



Kleenoil Onboard  
Oil Recycling Systems

*Go Green - Keep it Kleen!*



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# Kleenoil Onboard Oil Recycling Systems

*Go Green - Keep it Klean!*



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## Kleenoil Onboard Oil Recycling Systems History/Concept

Is Kleenoil's Bypass Filtration an established and tested technology? Yes, Kleenoil Filtration has been in business for over 26 years, and is in almost every country in the world. Bypass filtration itself has been in use for over 70 years. When faced with a national oil shortage during World War II, US Armed Forces used bypass filtration to extend oil life. With today's improved technology such as computer controlled manufacturing, more efficient filter designs and higher quality standards, bypass filtration has greatly improved.

How do Kleenoil Bypass Filters differ from the standard main flow, OEM Filters? Standard main flow filters are designed not to work! Think about it. If main flow filters were dense enough to keep your oil clean, (as dense as the Kleenoil filtration cartridge), it would restrict the oil flow to the point of engine shut-down. Because main flow oil filters cannot be restrictive, they can only filter particles down to around 25 to 40 microns. The tolerances between the moving parts in your engine are around 3 microns. Therefore the particles in your oil between 25 and 3 microns create the friction and wear in your engine. This is the reason why you currently change your oil. You change it in an attempt to keep it as clean as possible. It is a very poor attempt! According to a study by the Fluid Power Institute, at Milwaukee School of Engineering, the particles from 20 microns down to 5 microns are those responsible for up to 60% of engine wear.

If you could filter oil in the engine down to 1 micron or below, your oil would stay clean all the time. This is exactly what the Kleenoil Bypass Filter does. This process cannot be accomplished in the main oil flow. Kleenoil filters do it in a Bypass loop (thus the name Bypass Filtration). It uses a cellulose filter medium that not only filters particles down to the size of 1 micron or less, but it also filters 100% of any water that may accumulate through condensation, or through the combustion process itself. This eliminates the possibility of corrosion and hydrocracking. Water contamination in lubricants can cut bearing life by as much as 80%.

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## Features and Benefits

Page 1 of 2

### ✓ Eliminates Water & 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.

### ✓ 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

Page 2 of 2

### ✓ 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.

### ✓ 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.



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## 12 Month Oil Drain Normal Procedure

Anyone taught to believe that “whatever else you do or do not do, you must change the oil regularly” finds the bypass filtration concept very difficult to believe and to trust. It goes against everything that they believe and they need to be very open minded and intelligent individuals to adopt such a radical and innovative thought. But is it really so radical? In fact, the basic theory does not change; only the way that same theory is applied. Why was the oil changed in the first place? Oil changes were the traditional way to clean the oil. By taking away the dirty oil, disposing of it, and then replacing it with fresh oil, the oil was “cleaned.”

The Kleenoil bypass filter cleans the oil as it flows. The more the engine is working the more the bypass filter is cleansing the oil down to 1 micron particles and removing the water as it is produced. Enlightened mechanics and maintenance managers always wish that they had received the full impact of the bypass filter potential earlier. It takes away probably the dirtiest regular maintenance operation and allows the mechanic to carry out a much more intelligent and thorough maintenance check in the same time period. All of which leads to less down time and eliminates costly repairs while at the same time saving a substantial number of dollars. With the immediate savings running at around \$1,000 for each truck per year, enlightened managers soon receive recognition from their companies for the good job that they are doing.

Interstate truckers who cover 150,000 miles a year and need regular oil changes on route have a major headache and cost which is removed by the installation of a Kleenoil bypass filter system. Of course, they also benefit from having an extra thousand bucks in hand each year and an engine that will last at least twice as long and with fewer problems!

Villeneuve Transport Group, owners of 250 interstate trucks, will not put a new truck on the road until a Kleenoil bypass filter is installed.

