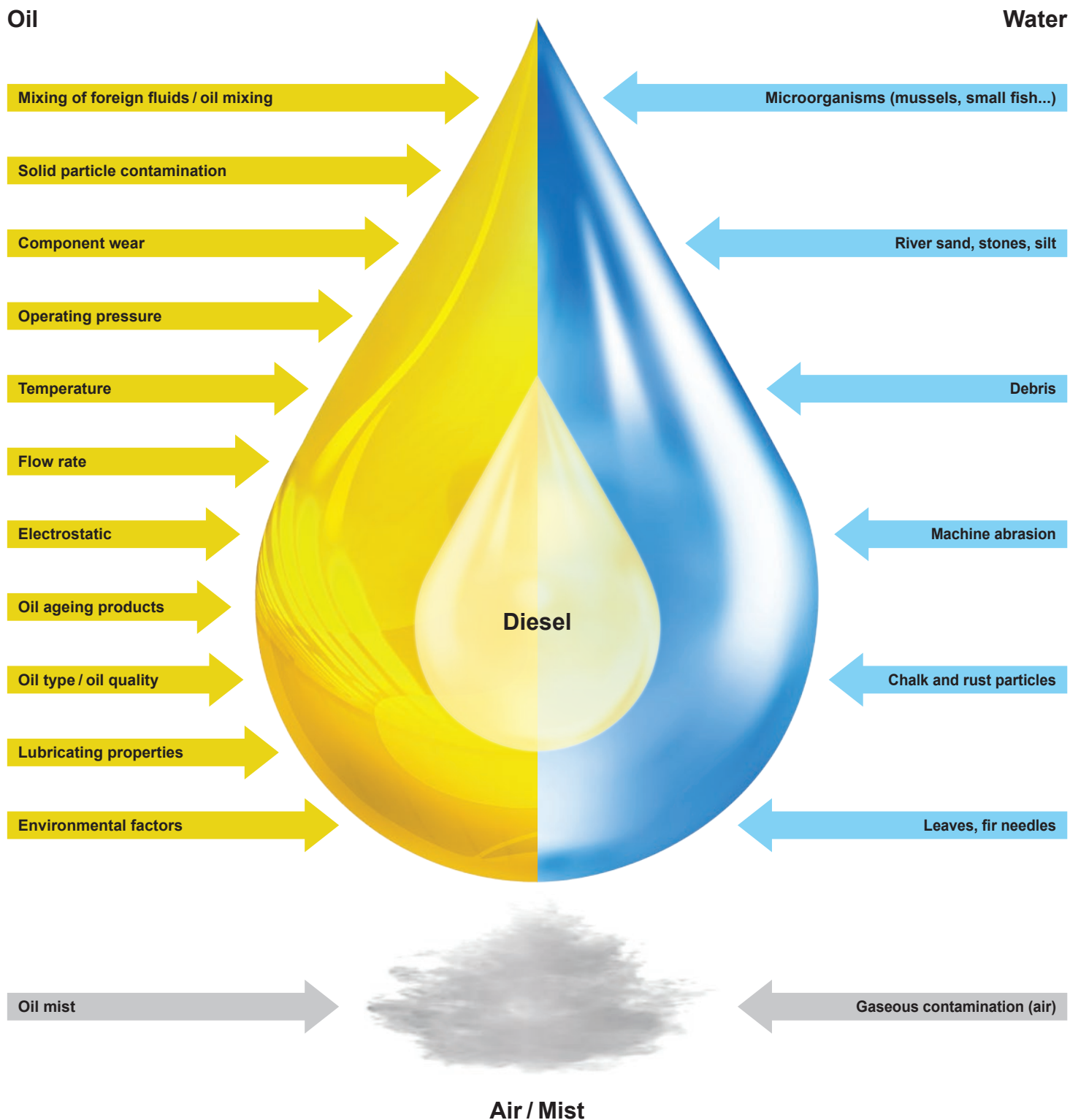
The information in this brochure relates to the operating conditions and applications described. For applications and/or operating conditions not described, please contact the relevant technical department.

Subject to technical modifications.

Various Types of Contamination

Various factors affecting fluid condition

Lubricant properties have a significant influence on the functionality and service life of your systems or machines. Fluid condition monitoring and corresponding fluid conditioning guarantee the functionality, availability and service life of industrial systems in stationary and hydraulics.



Origin and Effects of Fluid Contamination

Gaseous contamination

Origin:

- Contact with ambient air
- Outgassing of the fluid
- Leaks
- Process gas (e.g. Nitrogen)

Effects:

- Cavitation
- Oxidation
- Local overheating of the fluid
- Increase in speed of oil ageing
- Control inaccuracies
- Risk of explosion

Solid contamination

Origin:

- Installation contamination
- Ambient contamination
- Refilling of operating fluid
- Internal wear processes
- Oil ageing

Effects:

- Abrasive wear
- Increased leakage
- Component failure
- Control inaccuracies
- Blockage of control pistons
- Short fluid service life

Liquid contamination

Origin:

- Moisture from ambient air
- Cooling system leakages
- Process water/process steam
- Seal leakages
- High-pressure cleaner
- Chemical processes (incineration, oxidation, neutralization)

Effects:

- Corrosion
- Reduction in dynamic viscosity
- Reduction in lubricating film thickness
- Wear
- Change in the oil properties
- Creation of acidic oil degradation products
- Formation of sludge
- Increase in speed of oil ageing
- Cavitation damage

