

**KLEENOil®**

Microfiltration

Since 1986



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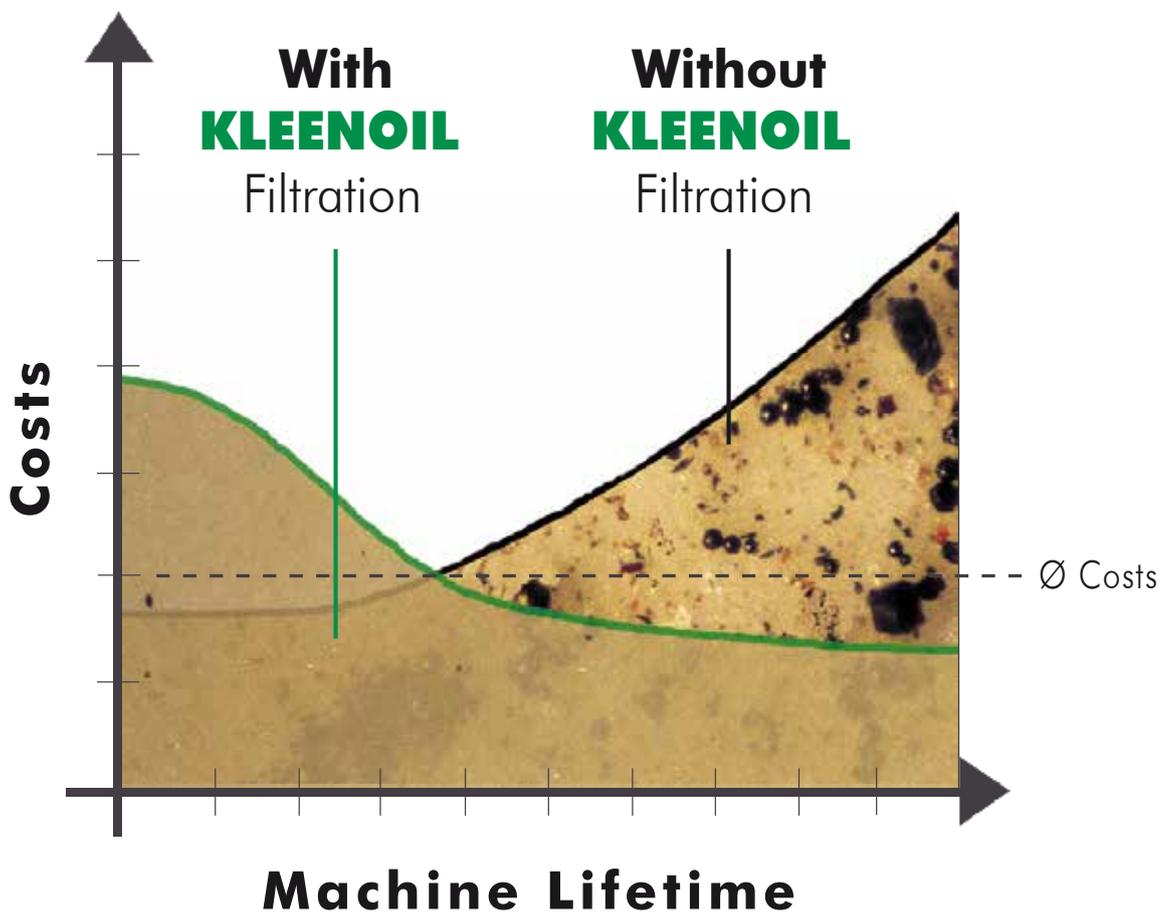
# GENERAL INFORMATION

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By using KLEENOIL Microfiltration a major part of the harmful contamination, even microparticles down to 1 micron and water are eliminated in the by-pass. This way oils can maintain their very good cleanliness for a long time. Thereby ideal functionality as well as an excellent wear protection can be achieved.

System failures, wear and breakdowns are reduced by decreasing the contamination in the oil. The ageing process of the fluid is slowed down because most of the harmful solid contaminants with catalytic effect as well as water are eliminated. The longevity of the oil is maintained and oil change intervals can be extended considerably. This reduces costs and protects the environment.

The most important advantages are the extension of the useful life of the components, as well as a reduction of the risk of breakdowns and thus a higher level of machine availability.



## Advantages

- Mechanical wear is clearly reduced
- Longer useful life of the components
- Ageing of the oil caused by oxidative or catalytic reactions is strongly reduced
- Premature breakdowns of machines are reduced to a minimum
- Higher reliability of the machines
- Oil change intervals can be extended considerably
- Protection of resources and reduced environmental impact



With KLEENOIL Microfiltration all hydraulic, gear, engine and other non-water based machine oils as well as diesel fuels can successfully be filtered.

It is wrong to believe that lubricants are clean, as well as it is wrong to assume that with a simple oil change the contamination can be eliminated from the system. A large part of the contamination can be found in the system. With the oil, contaminants - usually consisting of water or various particles - flow through the entire system. In the hydraulic pump these particles are pulverized and thus it becomes difficult to filter them out with the system filter. This results in an increased wear on all surfaces that are only protected by an oil film.

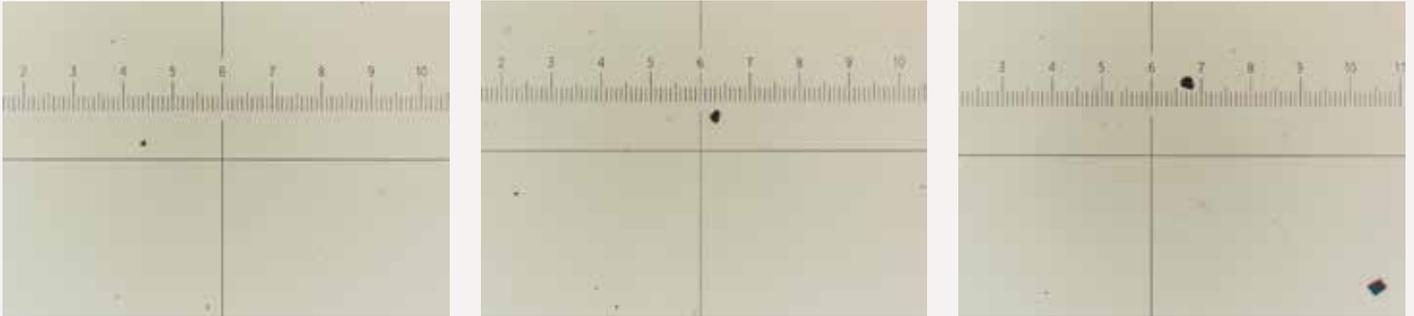
The operating costs of a machine stand in direct relation to the contamination of the used lubricants and pressure fluids. Even taking into account the additional cost of installing KLEENOIL Microfiltration, the operating costs will be reduced and an overall cost saving will be achieved. By eliminating the contaminants with abrasive and catalytic effect, system failures, wear and downtimes are minimized and as a result the operating costs are reduced.

# CLEANLINESS CLASSES

## ACCORDING TO ISO 4406 AND NAS 1638

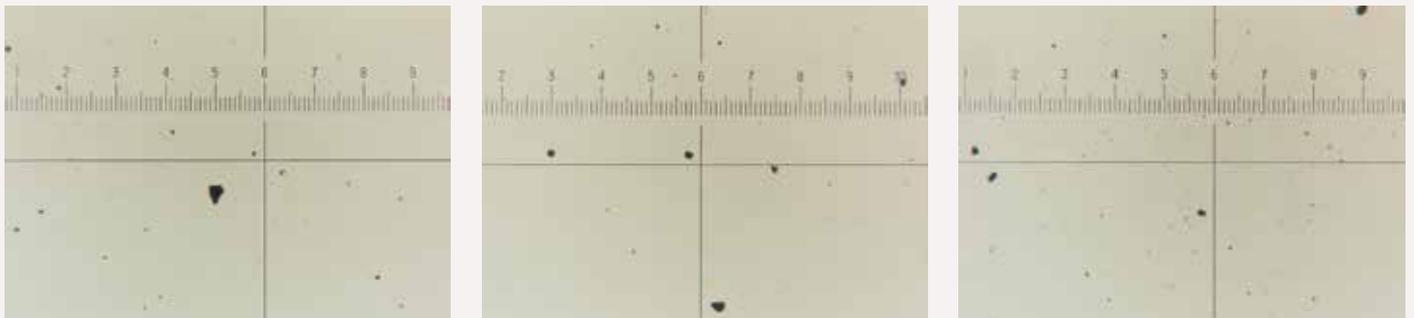
100 x magnification 1 scale mark = 10  $\mu\text{m}$