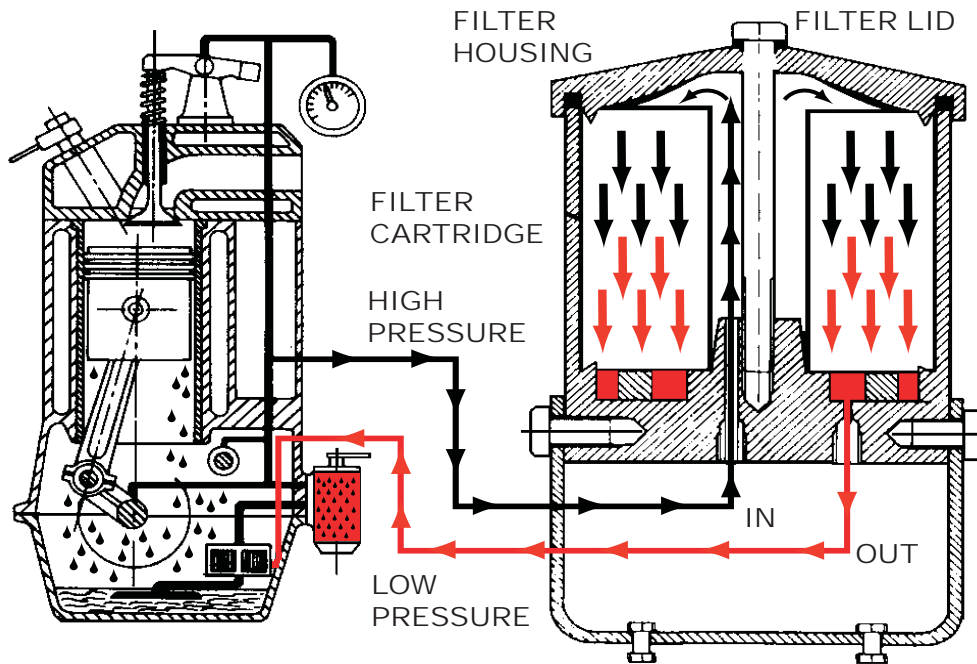


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## Eliminates Water & Particle Contamination

The Kleenoil bypass filter diverts a small percentage of the normal oil flow and 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 silican (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.

### THE KLEENOIL FILTER UNIT



Thus your engine oil lasts between three and five 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. This can be up to an eighty percent reduction in oil cost annually. By removing the two items which directly and indirectly cause damage, the engine life is dramatically extended.





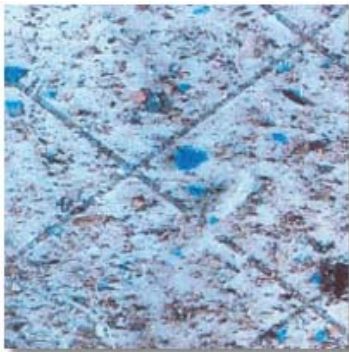
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## Kleenoil Reduces Engine Wear

Page 1 of 2

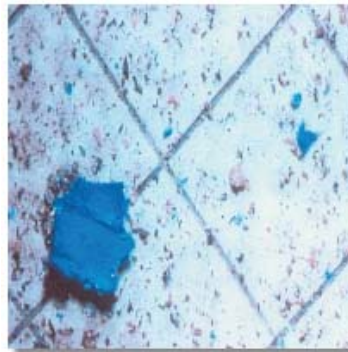
The Kleenoil BY-PASS Filtration System will remove dirt particles down to 1 micron and totally remove water. The particles normally present in oil, which will not be removed by the standard, full-flow filter, can be as much as 40 microns. The film of oil between two moving parts under load is normally 3 microns, so a wide range of particles will bridge this film, causing metal to metal contact, resulting in friction, heat, and wear.

### The Kleenoil Cartridge will Ensure No Particles Above 1 Micron Nominal (3 Absolute)!



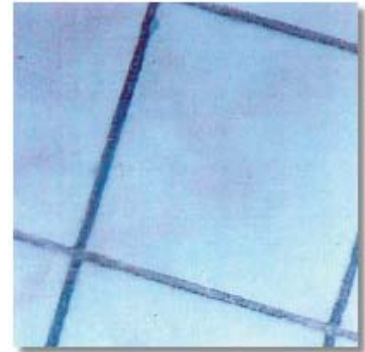
**Sample #1**

The first photo shown here is a sample of oil taken from a power steering unit of a large commercial scraper at time of refurbishment.