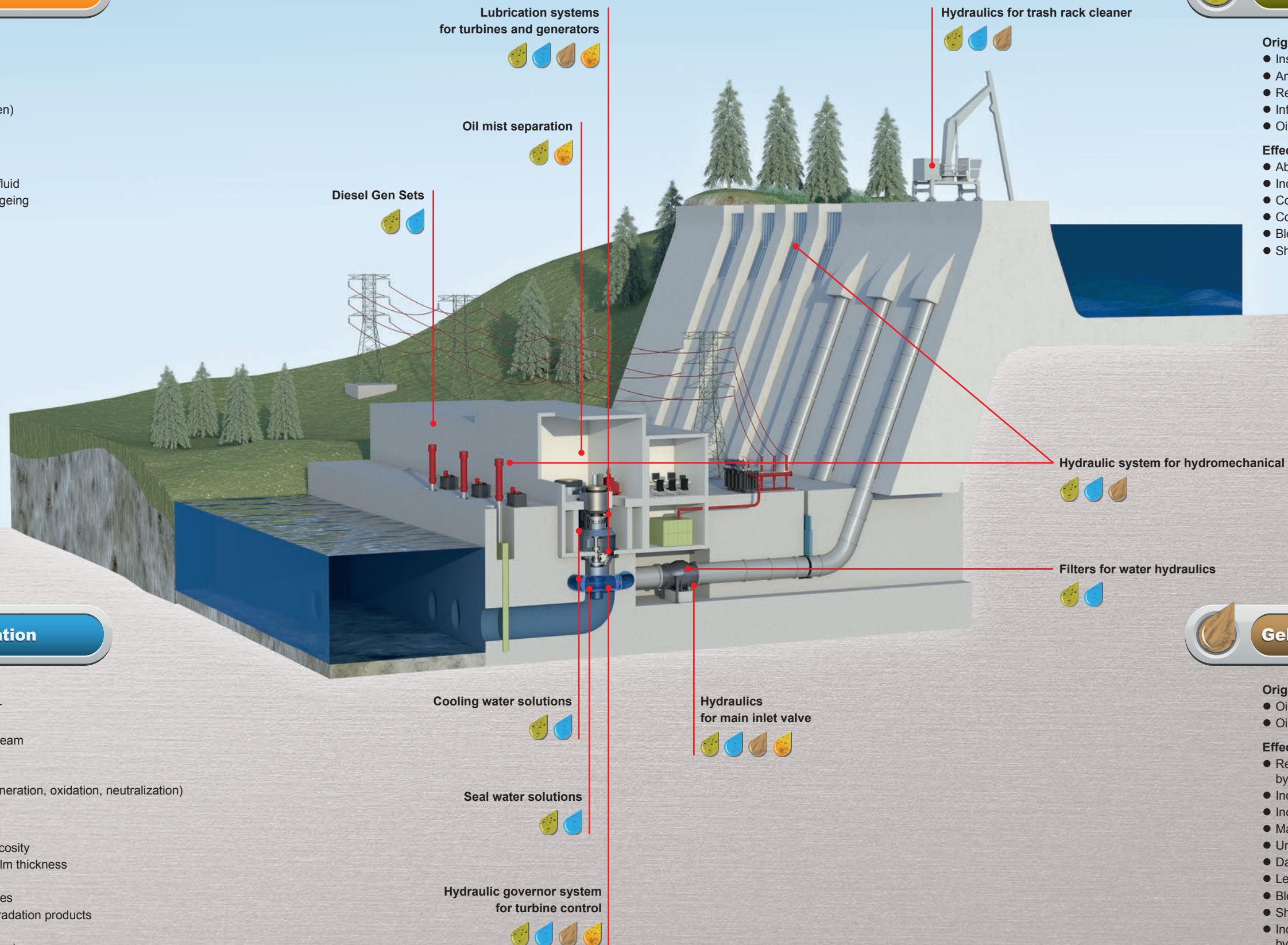
Gel-like contamination

Origin:

- Oil ageing
- Oil mixing

Effects:

- Reduced lubrication gaps caused by deposits
- Increased friction and temperature
- Increased bearing wear
- Malfunctions in valves
- Unstable control behaviour
- Damage to dynamic seals
- Leakages
- Blockage of filter elements
- Short filter life caused by sludge formation
- Increased bearing temperature caused by caking
- Reduced system efficiency



HYDAC Filter Components and Systems

Hydraulic and Lubricating Oil Filters – DF, LF, RFLD, FMND



Typical problem cases

In every hydraulic and lubricating oil system, particulate contaminants, such as fibres, metal particles or rubber abrasion enter the fluid, for example due to component wear or defective seals. The consequences vary, depending on the size and composition of these particles. These range from accelerated oil ageing to increased wear, up to failure of individual components or the entire system.

If, for example, a hard particle blocks the control piston in a valve, it can have serious consequences, especially in relation to safety-relevant components. This can result in costly downtimes and component failures.

Nothing but ultra-fine filtration using first rate technology can separate the dangerous and microscopically small particles out of the operating medium. HYDAC filter technology offers a range of high-quality filters with efficient element technologies for individual applications in the field of hydropower industry.