### 1. Range of results when KLEENOIL by-pass filtration is permanently applied



<b>ISO 4406/1999</b>	14/12/09	15/13/10	16/14/11
<b>NAS 1638/1964</b>	3	4	5

### 2. Prevalent range of results when KLEENOIL filtration systems are temporarily applied



<b>ISO 4406/1999</b>	17/15/12	18/16/13	19/17/14
<b>NAS 1638/1964</b>	6	7	8

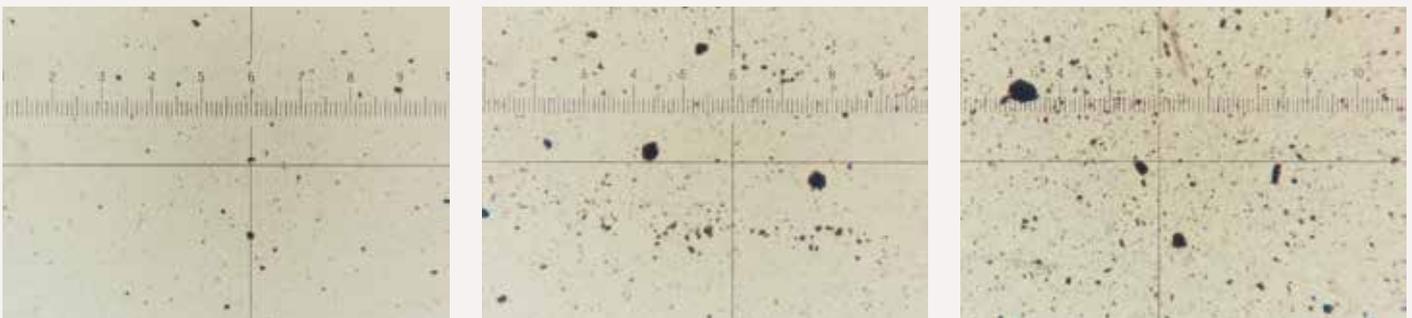
1. The best results by far can be achieved when KLEENOIL by-pass filtration is applied permanently - in form of fix installed by-pass filters.
2. Very good results can be achieved when KLEENOIL by-pass filtration systems are applied temporarily.

### 3. Min. required cleanliness class (tolerance range) for high pressure and servo hydraulic



<b>ISO 4406/1999</b>	19/17/14	20/18/15	21/19/16
<b>NAS 1638/1964</b>	8	9	10

### 4. High contamination - high probability of machine breakdowns



<b>ISO 4406/1999</b>	21/19/16	22/20/17	23/21/18
<b>NAS 1638/1964</b>	10	11	12

- Without additional by-pass filtration the cleanliness class value of the employed oil in most of the cases is kept in a range slightly below, corresponding to or slightly above the highest admissible value.
- Highly contaminated oils mostly can be found when maintenance is neglected, and / or machines are employed in extreme environments or under severe conditions.

ISO 4406	Number of particles / 100 ml			NAS 1638	
	≥ 4 μm	≥ 6 μm	≥ 14 μm		
12/10/06	4,000	1,000	64	-	
12/10/07	4,000	1,000	130	1	
12/10/08	4,000	1,000	250	-	
13/11/08	8,000	2,000	250	2	
14/12/09	16,000	4,000	500	3	Range of results when KLEENOIL by-pass filtration is permanently applied
15/13/10	32,000	8,000	1,000	4	
16/14/11	64,000	16,000	2,000	5	
16/14/12	64,000	16,000	4,000	-	Prevalent range of results when KLEENOIL filtration systems are temporarily applied
17/15/12	130,000	32,000	4,000	6	
18/16/13	250,000	64,000	8,000	7	
19/17/14	500,000	130,000	16,000	8	Min. required cleanliness class for high pressure and servo hydraulic
20/18/15	1,000,000	250,000	32,000	9	
21/19/16	2,000,000	500,000	64,000	10	
22/20/16	4,000,000	1,000,000	64,000	-	
22/20/17	4,000,000	1,000,000	130,000	11	High contamination
22/20/18	4,000,000	1,000,000	250,000	-	High probability of machine breakdowns
23/21/18	8,000,000	2,000,000	250,000	12	

We recommend to at least observe the range of cleanliness class requested by the component manufacturers, since it often is integral part of the guarantee and warranty conditions.

# WATER CONTAMINATION

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Even before being put into use, oils are at risk of water contamination during transportation and storage. When upright containers (particularly drums) are stored outside or during loading, water can collect on top of the container. As ambient temperatures rise and fall, moisture can be drawn into the barrel via the barrel caps.

During operation water can get into the oil through openings on the tank, as condensation from the air or through worn cylinders and seals. Condensation is the more common cause of water ingress into oil during operation.

Especially in the case of mobile machinery operating outdoors water vapour can condense in the tank every time the system cools down. If equipment is relatively static this often leads to rust and other corrosion problems, especially above the oil level. As soon as there is a higher amount of water in the oil, micro-organisms begin to grow. The result is the accumulation of sludge and a change in viscosity. The first signs of a problem are an unpleasant smell and a change in colour (clouding of the oil).



## Water content in hydraulic oils

Fluid type	Water content in new oils (harmless)	Max. tolerable value (according to current norms)	Filtration recommended starting from
HLP HVLP	100 - 400 ppm	500 ppm	> 400 ppm
HEES HETG HEPR	400 - 700 ppm	1,000ppm	> 900 ppm

# OIL CONTAMINATION

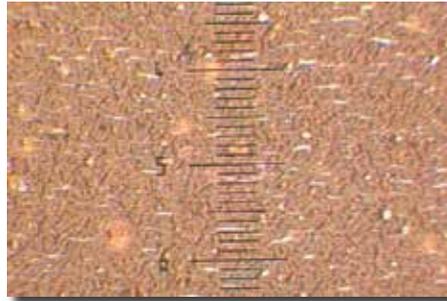
## ORIGIN AND CONSEQUENCES

Mostly rust and wear particles



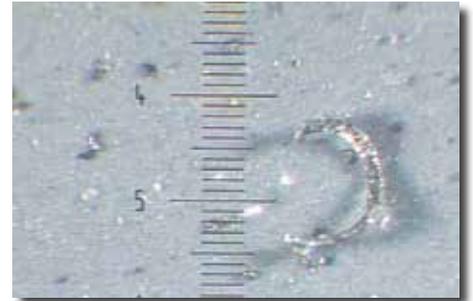
High wear as well as malfunctions at pumps and valves

Ageing products of the oil



Accumulation of dirt, filter blocking and system failures

Metal cutting



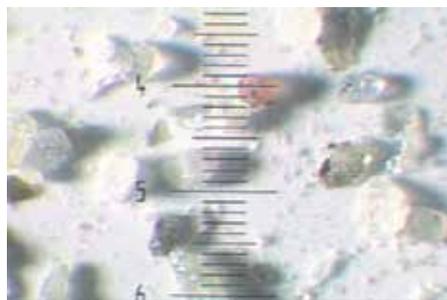
High wear as well as malfunctions at pumps and valves, damage of seals, leakages

Damage particles of bronze, brass or copper



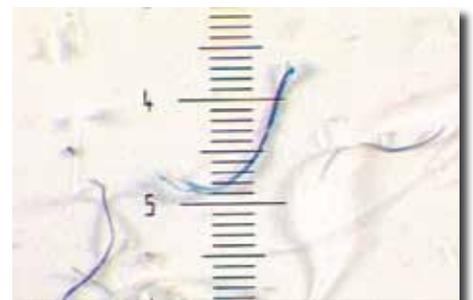
Imminent total breakdown, high wear, malfunctions at pumps and valves, damage of seals

Silicate (e.g. quartz), ambient contamination (ventilation)



