

**KLEENOIL**



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**Kleenoil Onboard Oil Recycling Systems  
Go **GREEN!** - Keep it KLEEN**

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# Kleenoil Bypass Filtration System



**KLEENOIL** 

# Going Green Initiative



We are committed to  
helping you reduce  
your utility and  
bucket service trucks  
oil usage up to 80%





# Economic Profitability

Fewer oil changes and  
reducing wear in  
hydraulic components  
yields revenue in  
areas often  
overlooked

**KLEENOIL** 



# Social Accountability

Less consumable oil  
used equals a  
smaller carbon  
footprint and a  
cleaner environment



**KLEENOIL**

# Select Kleenoil USA Inc. Customers

**Randalls**



**Tom Thumb**



**NASA**

**NUCOR**  
It's our Nature.™



**Schlumberger**



**Kiewit**

**CHRYSLER**



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# Select Kleenoil USA Inc. Drilling Customers



**Felderhoff**  
Brothers Drilling



**Dominion**<sup>®</sup>



**TRINIDAD**  
DRILLING

**Schlumberger**



**KLEENOIL** 

# Select Kleenoil and Power Up OEM's

Frontier Power



Bell Helicopter



Liebherr



Rottne



Idlekleen



th no special tools.

Boeing Helicopter



Kalmar Industries





# Kleenoil Bypass Filtration History / Concept

## Is the Kleenoil Bypass Filter an established and tested technology?

- Kleenoil Filtration has been in business for over 30 years
- In almost every country in the world.
- Bypass filtration has been around 70 years.
- US Armed Forces used bypass filtration in WWII to save oil.
- Today's improved technology has greatly improved bypass filtration.

## How do Kleenoil Bypass Filters differ from the standard main flow, OEM Filters?

- Full flow filters are designed not to work!
- Full flow oil filters cannot be restrictive, only filter 25 to 40 microns.
- Engine tolerances are between 3 and 20 microns.
- Oil particles between 20 and 3 microns create engine wear.
- This is the reason why you currently change your oil.
- Fluid Power Institute, at Milwaukee School of Engineering, says the particles from 3 - 20 microns responsible for up to 60% of engine wear.
- Filtering oil to 1 micron or below, oil would stay clean.
- Exactly what the Kleenoil Bypass Filter does.
- Process not possible full flow; Kleenoil does in bypass loop
- Uses a cellulose filter medium; filters to 1 micron, also filters 99.95% water
- Eliminates possibility of corrosion and hydro cracking.
- Water contamination can cut bearing life by as much as 80%.

# Features and Benefits

## ✓ Eliminates Water and Particles

Water will always be present because of the heating and cooling of components in an engine. Diesel fuel used as the source of combustion contains sulfur. Small amounts of fuel will pass by the piston rings and end up in the oil. The sulfur will mix with the water resulting in sulfuric acids. Using the Kleenoil Filtration System will remove all water down to less than 0.05%, reducing the formation of sulfuric acid that will cause accelerated wear to engine components.

## ✓ Removes Dirt and Contaminants

Dirt and wear metals will always be present in Hydraulic and Engine oil. The reasons that most fluid changes are done is to get rid of the dirt and contaminants. Conventional fluid filtration components will filter the fluid down to approximately 25 - 40 micron in size. Accelerated wear and damage occurs somewhere around 3 - 6 micron. Using the Kleenoil Filtration System you will filter the fluid down to 1-micron (3 absolute) in size reducing the chance of wear and ultimately reducing the number of engine failures and rebuilds that would have needed to be performed during the life of the unit.



# Features and Benefits

## ✓ Doesn't Remove Desirable Elements

Certain components are purposely placed in lubrication oil to make it effective. Some of the additives include dispersants, detergents, oxidation and rust inhibitors, pour-point depressants, metal deactivators, and anti-foaming and gelling agents. While the Kleenoil Filtration System is removing dirt, contaminants, wear metal particles and water; it is not removing the oil additives needed for continued use.

## ✓ Extends Drain Intervals

Because of the reasons mentioned above, oil can be run longer as it is kept clean, free of water and still maintain its additive package. Proper oil analysis will indicate the life of the oil but on average the drain is extended up to 10 times what it would be without the Kleenoil Filtration System.

# Features and Benefits

## ✓ Reduces Time Needed for Service

Changing the Kleenoil Filtration Cartridge requires much less time than what is required to perform a conventional full fluid change. Simply remove the lid from the container, remove the old cartridge and install the new cartridge and seal. All this can be performed in less than 10 minutes and without the worry of spilling oil and disposing of contaminated fluids.

## ✓ Continuous Protection Provided

The Kleenoil Filtration System is installed to filter the fluid whenever there is oil pressure. Once the engine or the hydraulic pump is activated and there is fluid pressure, the fluid is continuously passing through the densely wound filter cartridge. The cartridge is wound with pure coniferous long fiber wood pulp paper. This design allows the water to be extracted from the fluid and still allows the larger oil molecules to pass through unchanged. The dirt and wear particles are trapped in the filter giving you a continuous self-contained recycling system.