HYDAC solutions:

Filter housing

- DF Pressure filters for hydraulic systems up to 420 bar
- LF Pressure filters for hydraulic systems up to 100 bar
- RFLD Change-over pressure filters for lubricating systems
- FMND Change-over standard filter, up to 250 bar

Element technology

- Optimicon® – Innovative element technology for hydraulic systems
- Optimicon® Power – Optimised element technology made especially for lubrication systems
- Stat-X® – Element technology designed to prevent electrostatic discharges in the system

Areas of application:

- Hydraulic systems for gates and weirs, ball valves and turbine controllers
- Lubrication systems for turbines and generator bearings

Benefits for customers

- Reduced downtime
- Increased service life of components
- Protection of sensitive components
- Support for fluid's lubricity
- Increase in fluid's service life
- Cleaning of unwanted and harmful components out of the medium
- Reduction in operating costs

Our design program Filter-IT² makes convenient filter design possible under Online Tools at www.hydac.com



Wear marks on a valve piston

Filter Elements against Electrostatic Discharges Stat-X®



Typical problem cases

Modern high-performance fluids, such as those frequently used in lubrication systems often have very low electrical conductivity. This low conductivity in the oil or even outside the system can cause electrostatic spark discharges to occur when flowing through the filter element.

These discharges can lead to a variety of potentially very dangerous consequences:

- Burnt filter elements
- Danger to machine operators from discharges outside the system
- Disruption of electronic components
- Tank deflagrations
- Increased occurrence of oil degradation products (varnish)

In this case, a conductive filter element design is not sufficient to eliminate the dangerous discharges from the system.

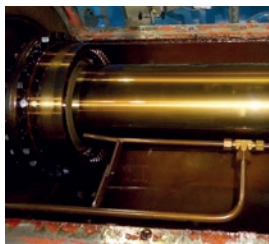
Reliable protection and a long service life of the system can only be ensured by using the highly specialised Stat X® element technology.

HYDAC solutions:

By using the cutting-edge Stat-X® element technology, you will significantly reduce electrostatic discharges and excessive oil charges, even in extremely critical systems with excellent ultra-fine filtration.



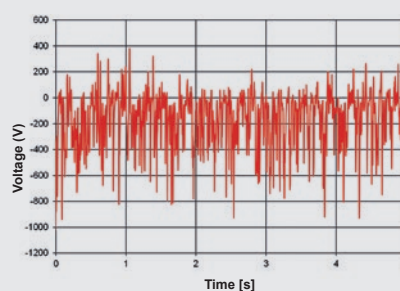
Blocked filter elements



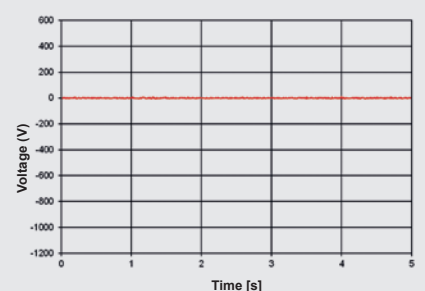
Increased occurrence of oil ageing products

Practical example: turbine bearing lubrication

Before



After



Benefits for customers

- Maximum safety for operators and system through proven reduction of electrostatic spark discharges
- Reduced occurrence of oil ageing symptoms (varnish) and longer intervals between oil changes
- Longer bearing life and avoidance of bearing corrosion
- Safe operation in potentially explosive atmospheres
- Reduction in unscheduled downtime
- Reduced maintenance costs and longer maintenance intervals

Water Hydraulics – Ball Valves / Servomotors AutoFilt® RF3 to 100 bar



Typical problem cases

Sediments and other solid contaminants endanger the safe operation of water-powered servo motors. To protect sensitive water hydraulics, filtration is absolutely necessary.

Conventional solutions such as double filters or sedimentation tanks are very expensive, space consuming and must be operated manually.

HYDAC solutions:

Backflush filters ensure a constant flow of clean hydraulic water. This special type of filter control ensures that clean working water is always available before each operation of the ball valve. There is no need for expensive sedimentation containers.

Areas of application:

- Process water filtration for the water hydraulics of the shut-off device (e.g. Ball valves)

Benefits for customers

- Compact
- Economical compared to sedimentation tanks
- Fully automatic backflushing of filter cartridges
- Self-cleaning
- Reliable ball valve operation

Sealing Water Treatment – AutoFilt® RF3, RF4 and ATF



Typical problem cases

Sealing water for the mechanical seal of the turbine shaft is often taken from the subsea water. The solids it contains can damage the sensitive mechanical seal and lead to serious damage.

To avoid this, protective filtration is necessary.

HYDAC solutions:

Due to the high levels of solids, e. g. in heavy rain or snowmelt, a filter cascade is usually required.

HYDAC AutoFilt® ATF, RF3 and RF4 self-cleaning filters with a fineness of 200 – 1,000 µm have proven themselves as pre-filters.

AutoFilt® RF3 and RF4 automatic backflush filters are suitable for fine filtration. Usual filtration fineness between 25 and 100 µm
All filters work fully automatically.

Areas of application:

- Sealing water treatment for the mechanical seal of the turbine

Benefits for customers

- Space-saving
- Low maintenance
- High degree of automation
- Self-cleaning
- Reliable

HYDAC also offers complete filter module solutions:



Cooling Water – AutoFilt® RF3 and ATF



Typical problem cases

Reservoir or river water is used to protect plate heat exchangers for bearing oil cooling or generator cooling.

The solids it contains (sand, silt, flotsam) lead to blockages in cooling ducts, fittings and heat exchangers.

Therefore, a suitable filtration of the cooling water for the protection of these components is absolutely necessary.

HYDAC solutions:

The back-flushing AutoFilt® RF3 filter is a proven cooling water filter for volume flows up to 9,000 m³/h. The filter elements are cleaned according to the differential pressure – without interrupting the filtration process.

For very coarse impurities, the self-cleaning AutoFilt® ATF is also recommended. This filter provides a combination of centrifugal force and candle filters. Heavy components are separated in the centrifugal force field, while light solids are retained on the filter element. In a short rinsing phase all solids are discharged from the apparatus.