System failures and high wear at components, high wear of seals

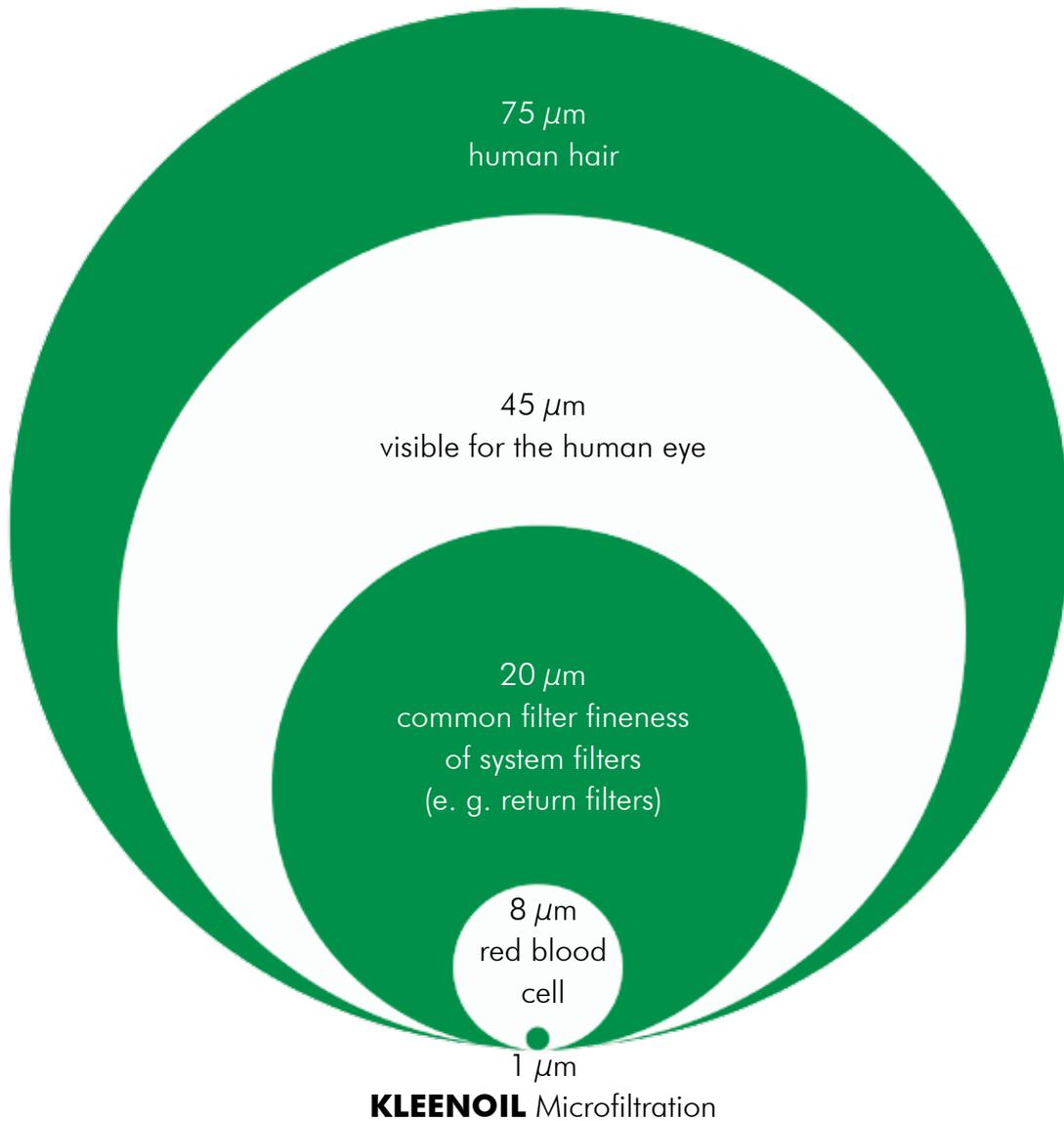
Fibres, assembly contamination, cleaning rags, etc.



Obstruction of the nozzles, leakages at the valves

# SIZE COMPARISON

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Most of the contamination in oil that can damage a machine is not visible to the naked eye. The necessity to filter the oil down to 1 micron filter fineness results from the fact, that narrowest fits e.g. in hydraulic pumps, control valves and seal clearances in parts, are only one or a few micron.

# FILTER ELEMENTS

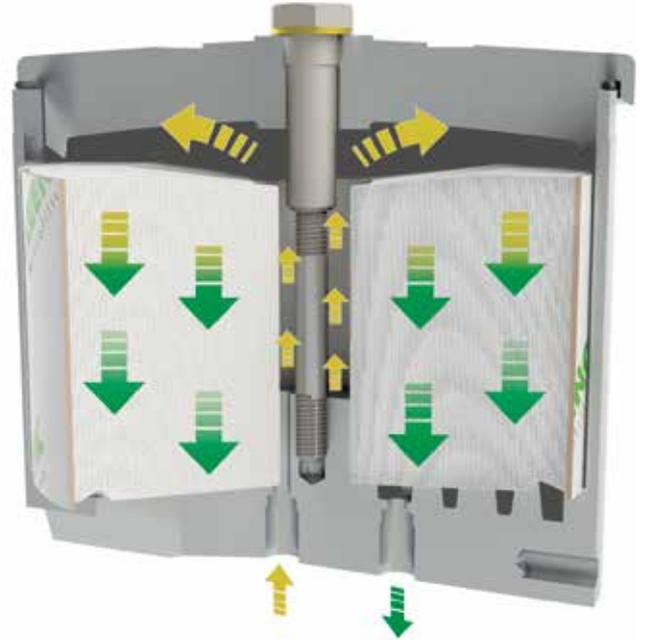
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KLEENOIL filter elements are made of long fibre cellulose, polypropylene and polyester. Its functioning is based on depth sedimentation. The oil is conducted axially through the filter with low pressure and a reduced flow. Compared to the size of the filter, the dirt and water absorption capacity is higher than average. The additives of the oil are not influenced.

The filtered oil is kept within its application specifications for a very long time. Micro-contaminants down to a size of 1 micron and condensate are efficiently separated from the fluid. This is ensured by the special construction of the filter housing and the way the oil is lead through the filter element. Even oil decomposition products and varnish can be eliminated by permanent application.

The construction of the KLEENOIL filter housing and the respective filter element are coordinated between each other. We recommend to exclusively use original KLEENOIL filter elements. The whole construction grants a reliable oil maintenance, protecting the oil in a low pressure range. Only this way it can be ensured, that despite the low filter fineness the additivation of the oil remains unchanged.

Under extreme conditions, for example if a high quantity of water contamination is brought to the filter element abruptly and/or after re-commissioning with filter elements which in parts are already loaded with contamination, this can cause a filter collapse (deformation). In this case the filter elements have to be changed and, depending on the application, the change intervals have to be reduced.



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## Application

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**Retention capacity up to**

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**Filter fineness**

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**Packing unit**

Basically it has to be considered that due to the excellent retention capacities the KLEENOIL filter elements are only suitable for application in by-pass filters or in particularly constructed filtration systems. The KLEENOIL filter elements are constructed in a way that they eliminate solid particles as well as water from the oil in a combined function. In relation to the indicated filtration fineness and the retention capacity some particularities have to be considered, which apply only for filters functioning based on the principle of depth filtration.

**LDFC**

**HDFC-N**

**SDFC**

**SDFC-P**



LDU filter housing

HDU filter housing

SDU filter housing & KLEENOIL filter systems

SDU filter housing & KLEENOIL filter systems

500 g solid particles / 230 ml water

1,000 g solid particles / 300 ml water

2,000 g solid particles / 500 ml water

2,000 g solid particles

1  $\mu\text{m}$  nom.

1  $\mu\text{m}$  nom.

1  $\mu\text{m}$  nom.

< 10  $\mu\text{m}$  nom.