**Sample #2**

The second photo shown here is a sample of oil taken from a test unit with 10 micron filtration.



**Sample #3**

The third photo shown here is a sample taken from the same source as Sample #1 after passing through the Kleenoil BY-PASS Filtration System.

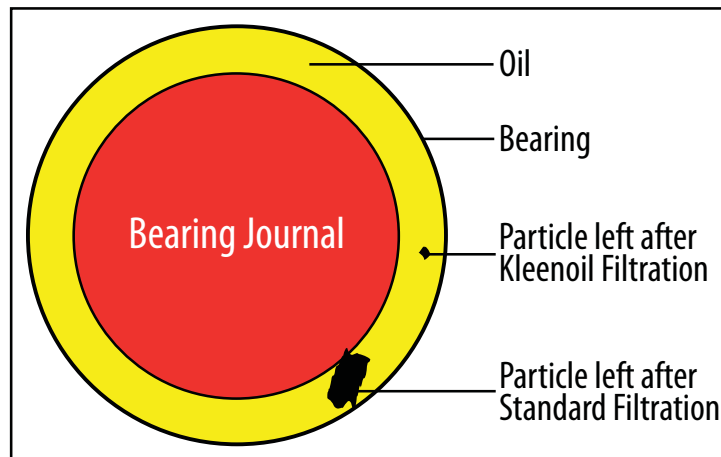




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## Kleenoil Reduces Engine Wear

Page 2 of 2



These engine bearings were on an engine installed with the Kleenoil BY-PASS Filtration System



IDENTICAL BEARINGS FROM A CATAPILLER 3406C THAT WAS HAULING A TANDAM MILK TRUCK TRAILER. IN THE PAST, THE BEARING ON THE LEFT HAD TO BE REGULARLY CHANGED DUE TO THE STRAIN ON THE MOTOR FROM THE LIQUID LOAD SHIFTING BACK AND FORTH DURING MOVEMENT. THE BEARING ON THE RIGHT CAME FROM THE SAME TRUCK THAT NOW HAS OVER 1,000,000 MILES ON IT AFTER HAVING THE KLEENOIL FILTRATION UNIT INSTALLED.

There is no scratching due to abrasive particles, or pitting and corrosion due to acid. At such a rate, the bearings will be functional for double or triple the normal lifetime. Bearing with same amount of miles in an engine without the Kleenoil BY-PASS Filtration System installed.



## Soot

Page 1 of 2

Kleenoil Bypass Oil filters are aimed to control soot levels through better filtration. The question is, "what is soot?"

Soot, which is also known as particulate matter, is a normally occurring byproduct of incomplete fuel combustion that takes place in gasoline as well as diesel engines. An engine creates chemical and organic compounds during the combustion of hydrocarbon-based fuels which contain both hydrogen and carbon. These compounds then cluster together in particle form to create soot, which is either released into the air as exhaust or passes through the rings of the combustion chamber and into engine oil. Soot may also come to life as the indirect byproduct of nitrogen oxides (NOx) and sulfur dioxides (SOx) reacting in the atmosphere. Soot's composition often includes hundreds of different chemical elements, including sulfates, ammonium, nitrates, elemental carbon, condensed organic compounds, and even carcinogenic compounds and heavy metals such as arsenic, selenium, cadmium and zinc.

Diesel engines form soot far more than their gasoline engine counterparts due to the differences in the ways fuel is injected and ignited in diesel engines compared to gasoline engines. In gasoline engines, fuel injection takes place during the intake stroke and is then ignited with a spark. In diesel engines, the process is different. With diesel engines, the fuel is injected during the compression stroke and the fuel is ignited spontaneously from the pressure in diesel engines. The end result is that gasoline engines are much more efficient from an emissions standpoint since the ignition process is better controlled and the air and fuel are more thoroughly mixed allowing for a better and more efficient burn process. This significantly reduces the amount of unburned fuel. With diesel engines, fuel injection takes place later in the cycle which makes for a less efficient mixture of the fuel and air. This causes fuel dense pockets in the combustion chamber. The end result is that the diesel exhaust will contain far more unburned fuel than a gasoline engine and which means more soot production than in their gasoline counterparts.

