

Product: EXCAVATOR  
Model: 311D LRR EXCAVATOR AKW  
Configuration: ISJ HEX COMMONALITY CHART AKW00001-UP (MACHINE)

## **Operation and Maintenance Manual Caterpillar Filters Recommendations**

Media Number -SEBU9208-00

Publication Date -01/11/2018

Date Updated -13/12/2013

## **Foreword**

SMCS - 7000

## **Fluids/Filters Recommendation**

### **Literature Information**

This manual should be stored in the literature holder or in the literature storage area on the machine. Immediately replace this manual if lost, damaged, or unreadable.

The information contained in this document is the most current information available for fluid maintenance and service products. Special maintenance and service products may be required for some machine compartments. Refer to the Operation and Maintenance Manual for your machine for the maintenance and service requirements. Read, study, and keep this manual with the product. This manual should be read carefully before using this product for the first time and before performing maintenance.

Whenever a question arises regarding your product, or this publication, consult your dealer for the latest available information.

### **Safety**

Refer to the Operation and Maintenance Manual for your machine for all safety information. Read and understand the basic safety precautions listed in the Safety Section. In addition to safety precautions, this section identifies the text and locations of warning signs used on the machine.

Read and understand the applicable precautions listed in the Maintenance and Operation Sections before operating or performing lubrication, maintenance, and repair on this machine.

### **Maintenance**

Refer to the Operation and Maintenance Manual for your machine to determine all maintenance requirements.

Proper maintenance and repair are essential to keep the equipment and systems operating correctly. As the owner, you are responsible for the performance of the required maintenance listed in the Owner Manual, Operation and Maintenance Manual, and Service Manual.

### **Maintenance Interval Schedule**

Use the Maintenance Interval Schedule in the Operation and Maintenance Manual for your machine to determine servicing intervals. Use the service hour meter to determine servicing intervals. Calendar intervals shown (daily, weekly, monthly, etc.) can be used instead of service hour meter intervals if calendar intervals provide more convenient servicing schedules and approximate the indicated service hour meter reading. Recommended service should always be performed at the interval that occurs first.

Under extremely severe, dusty, or wet operating conditions, more frequent lubrication and/or filter changes than is specified in the maintenance intervals chart might be necessary.

Following the recommended maintenance intervals reduces the risk of excessive wear and potential failures of components.

## **Aftermarket Products and Warranty**

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### **NOTICE**

**When auxiliary devices, accessories or consumables (filters, oil, additives, catalysts, fuel, etc.) made by other manufacturers are used on Cat products, the Caterpillar warranty is not affected simply because of such use. Failures that result from the installation or usage of other manufacturers auxiliary devices, accessories or consumables, however, are not Caterpillar factory defects and therefore are NOT covered by Caterpillar's warranty.**

**Caterpillar is not in a position to evaluate the many auxiliary devices, accessories or consumables promoted by other manufacturers and their effect on Cat products. Installation or use of such items is at the discretion of the customer who assumes ALL risks for the effects that result from this usage.**

**Furthermore, Caterpillar does not authorize the use of its trade name, trademark, or logo in a manner which implies our endorsement of these aftermarket products.**

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## **General Filter Information**

SMCS - 1054; 108K; 1261; 1263; 1308; 5068; 7342

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### **NOTICE**

**Every attempt is made to provide accurate, up-to-date information. By the use of this document, you agree that Caterpillar Inc. is not responsible for errors or omissions.**

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The information that is provided is the latest recommendations for Cat machines and diesel engines. This information supersedes all previous published recommendations related to filters.

Specific filters, for example High Efficiency or Ultra High Efficiency, may be required for certain applications and use of these special products will be continue to be necessary. Refer to the applicable Operation and Maintenance Manual.

This publication is a supplement to the Operation and Maintenance Manual. This publication does not replace the engine-specific Operation and Maintenance Manual.

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### **NOTICE**

**In order to avoid potential damage to your Cat machine and/or Cat engine, only purchase Cat filters and Cat fluids through your Cat dealer or Cat authorized outlets. For a list of authorized Cat parts outlets in your area, consult your Cat dealer.**

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**If you purchase what appear to be Cat filters and/or Cat fluids through other outlets or sources, you are at a very high risk of purchasing counterfeit products.**

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Counterfeit or "look-alike" products may visually appear the same as the original Cat product, but the product performance and internal quality will typically be very low.

Counterfeit or "look-alike" products have a very high likelihood of causing and/or allowing engine and/or machine compartment damage.

Many of the guidelines, recommendations, and requirements that are provided in this Special Publication are interrelated. Before using the provided information, the user of this Special Publication is responsible for reading and understanding the information provided.

The user of this Special Publication is responsible for following all safety guidelines found in this Special Publication and in the engine and/or machine-specific Operation and Maintenance Manual when performing all recommended and/or required engine, engine systems, and/or machine maintenance.