# Features and Benefits

## ✓ Good for the Environment

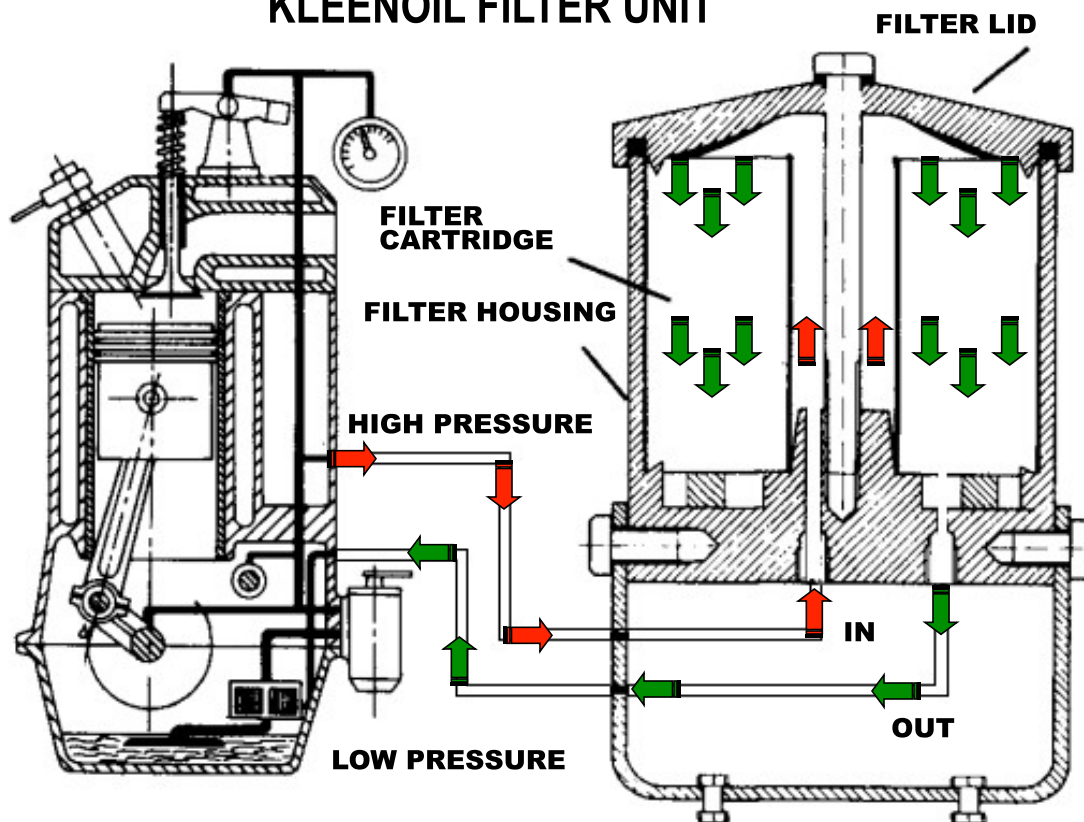
Because the fluid is being recycled inside of its own application, longer drain intervals can be realized. Oil is a finite resource that one-day will run out. Keeping the fluid running longer reduces the amount of oil you will have to purchase throughout the now extended life of the unit.

Disposing of the used contaminated oil also creates a risk to the environment. Proper disposal methods are needed to safeguard the environment for our children. Reducing the amount of fluid that has to be disposed of is one way of reducing the impact on the already taxed environment.

Whenever a full fluid change is required to be done there is always a risk of spills and ground contamination. Reducing the number of full drains reduce this risk dramatically.

# How Bypass Filtration Works

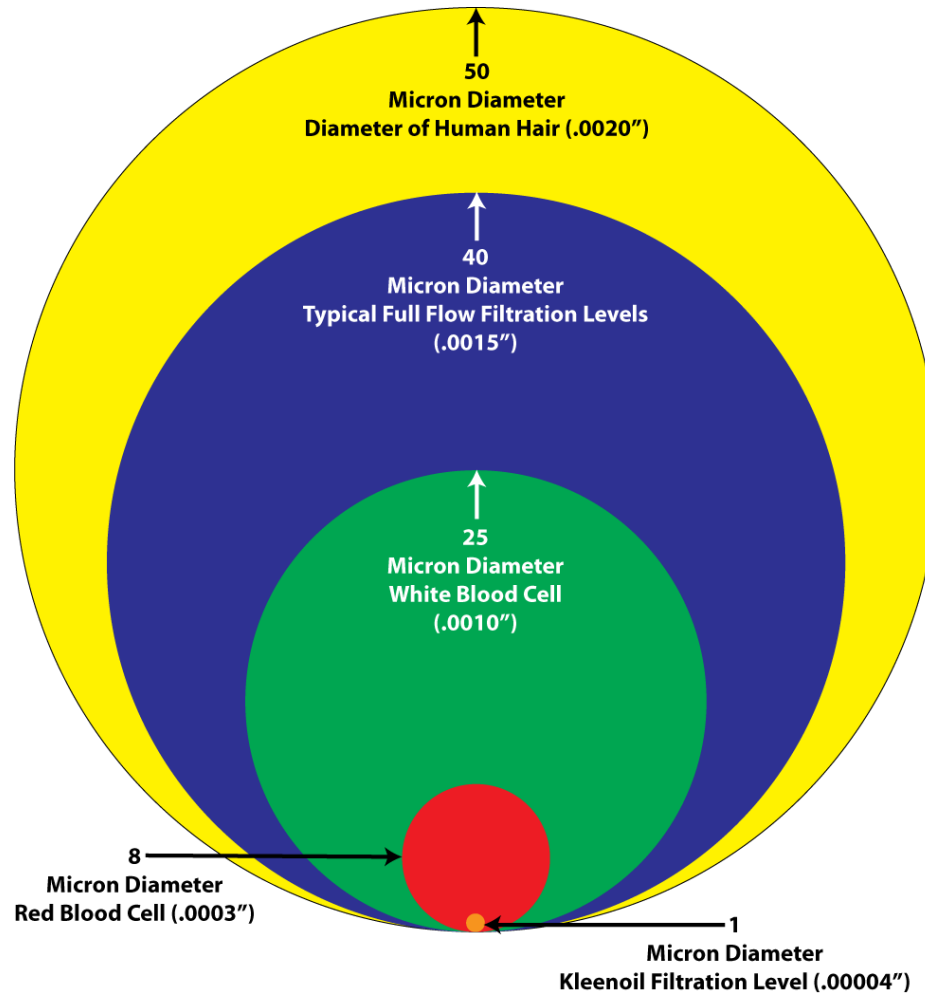
KLEENOIL FILTER UNIT



- The Kleenoil bypass filter diverts a small percentage of the normal oil flow then directs it through a bypass loop.
- As it passes through the bypass filter, and before it returns to the normal flow, abrasive particles such as carbon, soot, wear metals and silicon (dirt) down to one micron size are removed, along with all water.
- The cleaned oil is then returned to the normal flow effectively in its original new condition.
- By removing these impurities as they occur, the Kleenoil bypass filter prevents the buildup of acid and particulates and maintains the oil within its operating specification.