Newer EGR (exhaust gas recirculation) diesel engines will run hotter and produce more soot and acids than previous models of diesel engines. Most engine builders have decided that cooled EGR is the most effective way to reduce combustion temperatures. Small amounts of exhaust gas will be piped to the chambers to displace oxygen; less oxygen means cooler combustion. Before going to the cylinders, some of the exhaust gas heat will be absorbed by the engine's coolant, thus the term "cooled EGR." Federal rules now require diesel engines to produce about 50% less nitrous oxide, or NOx, than current diesels thus the reason for the newer EGR diesel motors. More heat, soot and acid will form during combustion in



## Soot

most of these new EGR diesels, say engineers.

Excessive soot formation in oil occurs from many different things: poor fuel spray patterns, worn out piston rings, clogged or dirty injectors, idling, as well as incorrect air to fuel mixtures. A faulty fuel nozzle may spray more fuel than desired, increasing the fuel-to-air ratio and causing incomplete combustion and soot accumulation, or the air filter may become clogged, decreasing air supply and increasing the fuel-air ratio.

Soot particulates in general are small in size and shape (less than .05 microns). For reference, diesel engine soot particles are about 1/30 the size of a human hair. The individual soot particles aren't much cause for concern because the majority leaves through exhaust but some will end up in the engine oil as it passes the cylinder rings. Once in the engine oil however, soot can cause engine damage as it accumulates into larger and larger particles that can cause wear on the internal engine parts like fine grains of sand. Engine motor oil does contain dispersants designed to reduce the likelihood of this happening but in conditions where soot is much higher (i.e. EGR engines or poor fuel mixtures) the dispersants just can't keep up with the soot build up.

High soot load conditions lead to loss of oil dispersancy as an oil's dispersant additives are consumed. As dispersancy is lost, soot particles accumulate and form larger particles that build up on engine surfaces. This build up of soot and sludge will eventually slow and impede oil flow. Soot and sludge buildup can also form on oil filters, which over times will block oil flow and allowing dirty oil back into the engine since the engine oil filter can't work when it is clogged or impeded. In addition, high soot levels within a motor oil increase its viscosity, further impeding oil flow and increasing engine wear. Anti-wear additive performance is also affected in high soot conditions as additives are gradually removed from the oil by adsorption to soot particles, leading to increased wear and premature engine failure.

When soot conditions are especially high, carbon particles can form on the piston ring grooves, causing degradation of the oil seal between the ring and cylinder line and abrading the ring and liner. As the gap between the ring and liner increases, combustion byproducts such as gases and unburned fuels blow into the crankcase, a problem known as blowby, eventually causing expanding gases to lose ability to push the piston down and generate the power necessary to propel the vehicle. Horsepower is lost and fuel efficiency decreases. Ring sticking and poor heat transfer from the piston to the cylinder wall can also result.



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## Environmental Concerns



Is the decision to extend oil drain intervals a maintenance issue only? No. Extended oil drain intervals are not strictly a maintenance concern. Environmental issues and costs are also pertinent.

What is the cost of disposing of used oil? The cost of used oil disposal with less than 5% water may be 5 to 10 cents per gallon. If it contains more than 5% water, then the cost can rise to 10 to 25 cents per gallon. This is 25% of its original value when new. Projected estimates suggest that the disposal cost of non contaminated used oil, could equate to the value of new oil within the next 5 years.

## Friend of the Environment

The Kleenoil bypass filtration system is a major friend of the environment. It naturally encourages the conservation of our earth's resources. With the current and impending laws on the use and disposal of oil, Kleenoil offers a way to protect not only the environment, but also the user. This is particularly true for unnecessary consumption and disposal costs.