Areas of application:

- Cooling water filtration for generators and turbines

Benefits for customers

- Extremely flexible
- Easy to maintain
- High degree of automation
- Self-cleaning
- Tried-and-tested
- Highly reliable



Offline Filtration— Offline Filter OLF



Typical problem cases

Particulate contamination enters the hydraulic or lubricating oil in various ways, e.g. through assembly contamination, internal wear processes or the refilling of oil.

The consequences include abrasive wear, component failure, control inaccuracies and short fluid service lives.

HYDAC solutions:

The OffLine filters are robust bypass filter units for stationary use in hydraulic and lubrication systems. The Dimicron elements used in these filters are noted for their particularly high contamination retention capacity and an environmentally safe method of disposal (incinerable).

The optional monitoring equipment ContaminationSensor CS1000 is used to monitor the solid particle contamination in the oil. The AquaSensor AS1000 measures the water saturation (in %) as well as the temperature of the fluid. The measurements can be transferred to a PC using a USB memory stick or be integrated into a plant control system using analogue outputs.

Areas of application:

- Bypass filtration of hydraulic and lubrication systems (e.g. hydraulics for steel construction in water, screen cleaners, shut-off devices, turbine controllers and lubrication systems)

Benefits for customers

- Optimised service life for components and system filters
- Increased machine availability
- Longer oil change intervals
- Easy to service
- Optional sensors for monitoring contamination in the oil

Dewatering and Degassing Unit Fluid Aqua Mobil FAM



Typical problem cases

In lubricating oil and hydraulic systems – such as the angle adjustment in water turbines – undesirable high water concentrations often occur in the oil. This increases oil ageing and reduces lubricating properties. Unscheduled downtimes are the result.

HYDAC solutions:

The FluidAqua Mobil FAM operates on the principle of vacuum dewatering to eliminate free and dissolved water as well as free and dissolved gases. Thanks to the HYDAC bypass filter element technology with high contamination retention capacity and separation capacity, the unit achieves a very high economic efficiency.

The FAM is equipped with an AquaSensor for continuous monitoring of the water content and control of the unit.

The FAM is an optimal alternative to centrifuges due to low maintenance costs, easy operation and the avoidance of water entering the lubrication system.

Areas of application:

- Dewatering of lubrication and hydraulic systems (e.g. hydraulics for steel construction in water, screen cleaners, shut-off devices, turbine controllers and lubrication systems)

Benefits for customers

- Extended intervals between oil changes
- Improved component service life
- Increased machine availability
- No costs due to unscheduled downtimes
- Reduction of life cycle cost (LCC)

Elimination of Oil Ageing Products – Varnish Elimination Unit VEU-F



Typical problem cases

Oil ageing products in hydraulic and lubrication oil systems accumulate in dark deposits on tank walls, coolers or valves, where they can lead to malfunctions and increased bearing temperatures. The result is unscheduled downtime and high costs.

HYDAC solutions:

The Varnish Elimination Unit VEU-F is connected to the bypass flow and continuously removes ageing products from the oil. With this technology, the solubility of oil degradation products decreases as the oil cools down. Subsequently, these can be separated through filtration.

This type of purification functions in a similar way to offline filtration and works 24-hours/day, 365 days/year. The oil is cooled down to below 30 °C in a single pass. For cooling, a plate heat exchanger or a cooling unit can be used.

Areas of application:

- Lubrication and hydraulic systems

Benefits for customers

- Extended intervals between oil changes
- Increased machine availability
- No costs due to unscheduled downtimes
- Reduced life cycle cost

Diesel Preparation – LowViscosity Unit Coalescer Diesel LVU-CD



Typical problem cases

Diesel fuel is often subject to long storage periods, especially in tanks which may be used infrequently (e. g. emergency power units). Solid particle contamination and water often settle on the bottom of the tank and are sucked into the pump when it is turned on.

In addition, over an extended period of time free water in a tank provides a breeding ground for diesel fuel pests (microorganisms such as bacteria, algae and fungus). Both can lead to rapid blocking of fuel filters and damage to the components of the injection system. This leads to high costs for downtime, spare parts, maintenance and diesel disposal.

HYDAC solutions:

The LowViscosity Unit LVU-CD from HYDAC is intended for two-stage offline filtration. It works independently of the motor's fuel filter. It removes solid particle contamination and free water from diesel fuel. Here, the dewatering process follows the coalescence principle: tiny water droplets are combined into larger drops in the coalescing unit and separated from the diesel by force of gravity. The LowViscosity Unit LVU-CD is a dewatering unit for diesel fuels with densities of less than 950 kg/m³.

Areas of application:

- Diesel unit for emergency power generation

Benefits for customers

- Reduced risk of diesel pests, costly clogging of fuel filters and injectors thanks to separation of free water from diesel fuel
- Care and dewatering possible even when the combustion engine is turned off
- Different versions available, e. g. adjustable pumping function (continuous or time-controlled) or automatic water drain from the coalescer

Filling Filtration – Mobile Filtration Unit MFU Filter-Umpump Unit OFU



Typical problem cases

Impurities such as solid contaminants and water in hydraulic and lubricating oils represent a major hazard for systems. 70 – 80 % of failures of lubrication and hydraulic systems are due to fluid contamination.

Impurities such as particles and water enter the operating medium through friction, wear, leaks and excessive temperatures. However, contamination can also be introduced into the system during start-up or servicing when filling and refilling (fresh) oil. This is because the level of purity usually does not meet the cleanliness requirements of the installed components.

In order to prevent costly damage and system failures, filling filtration and monitoring of hydraulic systems for cleanliness are recommended.