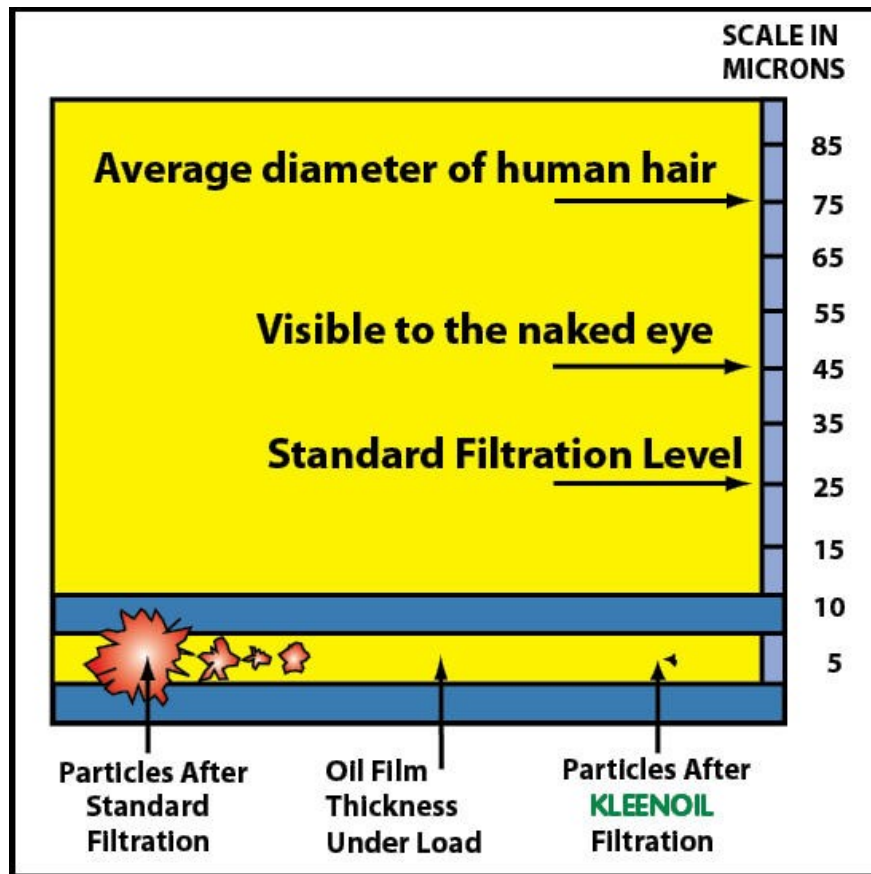
Thus your engine oil lasts between 4 - 5 times longer than it used to under certain conditions and hydraulic up to ten times longer: you only need to change it one fifth as often as you did before. By removing the two items which directly and indirectly cause damage, the engine life is dramatically extended.

# Exactly How Big is 1-Micron?





# Oil Contamination Levels



The cleanliness of your hydraulic fluid is critical to the trouble free and cost effective operation of your system. Hydraulic components are very expensive and need special consideration when selecting and filtering this fluid. ISO 4406 (International Standards Organization) code is a standard that is recognized in the industry. Certain recommended fluid cleanliness quantities are necessary to realize the best performance and cost saving operation of your hydraulic system.

## Life Extension of Equipment Components

ISO 4406 Particle Counts

ISO Code	Particles per 1 ml > 6 Micron in Size	Particles per 1 ml > 14 Micron in Size
21/18	0,000 - 20,000	1280 - 2560
21/17	0,000 - 20,000	640 - 1280
21/16	10,000 - 20,000	320 - 640
21/15	10,000 - 20,000	160 - 320
20/17	5000 - 10,000	640 - 1280
20/16	5000 - 10,000	320 - 640
20/15	5000 - 10,000	160 - 320
20/14	5000 - 10,000	80 - 160
19/16	2500 - 5000	320 - 640
19/15	2500 - 5000	160 - 320
19/14	2500 - 5000	80 - 160
19/13	2500 - 5000	40 - 80
18/15	1300 - 2500	160 - 320
18/14	1300 - 2500	80 - 160
18/13	1300 - 2500	40 - 80
18/12	1300 - 2500	20 - 40
17/14	640 - 1300	80 - 160
17/13	640 - 1300	40 - 80
17/12	640 - 1300	20 - 40
17/11	640 - 1300	10 - 20
16/13	320 - 640	40 - 80
16/12	320 - 640	20 - 40
16/11	320 - 640	10 - 20
16/10	320 - 640	5 - 10
15/12	160 - 320	20 - 40
15/11	160 - 320	10 - 20
15/10	160 - 320	5 - 10
15/09	160 - 320	2.5 - 5
14/11	80 - 160	10 - 20
14/10	80 - 160	5 - 10

Component Life Extension AFTER Kleenoil - New Cleanliness Level (ISO CODE)

	20/17	19/16	18/15	17/14	16/13	15/12	14/11	13/10	12/9	11/8	10/7
26/23	5 3	7 3.5	9 4	>10 5	>10 6	>10 7.5	>10 9	>10 >10	>10 >10	>10 >10	>10 >10
25/22	4 2.5	5 3	7 3.5	9 4	>10 5	>10 6	>10 7	>10 9	>10 >10	>10 >10	>10 >10
24/21	3 2	3.5 2.5	4.5 3	5 3.5	6.5 4	8 5	9 6	10 7.5	>10 9	>10 >10	>10 >10
23/20	3 2	4 2.5	6 3	7 4	9 5	>10 6	>10 7	>10 8	>10 10	>10 >10	>10 >10
22/19	2.5 1.5	3 2	4 2.5	5 3	6.5 4	7.5 5	8.5 6	9.5 7	>10 8	>10 10	>10 >10
21/18	2 1.5	3 2	4 2.5	5 3	7 3.5	9 4	>10 5	>10 6	>10 8	>10 9	>10 >10
20/17	1.7 1.3	2.3 1.5	3 2	3.7 2.5	5 3	6 3.5	7 4	8 5	10 6.5	>10 8.5	>10 10
19/16	1.6 1.3	2 1.6	3 2	4 2.5	5 3	7 3.5	8 4	>10 5	>10 6	>10 7	>10 >10
18/15	1.4 1.1	1.8 1.3	2.3 1.7	3 2	3.5 2.5	4.5 3	5.5 3.5	7 4	8 5	10 5.5	>10 8.5
17/14	1.3 1.2	1.5 1.5	2 1.7	3 2	4 2.5	5 3	7 3.5	9 4	>10 5	>10 7	>10 >10
16/13	1.2 1.1	1.5 1.3	1.8 1.4	2.2 1.6	3 2	3.5 2.5	4.5 3	5 3.5	7 4	9 5.5	10 8
15/12		1.3 1.2	1.6 1.5	2 1.7	3 2	4 2.5	5 3	7 4	9 5	>10 7	>10 9
14/11		1.2 1.05	1.5 1.3	1.8 1.4	2.3 1.7	3 2	3.5 2.5	5 3	6 4	8 5.5	10 7
13/10			1.3 1.2	1.6 1.5	2 1.7	3 2	4 2.5	5 3	7 4	9 6	>10 8
			1.2 1.1	1.5 1.3	1.8 1.5	2.2 1.7	3 2	3.5 2.5	5 3.5	7 4.5	9 6
				1.3 1.2	1.6 1.5	2 1.7	3 2	4 2.5	5 3	7 4.5	>10 6
				1.2 1.1	1.5 1.3	1.8 1.5	2.3 1.7	3 2	3.5 2.5	5.5 3.7	8 5
					1.3 1.2	1.6 1.5	2 1.7	3 2	4 2.5	6 3	8 5
					1.2 1.1	1.5 1.3	1.8 1.5	2.3 1.7	3 2	4 2.5	6 3.5
						1.3 1.2	1.6 1.5	2 1.7	3 2	4 3.5	6 4
						1.2 1.1	1.5 1.3	1.8 1.5	2.3 1.8	3.7 3	4.5 3.5
							1.3 1.2	1.6 1.5	2 1.7	3 2	4 2.5
							1.2 1.1	1.5 1.4	1.8 1.5	2.3 1.8	3 2.2
								1.3 1.3	1.6 1.6	2 1.8	3 2
								1.3 1.2	1.6 1.4	1.9 1.5	2.3 1.8
									1.4 1.2	1.8 1.5	2.5 1.8
									1.2 1.1	1.6 1.3	2 1.6