Box of 12

Box of 12

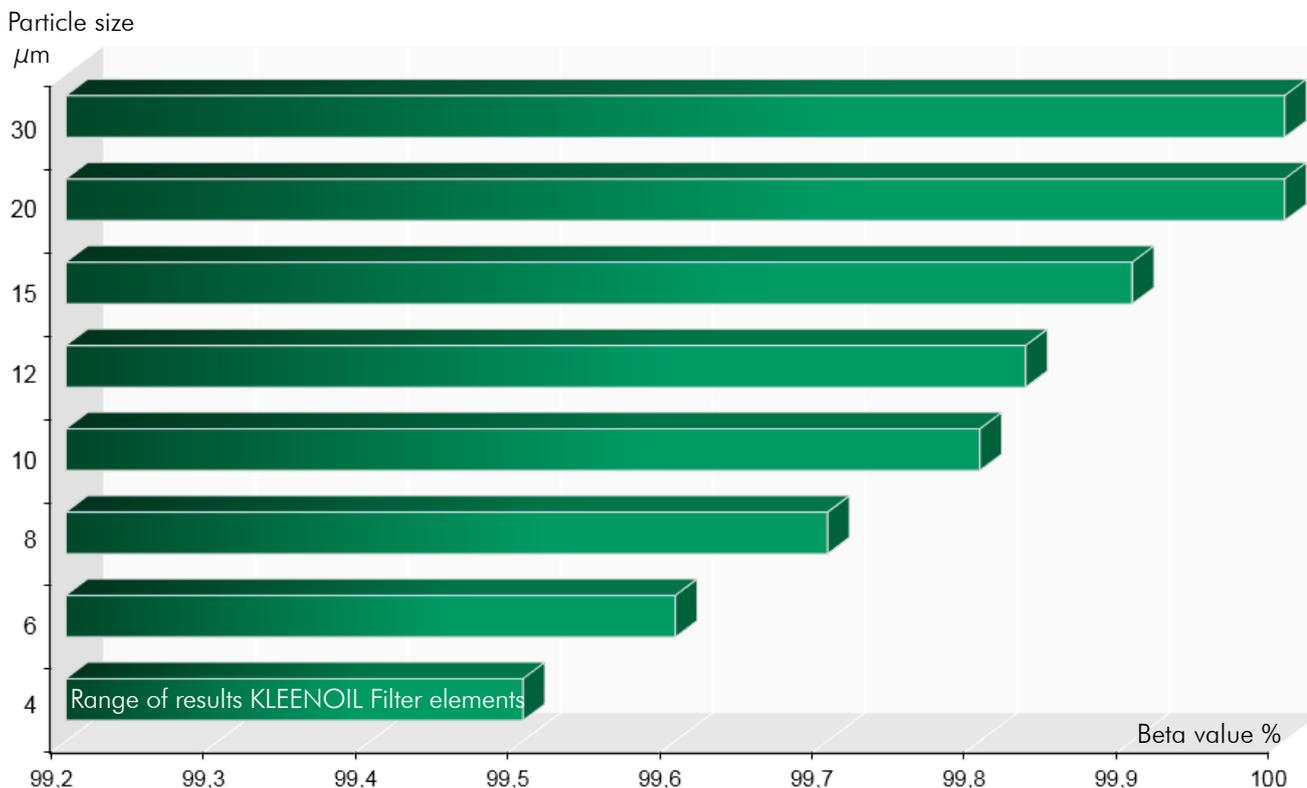
Box of 6

Box of 6

Suitable also for filtration of water based lubricants

Based on the utilization of ISO MTD test particles the test results confirm that the KLEENOIL filter elements have a retention capacity of  $< 4 \mu\text{m}$  in the absolute range. According to ISO 4572 (ACFTD), this corresponds to a filter fineness of  $1 \mu\text{m}$  nominal.

### Filtration efficiency KLEENOIL SDFC filter elements



The efficiency of a filter element is not only determined by the filter fineness, but also by the retention capacity. The result is indicated as beta ( $\beta$ ) value. The beta value and the filtration fineness are indicated in relation to each other in the result. Due to lack of measuring possibilities with calibrated particles  $< 4 \mu\text{m}$  in this case  $4 \mu\text{m}$  particles are also used and the filtration fineness  $< 4 \mu\text{m}$  is determined arithmetically.

Basic explanations to the retention ratio / beta ( $\beta$ ) value:

The term "beta value" ( $\beta$  value) indicates the filter efficiency. This value qualifies the measuring unit for indication of the filtration capability of a filter element. With the beta value the filtration efficiency in percentage is indicated, for example 2 (50%) up to 1,000 (99.9%) and is respectively valid for all particle sizes (x) or for a fix determined particle size (e. g.:  $\beta 10 = \text{particles} \geq 10 \text{ micron}$ ).

Beta value and filter fineness of the KLEENOIL filter elements:

$\beta 4$  (ISO MTD)  $\geq 200$ , corresponds to  $\beta 1$  (ACFTD)  $\geq 200$ , filtration fineness:  $1 (4) \mu\text{m}$  nominal

# FILTER ELEMENT CHANGE

Deployment	Conditions	Change Interval
Mobile hydraulic	normal extreme*	500 operating hours 250 operating hours
Industrial hydraulic (indoors/ continuous operation)	normal extreme*	2,000 operating hours 1,000 operating hours
Gear boxes in the industrial sector	normal extreme*	2,000 operating hours 1,000 operating hours
Engine - short distance traffic, work and construction machines	normal extreme*	20,000 km / 500 operating hours 15,000 km / 250 operating hours
Engine - long distance application, stationary engines	normal extreme*	60,000 km / 1,000 operating hours 30,000 km / 500 operating hours



Change set consisting of filter element and lid seal

\* Application where equipment is under extreme load, in dusty or humid conditions, or in cases where there is potential for contamination to be frequently introduced e.g. in applications where there are regular changes of attachments.

# BY-PASS FILTERS

## LDU-M8



## LDU-H8



## LDU-H300



<b>For machines up to</b>	15 litres engine oil / 150 kW	100 litres hydraulic oil	100 litres hydraulic oil
<b>Inlet pressure</b>	2 - 6 bar	2 - 6 bar	5 - 300 bar
<b>Filter element</b>	LDFC	LDFC	LDFC
<b>Height</b>	287 mm	287 mm	287 mm
<b>Diameter</b>	123 mm	123 mm	123 mm
<b>Diameter fitting dimension</b>	139 mm	139 mm	149 mm
<b>Weight</b>	3.0 kg	3.0 kg	4.6 kg
<b>Connection inlet</b>	1/4" BSP external thread	1/4" BSP external thread	M 12 x 1,5 internal thread
<b>Connection outlet</b>	1/4" BSP external thread	1/4" BSP external thread	M 18 x 1,5 internal thread



## HDU-M8

## HDU-H8

## HDU-H300



30 litres engine oil /  
300 kW

200 litres  
hydraulic oil

200 litres  
hydraulic oil

2 - 6 bar

2 - 6 bar

5 - 300 bar

HDFC-N

HDFC-N

HDFC-N

261 mm  
168 mm  
187 mm

261 mm  
168 mm  
187 mm

261 mm  
168 mm  
187 mm

4.7 kg

4.7 kg

6.3 kg

1/4" BSP  
external thread

1/4" BSP  
external thread

M 12 x 1.5  
internal thread

1/4" BSP  
external thread

1/4" BSP  
external thread

M 18 x 1.5  
internal thread

The construction components used in modern and efficient machines can only permanently maintain their accurate productive efficiency with clean operating fluids. This can be ensured with the KLEENOIL by-pass filtration. KLEENOIL by-pass filters offer a cost-efficient and up to date opportunity to protect operating materials and components. The installation is possible on the majority of the systems. Due to the fact that amongst others the oil ageing process is slowed down, by using KLEENOIL by-pass filters the oil change intervals can be extended. By eliminating contaminants with abrasive effect (solid particles) the mechanical wear is minimised and by eliminating the contaminants with catalytic effects (water and metal parts) the oxidative-catalytic reactions are slowed down considerably.

Please consider the current datasheets of the respective by-pass filters!