HYDAC solutions:

The Mobile Filtration Unit MFU 15 is used as a portable service unit for filling hydraulic systems, flushing small hydraulic systems and for cleaning them in bypass flow (up to 15 l/min). Solid particle contamination as well as free water can be removed by the filter elements.

The MFU 15 can also be fitted with an optional CS 1000 Contamination Sensor. This allows the solid particle contamination in the oil to be monitored at the same time. The cleanliness class results are displayed according to ISO, SAE or NAS classifications.

For higher flow rates (100 l/min), the OFU mobile filter-recirculation unit is used for filtration when filling systems and when recirculating hydraulic and lubricating media.

Areas of application:

- Filling of any hydraulic or lubrication system (e.g. hydraulics for steel construction in water, screen cleaners, shut-off devices, turbine controllers and lubrication systems)

Benefits for customers

- Optimised service life for components and system filters
- Increased system availability
- Reduction of life cycle costs (LCC)

Oil Mist Separator STENO



Typical problem cases

Oil mist separators are a major component of lubricating oil systems in hydraulic turbines. In the bearings of these turbines, a fine oil mist is formed from the lubricant. The escape of this oil mist through the seals of the bearings must be prevented. The oil mist separators are used to extract the air from the bearings and filter out the fine oil mist. Once recovered and filtered, the lubricant finally returns to the lubricating oil tank via a drainage pipe.

HYDAC solutions:

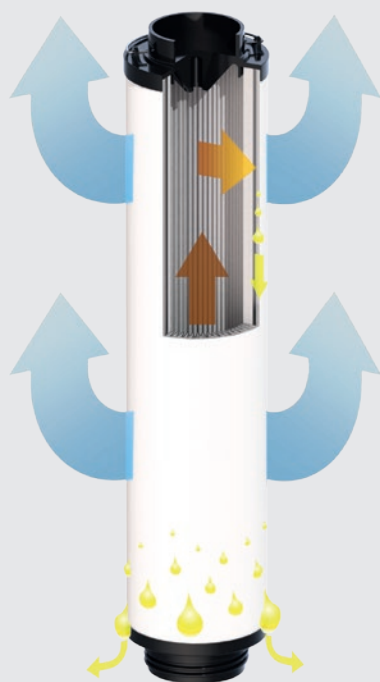
At the heart of the HYDAC oil mist separators lies the innovative and efficient Optimicron® Drain filter element technology. Compared to the standard glass fibre cartridges on the market, the Optimicron® Drain Element consists of a star-folded, multi-layer coalescence filter mat and a cylindrical drainage layer. The highly efficient construction and the special geometry of the element ensure that only a single element is required in the STENO (for sizes 50 – 200). Using HYDAC Optimicron® Drain elements allows over 99.99 % of the 0.1 µm sized oil droplets to be separated. Thus, even at high oil mist concentrations, residual oil contents of less than 5 mg/m³ are achieved. The legal requirements are thus significantly undercut over the full service life. Furthermore, the sustainably clean exhaust air and the recovery of the clean lubricating oil reduce environmental pollution.

Areas of application:

- Turbine and generator bearings

Benefits for customers

- Residual oil contents below 5 mg/m³ which is considerably below the legal requirements
- Excellent filter performance of > 99.99 % per 0.1 µm
- Significantly longer service life
- Only one element in the housing (STENO 50–200)
- Quick and safe element replacement in less than 10 minutes thanks to simple screw connection without tie rod
- Durable and robust side channel blower with highly efficient performance
- Considerable reduction of installation space and weight due to compact design
- Equal mounting sizes and dimensions across several sizes
- Various options such as ATEX or stainless steel versions available



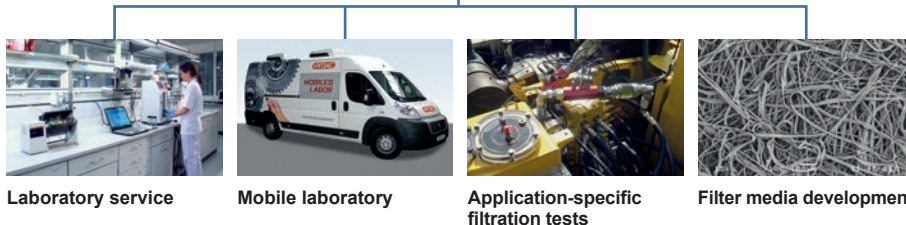
Application examples

Of course, these are just a few of our solution examples. Please contact one of our consultants for a range of solutions.

FluidCareCenter

You can count on top quality and innovation

Development at HYDAC means designing application-orientated filtration systems based on test results from our research, test laboratories and on-site analyses, whilst taking the requirements of the user and installer into account.



At the HYDAC FluidCareCenter, we collaborate with our customers to develop innovative products in a wide range of industries.

A skilled development team, using state-of-the-art computer-aided analysis, measuring and testing equipment and test rigs, ensures prompt implementation of the project.



Service

Your key to higher process reliability and equipment availability

The HYDAC Servicenter offers a systematic, comprehensive range of services, with objective maintenance and inspection procedures that significantly help to increase the useful life of hydraulic systems, lubrication systems and electrohydraulic controls and regulators.

After an in-depth consultation, you can create a service package tailored to your needs.

Whether to support existing in-house maintenance or to sub-contract a complete maintenance package, we will always find the best solution for you.



Rental service

With specialised power units, low usage does not have to equal high investment costs. Leasing or renting of equipment presents an inexpensive and flexible alternative.

Anytime you need a filtration unit, a dewatering unit, a flushing unit, a measurement device or a nitrogen charger – we have one ready for you!