Hydraulics and Diesel Engines

Rolling Element Bearings

Journal Bearings and Turbo Machinery

Gear Boxes and Other

# ISO 4406 Contamination Chart

Table of ISO 4406 Particle Counts			
	ISO Code	Number of Particles per 1 ml > 5 Micron in Size	Number of Particles per 1 ml > 15 Micron in Size
	23/20	40000 - 80000	5120 - 10400
	23/19	40000 - 80000	2560 - 5200
	23/18	40000 - 80000	1280 - 2600
	23/17	40000 - 80000	640 - 1300
	22/19	20000 - 40000	2560 - 5200
	22/18	20000 - 40000	1280 - 2600
	22/17	20000 - 40000	640 - 1300
	22/16	20000 - 40000	320 - 640
	21/18	10000 - 20000	1280 - 2600
	21/17	10000 - 20000	640 - 1300
	21/16	10000 - 20000	320 - 640
	21/15	10000 - 20000	160 - 320
	20/17	5000 - 10000	640 - 1300
	20/16	5000 - 10000	320 - 640
	20/15	5000 - 10000	160 - 320
	20/14	5000 - 10000	80 - 160
	19/16	2500 - 5000	320 - 640
	19/15	2500 - 5000	160 - 320
	19/14	2500 - 5000	80 - 160
	19/13	2500 - 5000	40 - 80
Approximate New Oil	18/15	1300 - 2500	160 - 320
	18/14	1300 - 2500	80 - 160
	18/13	1300 - 2500	40 - 80
	18/12	1300 - 2500	20 - 40
	17/14	640 - 1300	80 - 160
	17/13	640 - 1300	40 - 80
	17/12	640 - 1300	20 - 40
	17/11	640 - 1300	10 - 20
	16/13	320 - 640	40 - 80
	16/12	320 - 640	20 - 40
	16/11	320 - 640	10 - 20
	16/10	320 - 640	5 - 10
	15/12	160 - 320	20 - 40
	15/11	160 - 320	10 - 20
	15/10	160 - 320	5 - 10
	15/09	160 - 320	2.5 - 5
	14/11	80 - 160	10 - 20
	14/10	80 - 160	5 - 10
Kleenoil USA	14/09	80 - 160	2.5 - 5
Bypass Filter	14/08	80 - 160	1.3 - 2.5
Range ----->	13/10	40 - 80	5 - 10
	13/09	40 - 80	2.5 - 5
	13/08	40 - 80	1.3 - 2.5

Studies have shown that for each grade the ISO code is lowered, the life of a hydraulic component can be doubled or tripled! As shown in the chart, new oil is approximately rated at 18/15. Kleenoil Bypass Filters will attain ISO 4406 to a standard of 14/9!

The ISO 4406 cleanliness level standard is used to reference the number of particles greater than 5 and greater than 15 microns in a known volume. For our usage, this volume will be 1 ml. The number of 5+ micron particles is used as a reference point for "silt" particles. The 5 - 15 size range indicates the quantity of larger particles present, which contribute greatly to potential catastrophic component failure. Now, the way the ISO chart lists the "ISO Code" is with a two number system. For example, the approximate rating of new oil off the store shelf would be rated at 18/15.

In this two number system, the first number indicates the number of particles that are greater than 5 micron in size. The second number after the / indicates the number of particles that are greater than 15 micron in size. Ideally, the lower you can get the two numbers in the ISO chart, the less internal damage there will be inside your engine or hydraulic system. To ensure that you achieve the most efficient and relative results, it is important to maintain an *oil analysis* program.