# BY-PASS FILTERS

## SDU-M8



## SDU-H8



## SDU-H350



<b>For machines up to</b>	40 litres engine oil / 400 kW	400 litres hydraulic oil	400 litres hydraulic oil
<b>Inlet pressure</b>	2 - 6 bar	2 - 6 bar	5 - 350 bar
<b>Filter element</b>	SDFC	SDFC	SDFC
<b>Height</b>	308 mm	308 mm	308 mm
<b>Diameter</b>	217 mm	217 mm	217 mm
<b>Diameter fitting dimension</b>	239 mm	239 mm	239 mm
<b>Width</b>	-	-	-
<b>Depth</b>	-	-	-
<b>Weight</b>	7.6 kg	7.6 kg	9.2 kg
<b>Connection inlet</b>	1/4" BSP external thread	1/4" BSP external thread	M 12 x 1.5 internal thread
<b>Connection outlet</b>	1/4" BSP external thread	1/4" BSP external thread	M 18 x 1.5 internal thread



**SDU-H350  
RK/TWIN**



**2S-350-C4**



**4S-350-C8**



**6S-350-C12**



1,000 litres  
hydraulic oil

1,000 litres  
hydraulic oil

3,000 litres  
hydraulic oil

> 3,000 litres  
hydraulic oil

5 - 350 bar

5 - 350 bar

5 - 350 bar

5 - 350 bar

SDFC

SDFC

SDFC

SDFC

255 mm

328 mm

328 mm

328 mm

-

-

-

-

-

-

-

-

482 mm

570 mm

628 mm

865 mm

235 mm

231 mm

447 mm

447 mm

19.9 kg

25.0 kg

44.0 kg

62.0 kg

M 12 x 1.5  
internal thread

3/8" BSP  
external thread

3/8" BSP  
external thread

3/8" BSP  
external thread

15 L  
external thread

3/4" BSP  
external thread

3/4" BSP  
external thread

3/4" BSP  
external thread



# CONNECTION BY-PASS FILTERS

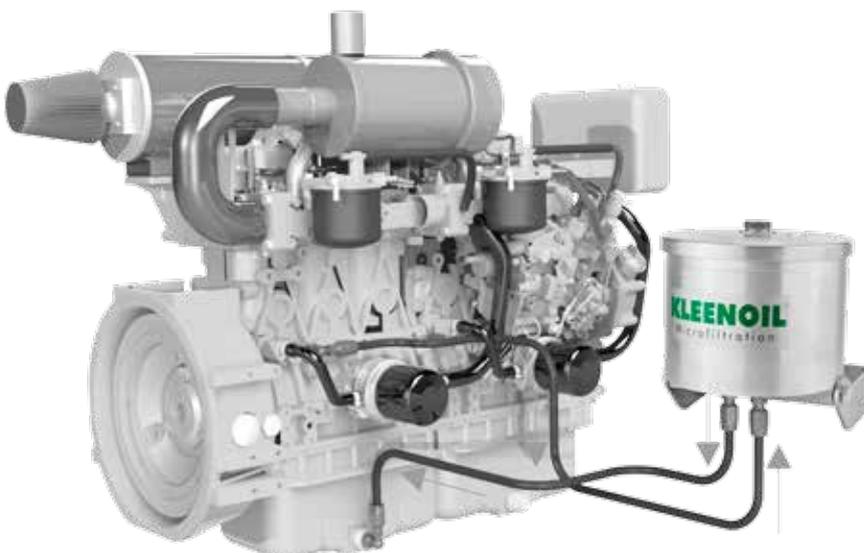
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KLEENOIL filters are exclusively by-pass microfilters. The connection always has to be made in a way, that at the connection point (filter inlet) a defined pressure as well as a quantity of 2 litres of oil per minute are available, and that this oil quantity can be taken from the system without influencing the system or causing malfunctions. The return line (filter outlet) always has to be as short as possible, sufficiently dimensioned and lead to the oil tank without pressure.

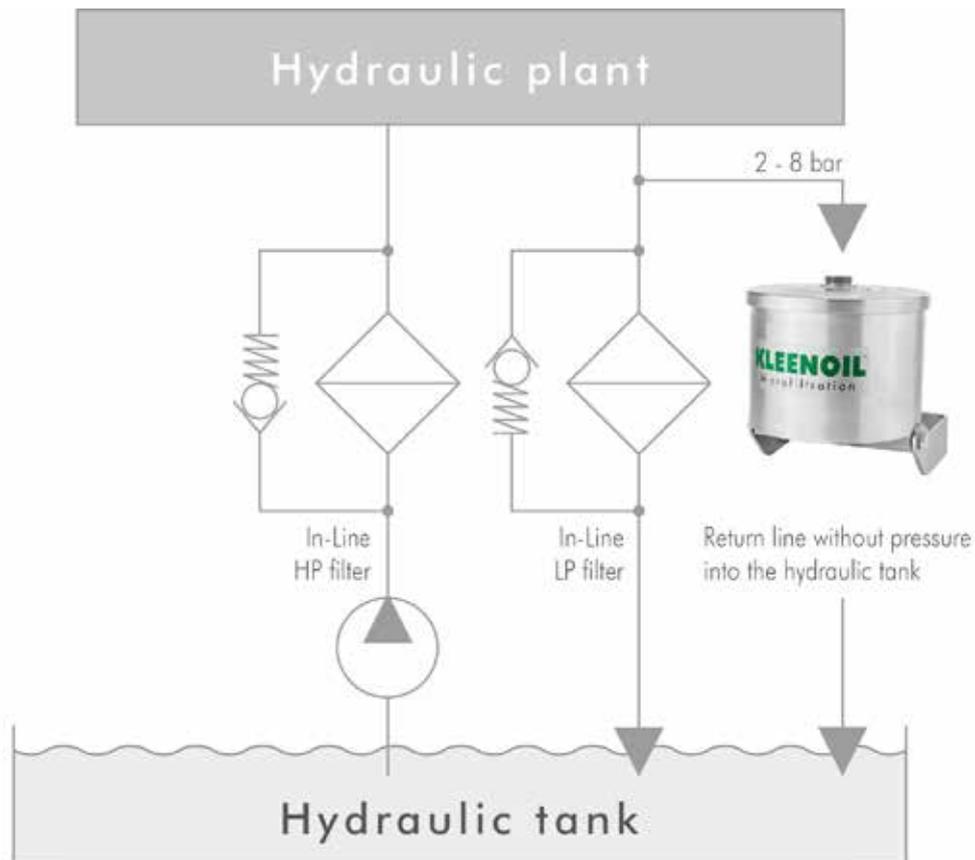
The installation site should be chosen in a way assuring that the by-pass filter unit is positioned above the oil level. Otherwise when changing the filter elements an oil leakage would occur through the filter housing. In case this would not be possible and the by-pass filtration unit inevitably has to be installed below the oil level, then a non-return valve with a minimal response pressure has to be installed in the return line. It must absolutely be avoided that the oil flowing back gets into the open filter housings.

KLEENOIL filtration units without particular pressure protection, that means all H and M models, can be installed with an inlet pressure of maximum 8 bar. Please observe that the ideal operating conditions are between 2 and 5 bar pressure. With permanently high inlet pressures we recommend to install a pressure-regulating-valve in the inlet line.

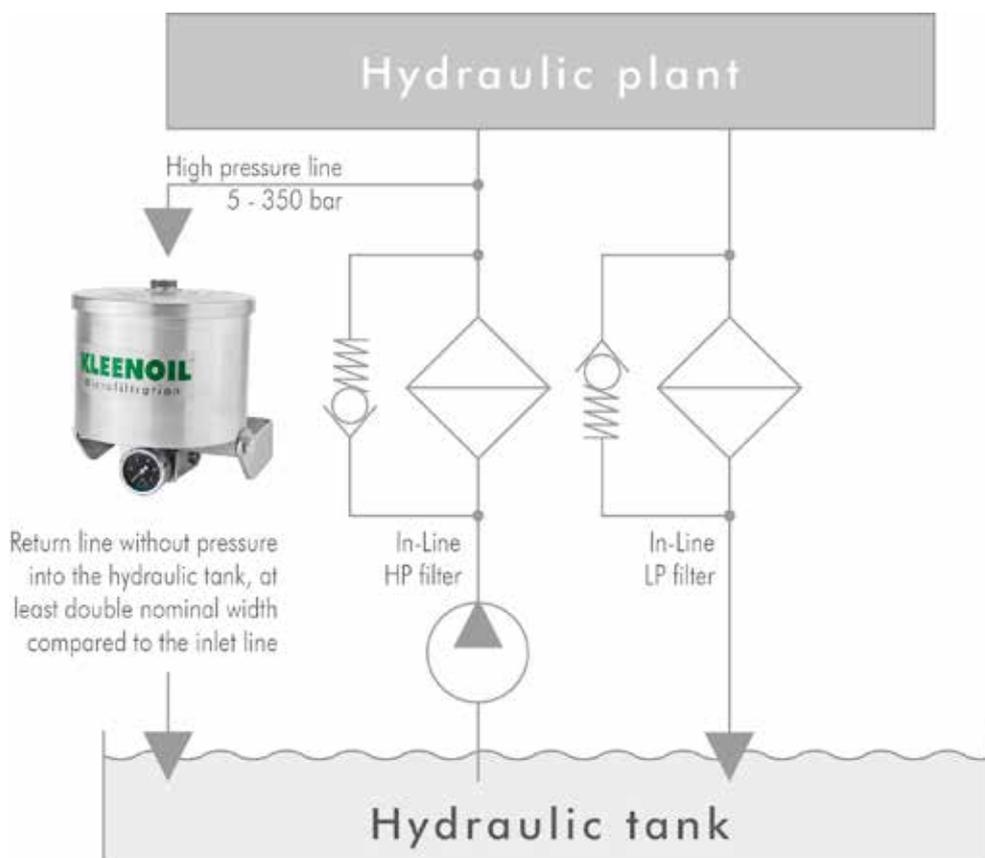
## Connection example by-pass filter for engines