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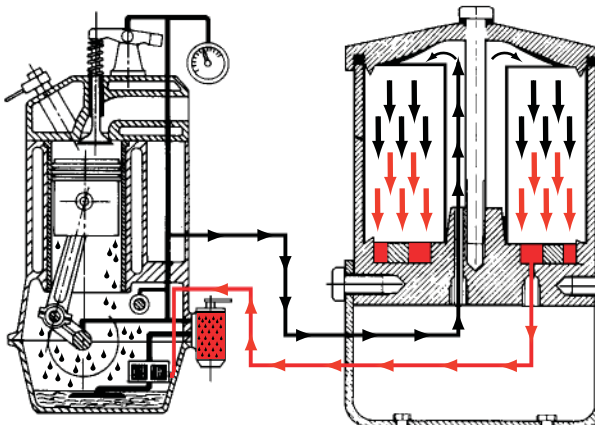
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# The Kleenoil Filtration Unit

Kleenoil Filter Unit Blueprint



Tech Data

- Remote Mounted Unit for easy servicing
- Maximum pressure rating of Unit 10 Bar
- Lid torque pressure 23lb/ft / 4Kg/cm<sup>2</sup>

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



<b>Specifications Table:</b>	
<b>Pressures:</b>	<b>Maximum rating of 10 Bar. Lid torque is 23 ft/lbs.</b>
<b>Oil Flow Rate:</b>	<b>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)</b>
<b>Operating Temperatures:</b>	<b>Within operating specifications of engine, gear and hydraulic oils.</b>
<b>Filtration Level:</b>	<b>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.</b>
<b>Castings:</b>	<b>Constructed of aluminum to BS 1490 (M) Subjected to batch and individual testing.</b>
<b>In accordance with our policy of continuous product improvements, we reserve the right to alter technical specifications without prior notice.</b>	





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# The Kleenoil Filtration Unit

Page 2 of 2



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.



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## The Kleenoil Filter Cartridge

Page 1 of 3



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.

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## The Kleenoil Filter Cartridge

Page 2 of 3

Continued:

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 fibres which form the tissue layer. The principle for filtering water is capillary absorption into the hollow vegetable fibre of the cellulose tissue. The molecular structure of the oil is too large to be absorbed by 'capillary action' into the fibres, however the water is absorbed into the fibre and separates from the oil.

The construction of the Kleenoil filter cartridge is cellulose tissue (paper), and we seek to always obtain a long fibre 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 fibre will have the ends crushed by the pressure of flow and a small portion of water will be permanently retained in each fibre. Water retention is approximately 1 quart per pound of tissue.

Most papers are made with a large amount of repulped material, and as a general rule the fibre 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 fibres will not have the tensile strength to permit the tension without breaking.



# The Kleenoil Filter Cartridge

Continued:

To conclude, the cellulose tissue used to manufacture a Kleenoil cartridge must be from 'virgin coniferous' or other long fibre 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.

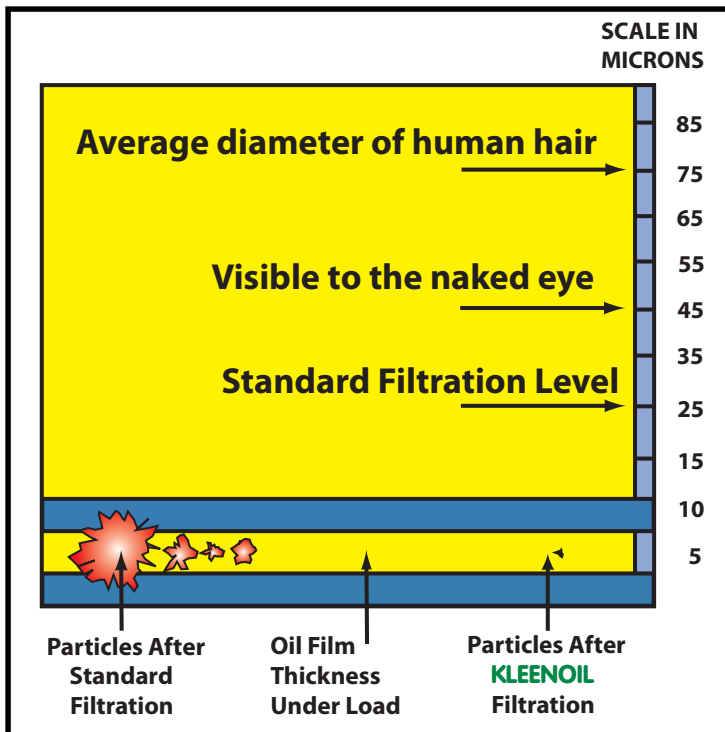
Important Note: While the filtration unit is extracting the water and the contaminant, it is continuously safeguarding the desirable elements compounded within the actual oil in use. These typically include, dispersants, detergents, oxidation and rust inhibitors, metal de-activators, pour-point depressants, 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.