# Kleenoil Component Life Extension



Fundamentals of Machinery Lubrication

## Life Extension Table

		NEW CLEANLINESS LEVEL (ISO CODE)																					
		20/17		19/16		18/15		17/14		16/13		15/12		14/11		13/10		12/9		11/8		10/7	
NEW CLEANLINESS LEVEL (ISO CODE)	26/23	5	3	7	3.5	9	4	>10	5	>10	6	>10	7.5	>10	9	>10	>10	>10	>10	>10	>10	>10	>10
		4	2.5	4.5	3	6	3.5	6.5	4	7.5	5	8.5	6.5	10	7	>10	9	>10	10	>10	>10	>10	>10
	25/22	4	2.5	5	3	7	3.5	9	4	>10	5	>10	6	>10	7	>10	9	>10	>10	>10	>10	>10	>10
		3	2	3.5	2.5	4.5	3	5	3.5	6.5	4	8	5	9	6	10	7.5	>10	9	>10	>10	>10	>10
	24/21	3	2	4	2.5	6	3	7	4	9	5	>10	6	>10	7	>10	8	>10	10	>10	>10	>10	>10
		2.5	1.5	3	2	4	2.5	5	3	6.5	4	7.5	5	8.5	6	9.5	7	>10	8	>10	10	>10	>10
	23/20	2	1.5	3	2	4	2.5	5	3	7	3.5	9	4	>10	5	>10	6	>10	8	>10	9	>10	>10
		1.7	1.3	2.3	1.5	3	2	3.7	2.5	5	3	6	3.5	7	4	8	5	10	6.5	>10	8.5	>10	10
	22/19	1.6	1.3	2	1.6	3	2	4	2.5	5	3	7	3.5	8	4	>10	5	>10	6	>10	7	>10	>10
		1.4	1.1	1.8	1.3	2.3	1.7	3	2	3.5	2.5	4.5	3	5.5	3.5	7	4	8	5	10	5.5	>10	8.5
21/18	1.3	1.2	1.5	1.5	2	1.7	3	2	4	2.5	5	3	7	3.5	9	4	>10	5	>10	7	>10	10	10
	1.2	1.1	1.5	1.3	1.8	1.4	2.2	1.6	3	2	3.5	2.5	4.5	3	5	3.5	7	4	9	5.5	10	8	
20/17			1.3	1.2	1.6	1.5	2	1.7	3	2	4	2.5	5	3	7	4	9	5	>10	7	>10	9	9
			1.2	1.05	1.5	1.3	1.8	1.4	2.3	1.7	3	2	3.5	2.5	5	3	6	4	8	5.5	10	7	7
19/16					1.3	1.2	1.6	1.5	2	1.7	3	2	4	2.5	5	3	7	4	9	6	>10	8	8
					1.2	1.1	1.5	1.3	1.8	1.5	2.2	1.7	3	2	3.5	2.5	5	3.5	7	4.5	9	6	6
18/15							1.3	1.2	1.6	1.5	2	1.7	3	2	4	2.5	5	3	7	4.5	>10	6	6
							1.2	1.1	1.5	1.3	1.8	1.5	2.3	1.7	3	2	3.5	2.5	5.5	3.7	8	5	5
17/14									1.3	1.2	1.6	1.5	2	1.7	3	2	4	2.5	6	3	8	5	5
									1.2	1.1	1.5	1.3	1.8	1.5	2.3	1.7	3	2	4	2.5	6	3.5	5
16/13												1.3	1.2	1.6	1.5	2	1.7	3	2	4	3.5	6	4
												1.2	1.1	1.5	1.3	1.8	1.5	2.3	1.8	3.7	3	4.5	3.5
15/12														1.3	1.2	1.6	1.5	2	1.7	3	2	4	2.5
														1.2	1.1	1.5	1.4	1.8	1.5	2.3	1.8	3	2.2
14/11																1.3	1.3	1.6	1.6	2	1.8	3	2
																1.3	1.2	1.6	1.4	1.9	1.5	2.3	1.8
13/10																		1.4	1.2	1.8	1.5	2.5	1.8
																		1.2	1.1	1.6	1.3	2	1.6

Based on ISO 4406:99 - 4 micron range number has been omitted.

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MLTI O MLTI O REF: Noria



This chart clearly demonstrates the effectiveness of the Kleenoil Filter System by showing the number of times that the life of engine and hydraulic components can be extended. The area highlighted on the chart in yellow shows the number of times that the life of a component would be extended when going from brand new oil right out of the barrel to oil that has been filtered using one of the Kleenoil Bypass Filtration Systems.



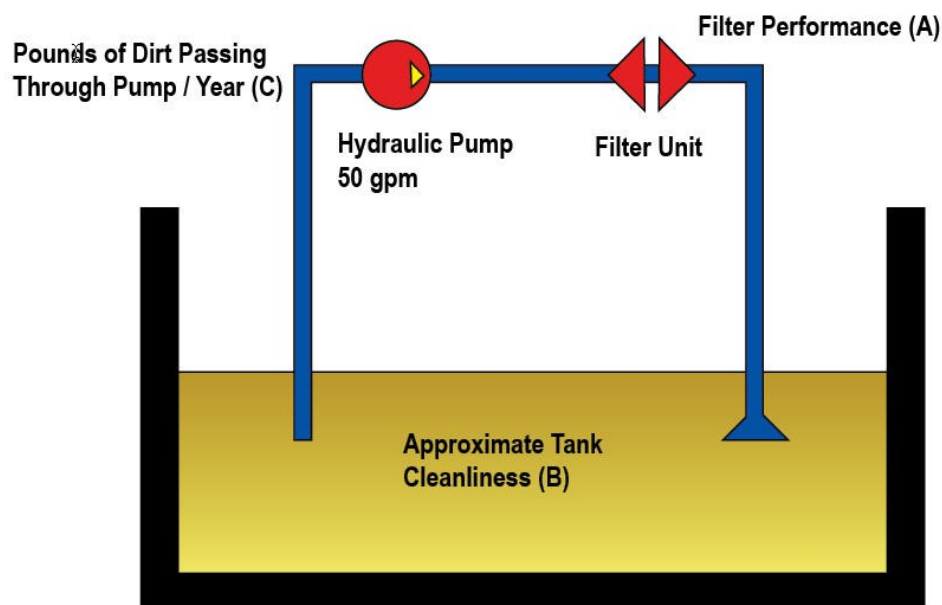
# Oil Pump or Dirt Pump



# Oil Pump or Dirt Pump?

Filter (A)	ISO Code (B)	Dirt (lbs.) (C)	50 lb Bags	Relative Pump Life
25 micron nominal	21/18	6784	136	1
10 micron nominal	19/16	1809	36	1.9
10 micron absolute	16/13	211	4.2	4.4
6 micron absolute	14/11	53	1	8.8
3 micron absolute	12/9	14	0.28	15

All figures are approximations. © Copyright 2002 Noria Corporation



**At ISO 14/11, only one 50-lb. bag of dirt passes through the pump.**

**At ISO 21/18, this hydraulic system passes 136 50-lb. bags of dirt through the teeth of the pump in one year.**

## Kleenoil Filtration Unit

**Description:** The Kleenoil filtration unit is made of cast aluminum with a galvanized steel mounting bracket. There are three basic sizes, which are installed according to the applications table below. It is connected to the engine lubricating oil circulating system in a bypass loop using high pressure braided hose and fittings to SAE standards.