All units for hire are maintained and checked regularly, so they are always reliable and ready for operation.

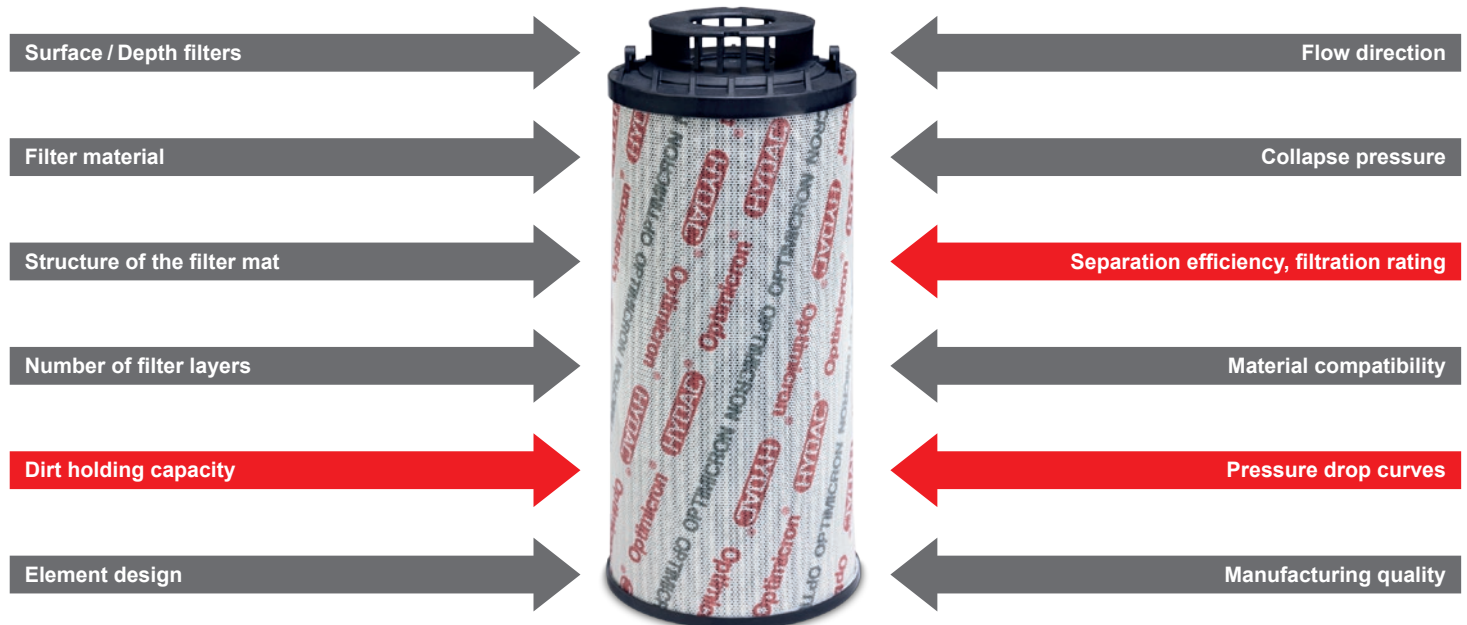
Our specialists will be pleased to advise you from the outset on selecting the best unit for your application.

We ensure that the hire equipment will be available on schedule so your project runs smoothly.

- Dewatering units
- Flushing units
- Filtration units
- N2 Server
- Assembly/commissioning units
- Analysis instruments
- Measurement devices

Filter Element Technology

The filter elements installed in the filter housing are the “heart” of the filter, carrying out the actual filtration work. Elements consist of several pleated filtration and support layers which are placed as a cylinder around or inside the stabilizing support tube and surrounded by an additional outer plastic sleeve (outer jacket). Depending on the application and function of the complete filters, different element techniques can be employed:



Optimicron®,

innovative element technology for hydraulic systems. The unique HELIOS pleating and high-performance filter materials in the filter elements ensure top-rate filtration in terms of filter performance and energy efficiency. They offer the best combination of separation efficiency, service life and differential pressure.

Stat-X®,

the latest element technology against electrostatic discharges. By using the cutting-edge Stat-X® element technology, you will significantly reduce electrostatic discharges and excessive oil charges, even in extremely critical systems with excellent ultra-fine filtration.

Further information is available on our micropage: stat-x.hydac.com

Optimicron® Power,

optimised element technology made especially for lubrication systems. They excel with increased robustness, safety and a particularly low pressure drop. They have a compact design and, thanks to the integrated Stat-Free® technology, provide increased operational reliability with regard to electrostatic charging.