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## 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.



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## 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
<b>Approximate New Oil</b>	<b>18/15</b>	<b>1300 - 2500</b>	<b>160 - 320</b>
	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
<b>Kleenoil USA</b>	<b>14/09</b>	<b>80 - 160</b>	<b>2.5 - 5</b>
<b>Bypass Filter</b>	<b>14/08</b>	<b>80 - 160</b>	<b>1.3 - 2.5</b>
<b>Range -----&gt;</b>	<b>13/10</b>	<b>40 - 80</b>	<b>5 - 10</b>
	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 less than 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 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 will be the internal damage inside your engine or hydraulic system.

To ensure that you achieve the most efficient and relative results, it is important to establish and maintain an oil analysis program.



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## Kleenoil Component Life Extention



The following 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 BY-PASS Filtration Systems.

Level of Cleanliness Code 4406 after running oil through Kleenoil USA Filter											
	21/18	20/17	19/16	18/15	17/14	16/13	15/12	14/11	13/10	12/9	11/8
Unfiltered Level of Cleanliness Code 4406	27/24	5	7	9	>10	>10	>10	>10	>10	>10	>10
	26/23	4	5	7	9	>10	>10	>10	>10	>10	>10
	25/22	3	4	5	7	9	>10	>10	>10	>10	>10
	24/21	2	3	4	6	7	9	>10	>10	>10	>10
	23/20	1.6	2	3	4	5	7	9	>10	>10	>10
	22/19	1.3	1.6	2	3	4	5	7	8	>10	>10
	21/18		1.3	1.6	2	3	4	5	7	9	>10
	20/17			1.3	1.6	2	3	4	5	7	9
	19/16				1.3	1.6	2	3	4	5	7
	18/15					1.3	1.6	2	3	4	5
	17/14						1.3	1.6	2	3	4
	16/13							1.3	1.6	2	3
	15/12								1.3	1.6	2
14/11									1.3	1.6	



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## Kleenoil Limited Lifetime Warranty



Kleenoil USA Inc. will warrant any Kleenoil Filtration Bowl for life. This includes incidental damage as a result of an accident, over-tightening of bolts, stripped threads, and any other physical damage or defect. Return the bowl to any US Distributor for replacement. The filtration bowl is insured by Colony Specialty Risks in Richmond, Virginia for damage to property that may specifically arise from any material defect in the Kleenoil Filtration Bowl. Internal or external Engine damage from any other cause is not covered. Material failure from improper installation, worn hoses, or operation of equipment without lubricants is not covered.

In the event that there is a suspected failure, an oil sample must be taken at the time of the incident and delivered to a Kleenoil representative at the corporate offices in Plano, Texas or Shreveport, Louisiana. Kleenoil shall have the right to examine maintenance records and oil sample reports for the previous three months. Kleenoil shall have the right to inspect the engine or equipment at any time that it is inspected by a Manufacturer's agent or mechanic, or at such time that the customer may disassemble the equipment for inspection. Reasonable notice to Kleenoil is required, to allow Kleenoil to have a representative present.

Extended drain intervals should always be monitored by regular oil testing to warrant the quality of the oil. Many factors, including fuel and water dilution can affect the quality of the oil not visible by visual inspection.

Kleenoil USA Inc. is committed to the cause of minimizing equipment wear and oil waste, by providing a product that is from renewable resources and fully recyclable.

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