### Tech Data

- Remote Mounted Unit for easy servicing
- Maximum pressure rating of Unit 10 Bar
- Lid torque pressure 23lb/ft / 4Kg/cm2

Castings subjected to batch and individual testing Constructed in aluminum (BS 1490 LM6 (M))



Specifications Table:	
Pressures:	Maximum rating of 10 Bar. Lid torque is 23 ft/lbs.
Oil Flow Rate:	Output levels are dependent on the viscosity, temperature, degree of contamination and oil pressure. (Guide - For SAE 15W40 oil at 158 degrees F and 60 psi, the flow rate would be 0.55 gpm to 0.81 gpm)
Operating Temperatures:	Within operating specifications of engine, gear and hydraulic oils.
Filtration Level:	Particulate contamination in accordance with BS 5540 part 4: 1981 and ISO/DIS 4406. ISO 14/9 equivalent to NAS 1638 class 6 - hydraulic oil specification.
Castings:	Constructed of aluminum to BS 1490 (M) Subjected to batch and individual testing.
In accordance with our policy of continuous product improvements, we reserve the right to alter technical specifications without prior notice.	



# Kleenoil Filtration Unit

**Description:** The Kleenoil filtration unit is made of cast aluminum with a galvanized steel mounting bracket. There are three basic sizes, which are installed according to the applications table below. It is connected to the engine lubricating oil circulating system in a bypass loop using high pressure braided hose and fittings to SAE standards.



Applications Table		
Kleenoil USA Part #	Type of Filter	Typical Usage
KU06	Mini Duty Filtration Unit	1. For engines with an oil pan capacity up to 6 quarts.
KU16	Light Duty Filtration Unit	1. For engines with an oil pan capacity up to 16 quarts. 2. For hydraulic systems with tanks up to 60 gallons.
KU50	Heavy Duty Filtration Unit	1. For engines with an oil pan capacity up to 50 quarts. 2. For hydraulic systems with tanks up to 200 gallons. 3. As a diesel fuel filter in full flow
KU65	Heavy Duty EGR Filtration Unit	1. For engines with an oil pan capacity up to 65 quarts. 2. For hydraulic systems with tanks up to 300 gallons. 3. As a diesel fuel filter in full flow.
KU85	Super Duty Filtration Unit	1. For engines with an oil pan capacity up to 85 quarts. 2. For hydraulic systems with tanks up to 400 gallons. 3. As a diesel fuel filter in full flow.

# Kleenoil Filter Cartridge



**Description:** The Kleenoil filter cartridge is a densely wound paper made from a long fiber coniferous pine tree that grows in Scandinavia where the pulp is only processed once. It is held together in a material casing and comes in specified sizes for use in the appropriate filtration units as shown in the specifications table.

**Action of the cartridge:** The filtration cartridge acts both by *absorption* and by *adsorption* in a continuous recycling process. The long fibers of the paper attract the water formed either through the combustion process or by condensation and absorb it like a sponge, at the same time rejecting the large oil molecules which are forced to pass between the tight windings of the cartridge. As the oil passes through the cartridge, minute carbon (soot), wear metals, and silicon particles (dirt) are extracted from the oil by adhering to the many surfaces of the filter - a process known as adsorption. Thus the cartridge, by removing water inhibits the production of acids which both degrade the oil and cause corrosion. The simultaneous removal of minute contaminants as they occur enables the oil life to be extended within its original operating specification.

# Kleenoil Filter Cartridge

The Kleenoil filter cartridge will remove particles down to 1 micron (3 absolute) and totally remove water. The principle for filtering particulate matter is 'liquid liquid chromatography' which is in effect allowing a fluid to drain down a surface which will progressively arrest particles. This is achieved by having the tissue rolled on a core. Oil is passed up the core of a paper roll where it collects in a cavity between the lid of the filter housing and the paper roll. It is then forced down between the layers of the tissue where particles are adsorbed within the matrix created by millions of cellulose fibers which form the tissue layer. The principle for filtering water is capillary absorption into the hollow vegetable fiber of the cellulose tissue. The molecular structure of the oil is too large to be absorbed by 'capillary action' into the fibers, however the water is absorbed into the fiber and separates from the oil.

The construction of the Kleenoil filter cartridge is cellulose tissue (paper), and we seek to always obtain a long fiber tissue which has not been previously processed. Short fibers will absorb the water, but the pressure of flowing oil will cause the water to be released back into the oil. A long fiber will have the ends crushed by the pressure of flow and a small portion of water will be permanently retained in each fiber. Water retention is approximately 2 quarts per pound of tissue.

Most papers are made with a large amount of repulped material, and as a general rule the fiber length is approximately halved each time it is re-pulped. The shortened fiber will not retain a significant amount of water, and tends to collapse into a repulped state when water is introduced. To be able to retain a large amount of very small particles the winding of the cellulose roll must be extremely precise. Normal paper converters operate at high speed and the motion is not particularly smooth.

To make an efficient filter the winding must reflect a constant and even tension, yet not be so tight that oil will not freely flow. Re-pulped tissue with shorter fibers will not have the tensile strength to permit the tension without breaking.



# Kleenoil Filter Cartridge

To conclude, the cellulose tissue used to manufacture a Kleenoil cartridge must be from 'virgin coniferous' or other long fiber wood. It must have no element of 'broke' (re-pulped material). There must be no chemicals such as optical bleach present, which could alter the features of other chemicals added to the oil being cleaned, There must be a constant slow wind to give the optimum density and tension of the material.

Any proprietary tissue would be unlikely to produce a filter which would meet the established specification of filtration to below 3 microns and total water removal within five passes.

**Important Note:** While the filtration unit is extracting the water and the contaminant, it is continuously safeguarding the desirable elements compounded within the actual oil in use. These typically include, dispersants, detergents, oxidation and rust inhibitors, metal de-activators, pour-point depressants, viscosity improvers, EP agents, friction modifiers, fungicidal, anti-foaming and gelling additives. These additives are held in suspension and their levels can be critical if the oil is to maintain its beneficial qualities.