## Connection example hydraulic system in a return by-pass circuit



## Connection example hydraulic system in a high pressure by-pass circuit



# FILTRATION SYSTEMS

## FOR WORKSHOP AND INDUSTRIAL DEPLOYMENT

230 VOLT

**1S**



**2S-500B**



**2S-500E**



<b>Filtration performance</b> (average value)	120 l/h (40 cSt)	240 l/h (40 cSt)	240 l/h (40 cSt)
<b>IP rating</b>	IP 55	IP 55	IP 55
<b>Length</b>	265 mm	672 mm	675 mm
<b>Width</b>	430 mm	480 mm	590 mm
<b>Height</b>	509 mm	1,065 mm	1,000 mm
<b>Weight</b>	25.5 kg	52 kg	65.5 kg
<b>Pre-filter</b>	FLT-STR-Y-3/8	FLT-STR-T-3/4-PLY	FLT-STR-T-3/4-PLY
<b>Equipment</b>	Overpressure and run dry protection with automatic switch-off	Overpressure protection	Overpressure and run dry protection with automatic switch-off

The KLEENOIL filtration systems of the construction series 1S to 2S-500E are suitable for the cleaning and filling of machines with oil contents up to 2,000 litres. The system cleaning is carried out by connecting the filtration system in an independent by-pass loop. For the hydraulic connection of the filtration systems the connection points and elements are preferably chosen to allow the filtration while the systems, that are to be cleaned, are in operation. The filtration time depends on the viscosity and the level of fluid contamination.

Please consider the current datasheets of the respective filtration system!

All our KLEENOIL filtration systems for workshop and industrial deployment are equipped with a 6 metre suction and return hose including quick release couplings and have a transfer connection for movement of the oil without filtration. The filter units in the filtration systems consist of our SDU microfilters including the respective filter elements. The installed pre-filters are washable.

### 4S-700B



480 l/h (40 cSt)

### 4S-700E



480 l/h (40 cSt)

### 4S-E



480 l/h (40 cSt)

### 6S-E



720 l/h (40 cSt)

IP 55

IP 55

IP 55

IP 55

967 mm  
590 mm  
1,000 mm

967 mm  
590 mm  
1,000 mm

1,036 mm  
554 mm  
988 mm

1,286 mm  
554 mm  
988 mm

95 kg

95 kg

120 kg

155 kg

FLT-200-SS-F2710

FLT-200-SS-F2710

FLT-200-F2710

FLT-200-F2710

Overpressure protection

Overpressure and run dry protection with automatic switch-off

Overpressure and run dry protection with automatic switch-off

Overpressure and run dry protection with automatic switch-off

Pre-heater

Pre-heater

The KLEENOIL filtration systems of the construction series 4S-700 to 6S-E are suitable for cleaning and filling of machines with medium or large oil volumes between 1,000 to 15,000 litres. The filtration time is dependent on the viscosity (max. 100 cSt) and the level of fluid contamination. The KLEENOIL filtration systems are based on the established KLEENOIL filter technology. Solid particles down to 1 micron are filtered out, water (only with SDFC filter elements) will be absorbed from the oil and bound in the filter element. The filtration efficiency of the filtration systems 4S-E and 6S-E is clearly increased by the integrated pre-heater but is still dependent on the level of fluid contamination.

# FILTRATION SYSTEMS

## FOR WORKSHOP AND INDUSTRIAL DEPLOYMENT

230 VOLT

**8S-1000-D**



**12S-E**



**12S-E-PH**



<b>Filtration performance</b> (average value)	2 x 480 l/h (40 cSt)	2 x 720 l/h (40 cSt)	2 x 720 l/h (40 cSt)
<b>IP rating</b>	IP 55	IP 55	IP 55
<b>Length</b>	1,597 mm	1,412 mm	1,412 mm
<b>Width</b>	554 mm	820 mm	820 mm
<b>Height</b>	1,073 mm	1,026 mm	1,026 mm
<b>Weight</b>	210 kg	200 kg	215 kg
<b>Pre-filter</b>	FLT-200-F2710	FLT-200-SS-F2710	FLT-200-SS-2710
<b>Equipment</b>	Overpressure and run dry protection with automatic switch-off  Pre-heater  Particle counter	Overpressure and run dry protection with automatic switch-off	Overpressure and run dry protection with automatic switch-off  Pre-heater

The KLEENOIL filtration systems of the construction series 8S-1000-D and 12S-E are suitable for the cleaning and filling of systems with large oil volumes between 1,000 and 25,000 litres. Both filtration system types can also be used with only half of the number of installed filtration units (4 or 6). This means that they are suitable for filtration of different oil types without the necessity to change the filter elements. The highest possible filtration efficiency is obtained when using all filter units at once. Even with these highly efficient filtration systems there is a relative dependency of the filtration time on the viscosity and the level of fluid contamination. The filtration system 12S has prevalently been designed for filtration of large quantities of oil, whereas the filtration system type 8S at the same time is suitable for a flexible employment as well as small or medium oil quantities. Furthermore this model offers a sophisticated control and monitoring equipment.

# FILTRATION SYSTEMS

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## FOR MOBILE DEPLOYMENT

24 VOLT

### 1S-24V



### 2S-24V



**Filtration performance**  
(average value)

120 l/h (40 cSt)

240 l/h (40 cSt)