Condition Monitoring

HYDAC products and they usage

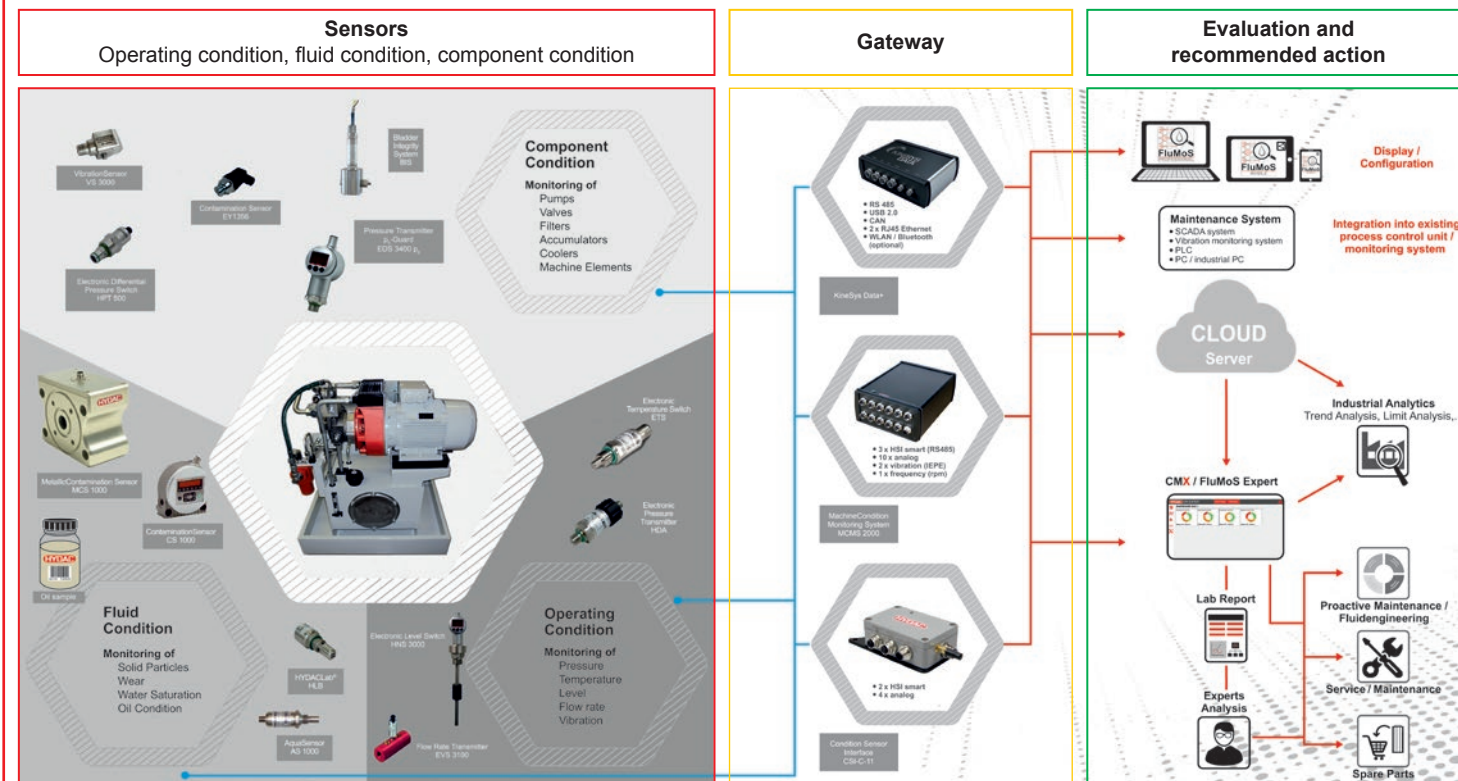
In hydraulic and lubrication oil systems, friction, wear, leakage and excess temperatures can contribute to the operating fluid becoming contaminated. Solid particle contamination and water are examples of this. This contamination then goes on to cause errors in components and subsystems and ultimately in the system as a whole. Furthermore, the normal ageing process of the fluid causes performance losses that often result in system downtime.

In order to prevent these time-consuming and costly consequences, monitoring the condition of the operating fluid is of major importance. The condition of the operating fluid is comparable to a “fingerprint” of the overall condition of the system. Implementing a predictive maintenance strategy allows the service life of all critical machine elements to be fully utilised, by detecting a variation from the fluid’s normal condition early on.

This is the basis for a significant reduction in operating costs: expensive, unplanned system downtime can be eliminated or minimised.

As soon as the beginnings of a deviation are detected, the remaining service life of the corresponding parameter or component can be estimated and used for ongoing production in a controlled manner. Meanwhile, spare parts can be procured and maintenance can be scheduled at minimal cost.

A predictive maintenance strategy thus allows available resources to be utilised optimally, reducing the total costs for the machinery throughout its service life (life cycle cost, or LCC).



ConditionSensor Interface CSI-C-11



SensorMonitoring Unit SMU 1200



Metal particle sensor MCS 1000



Water sensors AS 1000 and



AS 3000



Particle sensor CS 1000



Portable service unit FCU 1315 for temporary measurement of solid contamination and water saturation in hydraulic and lubrication systems



ContaminationSensor Module CSM Economy

Sensors and sensor modules

- Solutions for permanent system installation, including hydraulic and electrical adaptation (Online Condition Monitoring)
- Plug&Work measuring equipment for sporadic system analysis (Offline Condition Monitoring)

Measured variables

- Particle contamination in accordance with ISO SAE, NAS
- Water saturation
- Metallic abrasion particles
- Oil ageing
- and many more...

Contact us for more information!

HYDAC offers numerous solutions, e. g. sensors, gateways and system approaches up to correct evaluation including industry-specific recommendations for action.

We are happy to assist you with digitisation, preventive maintenance (PdM) and Industry 4.0.

Betterfit

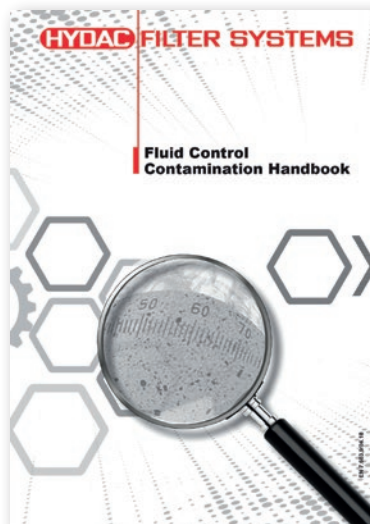
The use of low-quality elements in the system can have dramatic consequences. In addition to poorer cleanliness classes and thus inadequate component protection and a risk to operational safety, the lower-quality filter elements ensure shorter service lives and increased life cycle costs (LCC).