Specification Table:	Light Duty		Heavy Duty		Heavy Duty EGR		Super Duty	
	Unit	Cartridge	Unit	Cartridge	Unit	Cartridge	Unit	Cartridge
Code Number	KU16	KF16	KU50	KF50	KU65	KF65	KU85	KF85
Water Retention <0.05%		0.07 Gallon		0.12 Gallon				0.26 Gallon
Height	6.29 inch	4.13 inch	6.50 inch	4.13 inch	6.37 inch	4.13 inch	7.09 inch	4.13 inch
Diameter	4.72 inch	4.06 inch	6.61 inch	5.63 inch	7.50 inch	7.06 inch	8.35 inch	7.80 inch
Weight (Cartridges +/- 5%)	3.31 lbs		6.61 lbs.	1.05 lbs.			13.23 lbs.	2.15 lbs.

# Kleenoil is OEM on Liebherr

## LIEBHERR HYDRAULIC CIRCUIT

Your Liebherr hydraulic excavator can be equipped with additional oil filters mounted in the bypass of the hydraulic circuit between control valve block – return and the suction line of the working pumps. During operation a small amount of oil always flows via these filters in the bypass to the main return filters.

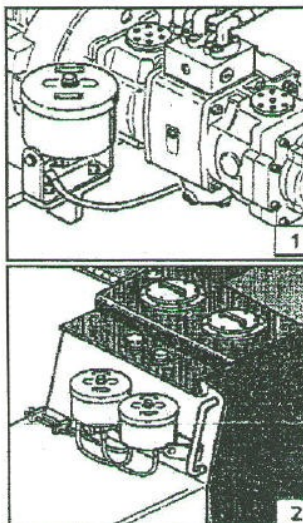
Predominantly, these filters are designed to drain water by absorbing the water contained in the oil. This guarantees the oil all positive qualities and/or characteristics between oil changes. See next page "appendix 1" as well.

Mounting bypass oil filters is especially recommended when using environmentally safe oils ("bio oils") because these kinds of oil feature a greater capacity to absorb water.

Note: Using these kinds of filters does not relieve the operator of the responsibility of regularly draining the water condensation from the hydraulic tank, see page 5.17.

### FILTER LOCATION

Depending on the size of the machine model, filters with one or two filter elements are mounted:



### Appendix 1 – THE KLEENOIL FILTER – CARTRIDGE

#### Description

The Kleenoil Filter Cartridge is made of densely wound long fibre cellulose. It is covered with a material casing and comes in specified sizes for use in the appropriate filter housings.

The variety of applications to which the cartridge is applicable is explained in greater detail in the appropriate data sheets.

#### Action of Cartridge.

The filter cartridge acts both by absorption and adsorption in a continuous recycling process. The long cellulose fibres attract the water formed either through the combustion process or by condensation and absorb it like a sponge, at the same time rejecting the larger oil molecules which are forced to pass between the tight windings of the cartridge. As the oil passes through the cartridge minute particles of carbon, wear metals, and silicon are extracted from the oil by adhering to the many surfaces of the filter – a process known as adsorption. Thus, the cartridge by removing water inhibits the production of acids which both degrade the oil and cause excessive wear. The simultaneous removal of minute contaminants as they occur enables the oil life to be extended whilst remaining within its original operating specification, as laid down by its manufacturer.

#### Important note

While the filter is extracting the water and contaminants it is continuously safeguarding the desirable elements compounded within the actual oil in use. These typically include, dependant on use, dispersants, detergents, oxidation and rust inhibitors, metal de-activators, pour-point depressants, VI improvers, lubricity agents, fungicidal, anti-foaming and gelling additives. These additives are held in suspension and their levels can be critical if the oil is to maintain its beneficial effect. The Kleenoil filter will not remove these additives.

#### Specification



Identification:	SDFC 1888, Super Duty Filter Cartridge for use with SDU 9788 Super Duty Unit
Application:	1. As an engine oil filter for sumps up to 80 lbs. 2. As a hydraulic oil filter 3. As a Diesel oil filter
Water retention level:	0.26 gall./1.2 ltr. (to less than 0.05%)
Weights and Dimensions:	Height: 110 mm Diameter: 195 mm Weight: 900 g. +/- 5%

Oil flow rate: Output levels are dependant on viscosity, temperature, degree of contamination, and oil pressure. Pressure difference – begin:  $\Delta p = 3$  bar.

Filtration Level: Particulate contaminants in accordance with BS 5540 part 4:1981 and ISO/DIS 4406. ISO 14/9 equivalent to NAS 1638 class 6 (hydraulic oil specification).

# Kleenoil Hydraulic Kits



The Kleenoil Hydraulic Block is mounted to the bottom of the Kleenoil Bypass Filtration System to convert the lower pressure bypass engine oil filter to a high pressure hydraulic fluid filter.

## Hydraulic Fluid Factoids

- More than 70% of hydraulic failures are caused by contaminants in the oil.
- Heavily contaminated oil can reduce power by as much as 15-20%, slowing machine response and taking longer to perform an operation.
- By following a few basic tips listed below, the life of piston rods, seals, valves, and pumps can be more than doubled.
- By Maintaining the hydraulic fluid in 'cleaner than new' condition, the life of components can be increased ten-fold.

# Kleenoil Hydraulic Kits



**Particles Breed Particles:** An abrasive particle passing through the system scrapes off further particles. Larger ones join the original to create a mass of wear catalysts, smaller ones become silt which builds up on metal surfaces to clog oil flow and cause sticking valve components. In line filters do not remove silt, (particles below 15 micron) and do not remove water.

**The main benefits of using the Kleenoil Hydraulic Kits along with Filter Units:**

- A dramatic reduction in component wear (seals, o-rings, valves, pumps, etc).
- A reduction in the incidence of sticking and worn valve components.
- Extended life of in-line filters.
- An end to the need to change hydraulic fluids.





# Volvo Letter



Gentlemen,

The filtration method I would recommend for machine L180E, serial # 9009, is more commonly called by-pass filtration. This system is fitted into a lower flow portion of the hydraulic circuit i.e. servo or cooler return, and filters the oil over a longer time frame but to a finer level.

During this filtration period the machine can be operated as normal and, in fact, the more functions that are operated the cleaner the system hydraulic oil becomes. This method has no effect on machine operation and requires no external power or pumps.

Here are some links to sites that sell/service bypass systems.