**IP rating**

IP 55

IP 44

**Length**

217mm

276 mm

**Width**

237 mm

509 mm

**Height**

315 mm

356 mm

**Weight**

15 kg

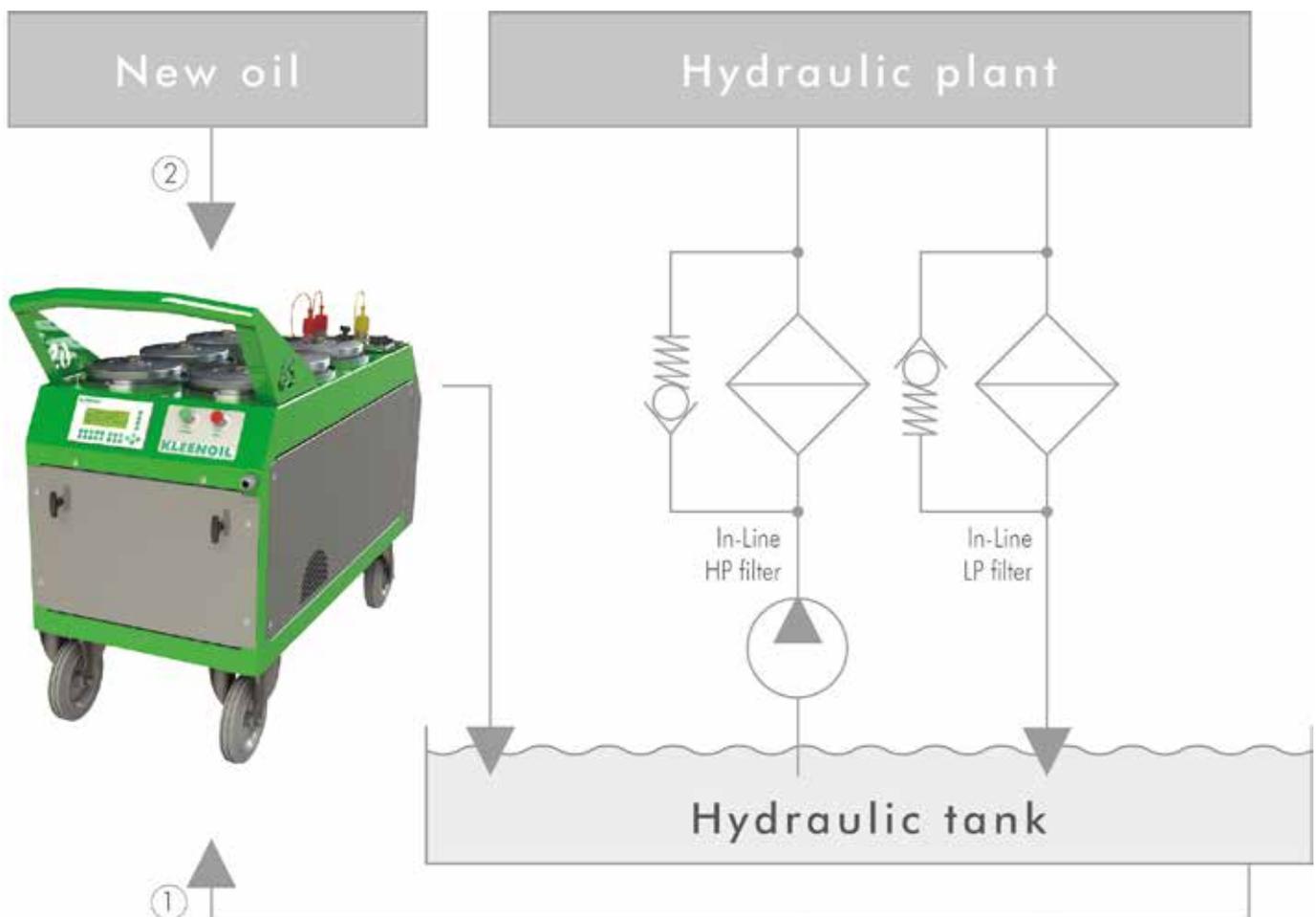
26.5 kg

KLEENOIL 24 volt by-pass microfiltration systems are designed for rotational or permanent filtration of oils in machines being in use. The application / filtration is carried out during the conventional employment of the machine. This way it can be assured that the complete system is cleaned / kept clean.

All our KLEENOIL 24 volt filtration systems are equipped with a 8 metre suction and return hose with quick release couplings as well as a pressure relief valve and a pressure gauge.

# CONNECTION FILTRATION SYSTEMS

All KLEENOIL filtration systems are employed for ① rotational oil maintenance in machines being in use and ② filling of new oil.

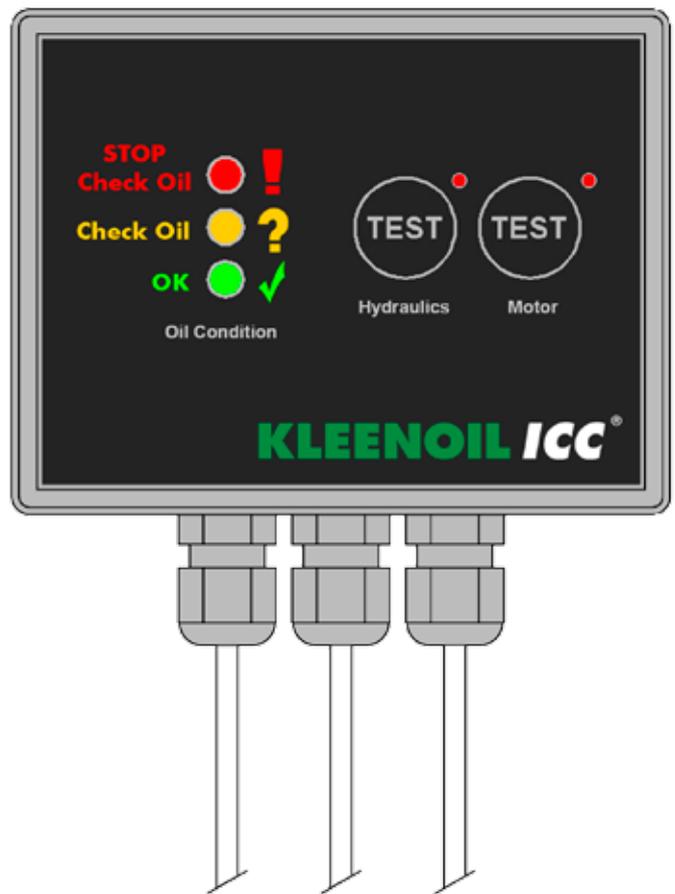


Duration and frequency of the filtration are dependent on the level of fluid contamination, the type of construction and the employment of the machine. It is important to observe that during the filtration all system functions have to be carried out intensely and frequently enough. Only if during the filtration time the entire system volume is circulated several times it can be ensured, that the contamination in the oil is removed by the filtration system.

KLEENOIL ICC - Identification Contamination Control is an on-board oil analysis sensor which has been designed for the continuous monitoring of vital parameters that cause an application relevant change of the fluid. To collect the data the KLEENOIL ICC uses a capacitive sensor to read the quality of the oil in comparison to the saved calibration. Based on the change of the oil dielectric the actual or rather the still existing oil quality or contamination is shown as a final result.

Most application relevant oil values are dependent on each other and this also applies to their changes. For this reason the KLEENOIL ICC and its installed measuring and analysis principle have been designed for the reading and monitoring of the overall condition. A retrieval of single values has not been allowed for.

During the operation of the machine the condition of the oil is checked every 30 minutes. The results are shown on the control panel in an easy understandable way using the "traffic light principle". The evaluating unit disposes of a digital connection to allow an implementation of the indicated signals in the on-board electronics of a machine and the connection to a remote monitoring system. KLEENOIL ICC is available for all main mineral oil based, fully or partially synthetic and in parts rapidly biodegradable hydraulic fluids.



# INTEGRATED FLUID CONCEPT

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## BRIEF DESCRIPTION

Oil change intervals even today are determined empirically and oil changes are realized without taking into consideration the real quality of the lubricant. This causes unnecessary costs. If an oil change is done too early, a still flawless lubricant is thrown away; if an oil change is done too late, machine damages can occur. The ideal case would be to do oil changes depending on the condition.

The INTEGRATED FLUID CONCEPT predominantly has been designed for the application areas of hydraulic, engine and gear oils. The complete concept consists of three components:

### 1. Oils suitable for long term use

Best results can be achieved with high-performance, shear-stable oils being suitable for long-term use. Regarding the rapidly biodegradable oils these mostly are products on a basis of saturated, synthetic esters.