In order that you may benefit from using third-party products with HYDAC quality, the HYDAC Betterfit program encompasses a wide range of replacement components in the required dimensions. Our Betterfit components are equipped with proven component technology in HYDAC quality. The high-quality filter elements thus ensure outstanding levels of cleanliness and high operational reliability thanks to filter media with high separation efficiency. Low operating costs are achieved through extremely low losses of pressure across the filter and filter element. You will also benefit from our comprehensive system competence and a global system approach based on our decades of experience in the hydraulics and lubricating oil industry.

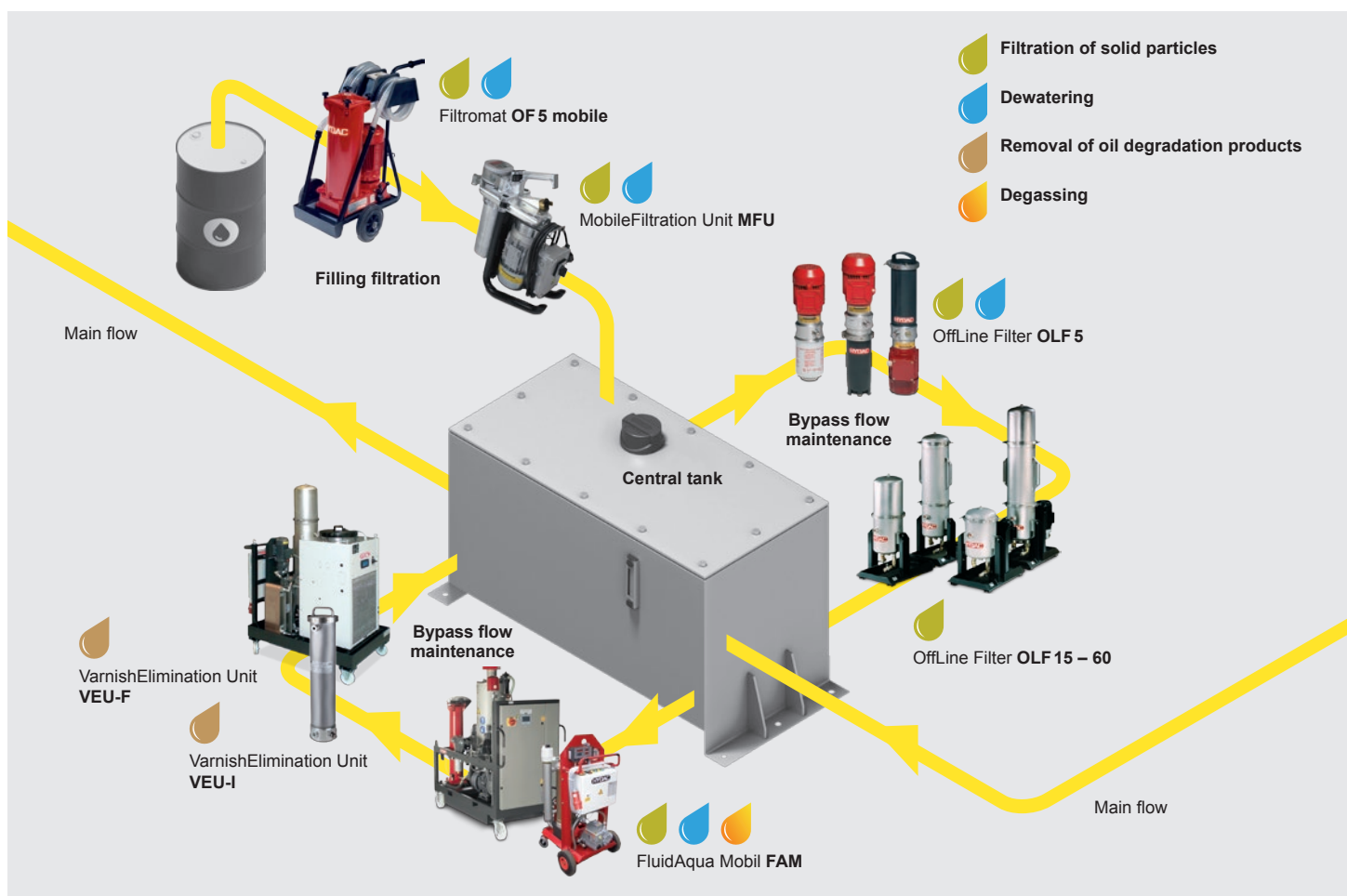
A Betterfit database for easy conversion of element names can be found on our website (www.hydac.com) under Online Tools.

Contamination Handbook

Further information on classes of cleanliness, types of contamination, hydraulics and lubricating oils can be found in our contamination handbook online (www.hydac.com) under prospectus no. 7.603../..

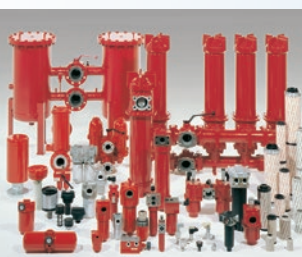


For Maximum Machine Availability – Filter Solutions for any Application





Accumulator Technology 30.000



Filter Technology 70.000



Process Technology 77.000



Filter Systems 79.000



Compact Hydraulics 53.000



Accessories 61.000



Electronics 180.000



Cooling Systems 57.000

**Global Presence.
Local Expertise.**
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- HYDAC Companies
- HYDAC Sales and Service Partners
- ▲ Free Sales Partners

HYDAC

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