<http://www.kleenoilusa.com/>

As we discussed, anyone who owns, rents or uses Volvo equipment can use the contact information below. I would prefer any other equipment owners/users to use:

[jhemmings11@comcast.net](mailto:jhemmings11@comcast.net)

Best regards,

Jim Hemmings  
Technical Support Specialist  
Volvo Construction Equipment North America  
One Volvo Drive  
Asheville, North Carolina 28803

E mail [james.hemmings@volvo.com](mailto:james.hemmings@volvo.com)

Tel 828-650-2083

Mob 828-230-4838

Fax 425-675-5968



# Manufacturer Warranty Concerns

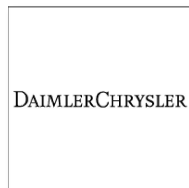
One of the number one questions received at Kleenoil USA is regarding installation of a Kleenoil Onboard Oil Recycling System on your truck or equipment and whether the installation could void the warranty?

Rest assured that due to the Magnuson-Moss Warranty Act, this is not a concern at all.

We also have a comprehensive list of the major manufacturers below and their statements on use of Kleenoil Onboard Oil Recycling System on their equipment.



A **NAVISTAR** COMPANY



**VOLVO**



**CATERPILLAR**



**JOHN DEERE**



**KLEENOIL**

**CATERPILLAR**

**CATERPILLAR**

Caterpillar Inc.  
Seattle District  
Suite 350  
2535 Factoria Blvd. SE  
Bellevue, Washington 98006

July 30, 2008

Craig McGree  
Evoilution, LLC  
1200 Gough St. Apt 11F  
San Francisco CA 94109

Dear Craig,

Caterpillar's standard engine warranty is limited to defects in material or workmanship of Caterpillar products found during the warranty period.

While the use of aftermarket attachments, accessory items or parts not sold or approved by Caterpillar does not void the warranty as such, the warranty statement makes clear that Caterpillar is not responsible for any failures resulting from such attachments, accessory items, or parts.

The bypass oil filtration systems noted in your correspondence have not been approved by Caterpillar and thus Caterpillar would not be responsible for any failures resulting from such items.

Sincerely,  
  
Engine Sales Manager

David G. Bradshaw  
Seattle District  
425-562-9659

Copy: Seth C. Prager  
Senior Corporate Counsel  
Legal Services Division  
Caterpillar Inc.  
AC 6105

**KLEENOIL** 

# KLEENOIL



To whom it may concern:

Summary: Cummins Engine Warranty

Solution: Thanks for your message. You have contacted Cummins, Inc. at our Customer Assistance Center located in Columbus, Indiana. This is our worldwide headquarters and has been our home since Clessie Cummins founded the company February 3, 1919.

Regarding your questions on the Kleenoil and Power Up products, the products themselves will not void the warranty however any progressive damage issue linked either directly or indirectly to aftermarket products or additives will not be covered by warranty.

We thank you for your interest in Cummins products. We occasionally misunderstand a question. If our answer to your communication looks like we have misunderstood your question, please reply with further inquiry.

To locate the nearest Cummins-authorized Dealer or Distributor Service Provider call our toll free customer assistance line 1-800-DIESELS (343-7357) or for computer assistance in locating a Service Provider, use Cummins Service Locator, which can be found on Cummins website:

<http://wsl.cummins.com/ServiceLocator/jsp/controller.jsp?action=showworldmap>

Please let us know if you have other questions and if away from your computer or have a time-critical request that needs more urgent attention, feel free to call us toll-free (from North America) on 1-800-DIESELS (343-7357). Cummins Email (via webpage):

<http://www.cummins.com/cmi/content.jsp?siteId=1&langId=1033&menuId=6&overviewId=33&menuIndex=7>

Customer Assistance Center  
Cummins, Inc.  
Columbus, Indiana, USA

# KLEENOIL





# KLENOIL



A **NAVISTAR** COMPANY

**NAVISTAR**  
ENGINE GROUP

Navistar, Inc.  
10400 West North Avenue  
Melrose Park, IL 60160 USA  
P : 708-865-4166

William G. Krohn  
Director of Powertrain  
Reliability & Quality

November 3, 2009

Mr. Jason Lazaroff  
Kleenoil USA  
6913 Avenue K, Suite #303  
Plano, Texas 75074

Dear Mr. Lazaroff,

This is in reply to you requesting a statement of our position regarding the use of your Kleenoil Bypass Filtration system on our equipment.

Navistar, Inc. neither approves nor disapproves any product(s) not manufactured or sold by Navistar, Inc. The use of your products on our vehicles do not in and of themselves void the warranty, but any damage which may result from their use might not be covered under warranty as a warrantable failure.

Kindest regards,

William G. Krohn  
Director of Powertrain  
Reliability & Quality

# KLENOIL



**KLEENOIL**

**VOLVO**

**VOLVO**

Volvo Trucks North America, Inc.

November 2, 2009

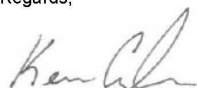
Jason Lazaroff  
Kleenoil USA  
6913 Ave K, Suite #303  
Plano, TX 75074

Dear Mr. Lazaroff,

This is in reply to you requesting a statement of our position regarding the use of your Kleenoil Bypass Filtration system on our equipment.

Volvo Trucks North America neither approves nor disapproves any product(s) not manufactured or sold by Volvo Trucks North America. The use of your products on our vehicles do not in and of themselves void the warranty, but any damage which may result from their use might not be covered under warranty as a warrantable failure.

Regards,



Ken Culver  
Director, Warranty & Quality

---

Volvo Trucks North America, Inc.  
7900 National Service Road  
Greensboro, NC 27410

Telephone  
(336) 393-2000

Fax  
(336) 393-2444

**KLEENOIL** 

# Kleenoil Lifetime Warranty

Original equipment warranties are unaffected by the installation of a Kleenoil Onboard Oil Recycling System.

Kleenoil USA Inc. Onboard Oil Recycling Systems - bypass filtration systems (excluding hoses and fittings) **carry a lifetime warranty.**

Kleenoil USA Inc. warrants the Kleenoil filter housing and brackets to the original purchaser for life.

Adaptors, hose ends, and hosing will all carry the normal warranty of the original supplier of those parts.

The Kleenoil Lifetime Warranty does not cover any damages caused by you or due to external causes, including any act of God, natural disaster, accident, flood, war, sabotage, terrorism, military actions, or problems with the engine, e.g., failure to maintain the engine in accordance with its documentation (other than manufactures recommended oil changes).



# General Motors Case Study - Noria



## Case Study: General Motors