### 2. KLEENOIL Microfiltration

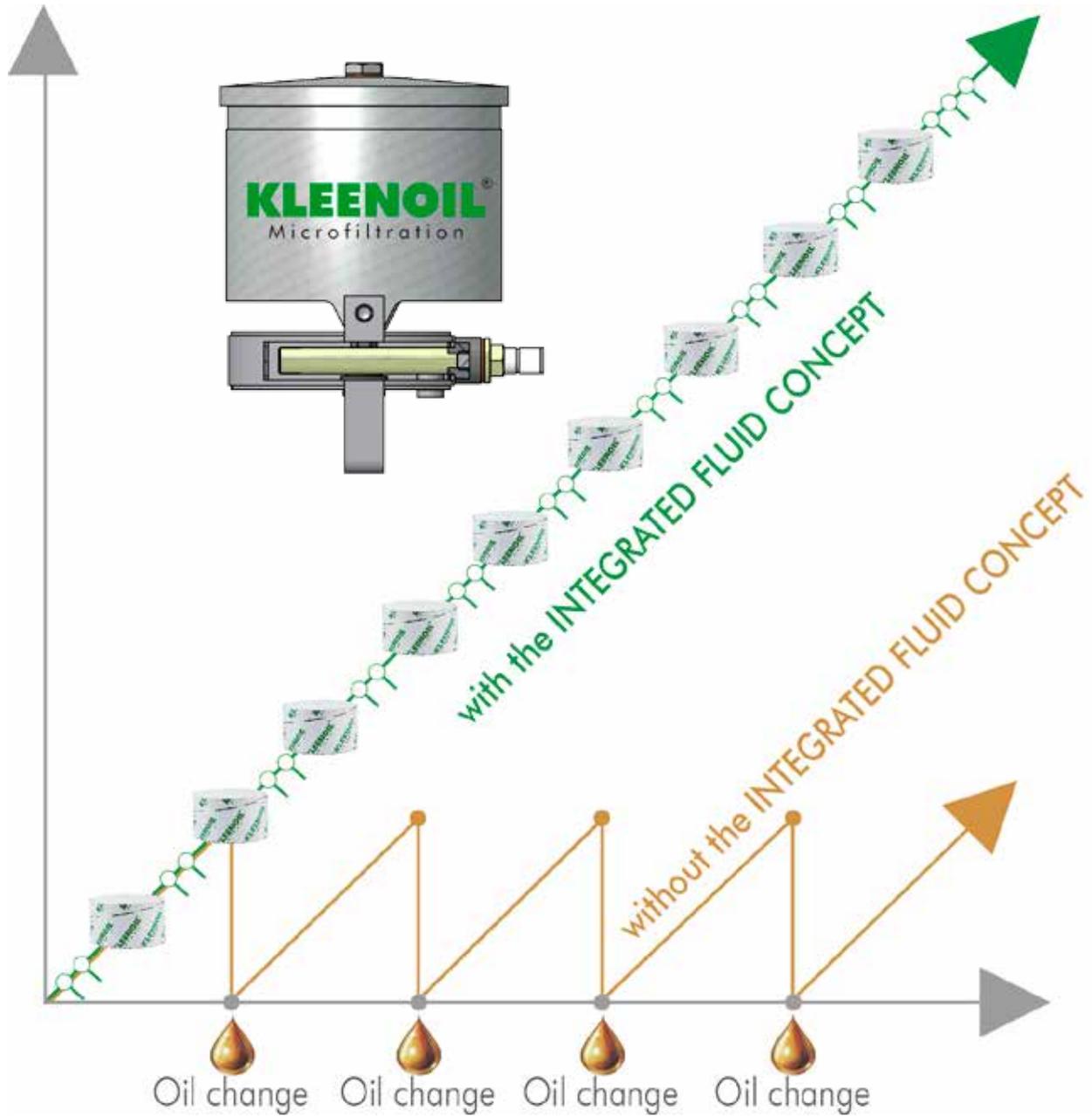
The application of KLEENOIL Microfiltration contributes to the reduction of system failures, wear and breakdowns. The ageing process of the fluid is slowed down, because with the KLEENOIL filter elements solid particles and water are eliminated from the oil.

### 3. KLEENOIL ICC

The oil analysis sensor KLEENOIL ICC (Identification Contamination Control) has been designed for on-board oil analysis indicating the condition of the oil during the operation of the machine every 30 minutes (standard model). The system is available with digital outlet so that a digital data processing and/or a remote monitoring is possible.

Best results can be achieved if the KLEENOIL ICC is integrated in the by-pass filter unit KLEENOIL SDU.

# SCHEMATIC



KLEENOIL IFC unit: by-pass filter with integrated KLEENOIL ICC



Continuous filter element change instead of oil change



With KLEENOIL ICC an oil analysis is carried out every 30 minutes

# INTEGRATED FLUID CONCEPT

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## ADVANTAGES

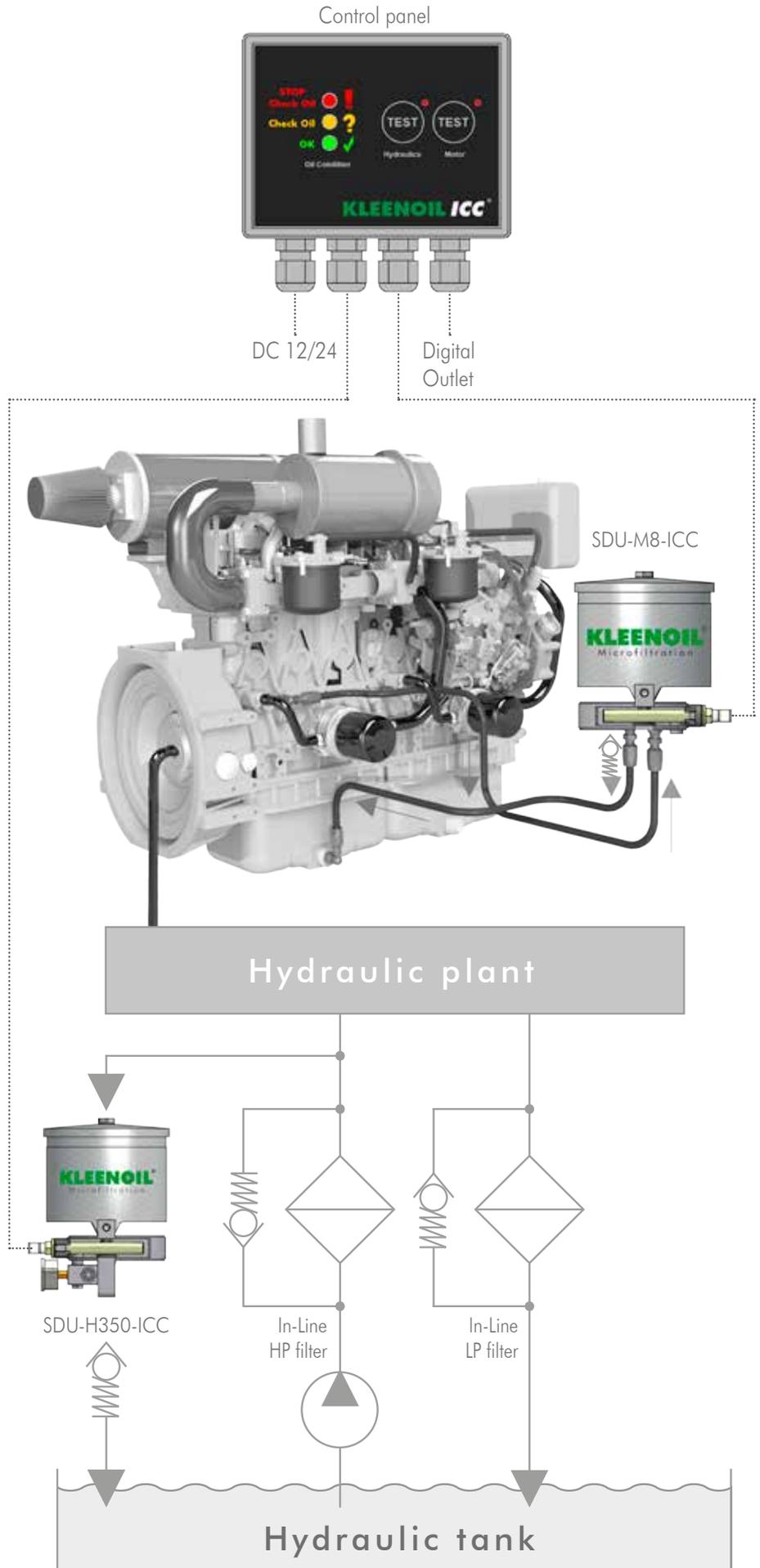
Compared to periodical oil change intervals the KLEENOIL long-time concept offers higher security and the INTEGRATED FLUID CONCEPT best security by at the same time reducing wear, system failures and breakdowns. In the INTEGRATED FLUID CONCEPT the oil is considered as a construction element and its excellent "ability of carrying information" is taken advantage of. Most of the changes in the machine can be detected in the oil. In contrast empirically determined oil change intervals are in a clear disadvantage from a technical as well as an economic point of view.

KLEENOIL ICC is employed to detect the oil condition. Preferably we recommend the employment of KLEENOIL ICC integrated in an SDU filtration unit. These filtration units by the majority are used as high performance by-pass filter units for diverse application fields.

In hydraulic systems (up to approximately 500 litres system content) mostly the high-pressure by-pass filter SDU-H350 is used. A little less frequent and with a slight disadvantage due to the fluctuation of the flow volume and pressure conditions also the return-by-pass filter unit SDU-H8 is used. For filtration of engine oils in the performance range between 100 and 500 kW, in most of the cases a by-pass filter SDU-M8 is used. All these filtration systems, as additional, integral part can be complemented with a KLEENOIL ICC. It will be installed in particularly constructed flow-containers (oil flow after the filtration). The control panel can be configured for one or two KLEENOIL ICC.

In the adjacent schematic example the by-pass filtration for engine and hydraulic oil with integrated ICC - INTEGRATED FLUID CONCEPT - is shown.

# SCHEMATIC



# **KLEENOIL®**

## Microfiltration

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