For questions concerning the information presented in this Special Publication and/or in your product Operation and Maintenance Manual, and/or for additional guidelines and recommendations (including maintenance interval recommendations/requirements) consult your Cat dealer.

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## NOTICE

**Commercial products that make generic claims of meeting "Cat" requirements without listing the specific Cat recommendations and requirements that are met may not provide acceptable performance. Commercial products may cause reduced engine and/or machine fluid compartment life. Refer to this Special Publication and refer to product specific Operation and Maintenance Manual for Cat filter recommendations and requirements.**

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## NOTICE

**Heavy loads and cycles, working in dusty environment, filling machine compartments with contaminated fluids, and poor system cleanliness are some of the contributors to shorter filter life. Filter maintenance intervals may be shorter under these conditions.**

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Refer to the appropriate Operation and Maintenance Manual for guidance.

Early filter plugging or even filter collapse may occur when operating in dusty environment, operating in heavily contaminated environments, operating at heavy loads and cycles, using fluids that are not clean and/or poorly maintaining systems cleanliness. If the plugged filters are not changed, component or engine damage may occur. The plugged filters cause restriction of the fluid flow and shutdown in some cases. Plugged filters cannot protect the engine or machine compartment from contamination. This contamination can cause a number of issues including an increase in component wear and damage, filter collapse, short component life, component down

time, increased cost, and other damage. If the filters are not changed at the first signs of bypass, or if the pressure indicator or other indicators are ignored, the potential for damage increases. Follow the filter service recommendations provided in this Special Publication and/or given in your engine Operation and Maintenance Manual.

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## NOTICE

**Use of filters that do not meet at least the minimum performance recommendations and/or requirements may lead to lower component performance and/or component failure. Problems/failures that are caused by using improper filters or filters that do not meet the minimum recommended and/or required performance level for the components are not warrantable by Caterpillar, and are the filter manufacturer and customer responsibility.**

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When filters made by other manufacturers are used on Cat products, the Caterpillar warranty is not affected simply because of such use. Failures that result from the installation or usage of other manufacturer filters, however, are not Caterpillar factory defects and therefore are NOT covered by the Caterpillar warranty. Caterpillar is not in a position to evaluate the many filters promoted by other manufacturers and the filter performance in Cat products. Installation or use of such items is at the discretion of the customer who assumes ALL risks for the effects that result from this usage.

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## NOTICE

**Not following the recommendations found in this Special Publication can lead to reduced performance and compartment failure.**

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## NOTICE

**When installing a new fluid filter, never add the used fluid into the new filter to help the engine or the machine compartment start. The dirty fluid is added at the clean side of the filter and will contaminate the engine or machine compartment with dirty fluid. Follow all the instructions for filter installation that are printed on the filter can or as described in your Operation and Maintenance Manual.**

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The overall performance of engine and machine compartments is dependent on the choice of lubricants and on maintenance and cleanliness practices such as choice of filtration products, contamination control, tank management, and general handling practices. Filtration products and lubricants that are produced by Caterpillar offer optimal performance and system protection.

This Special Publication covers the filtration products used on Cat products and offers general information on filtration products. This information is offered to assist customers in the selection and understanding of filtration products that are used on Cat machines and engines.

### **Cat Fluid Filters**

- Engine oil filters
- Hydraulic oil filters
- Powertrain oil filters
- Fuel filters
- Fuel water separators
- Breathers
- Priming pumps
- Diesel exhaust fluid filters
- Off board filters
- Bulk fuel filters
- Coolant filters

### **Cat Air Filters**

- Engine air filters
- Cab air filters

### **Cat Natural Gas Engine Filters**

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### **Cat Filters**

**SMCS - 1054; 108K; 1261; 1263; 1308; 5068; 7342**

Cat filters are designed and built by Caterpillar to offer optimum performance in Cat equipment and engines. Cat filters are manufactured worldwide to the same precise Caterpillar specifications. As a result, Cat filters are of common quality and design and offer the same performance worldwide.

Cat filters are extensively tested and validated to ensure the optimal performance in Cat machines and engines. Cat filters are optimized for Cat equipment.

Caterpillar designs and builds filters to service all the filtration needs of Cat complete machine and engine product lines. Cat filters have been designed and constructed of high-quality materials in order to keep machine compartment and engines at the desired level of cleanliness. These filters allow the machine compartments and engines to function per the quality designed into these components. Cat filters are used as factory fit and for product service.

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### General Information (Fluid Filters)

SMCS - 108K; 1261; 1263; 1308; 5068

Fluid filters, also called liquid filters, are responsible for continuously cleaning the fluids (also referred to as lubricants) in an engine or machine compartments by removing, or filtering out, particulate contamination from these fluids. When the recommended filters are used and the recommended maintenance intervals are followed, the particulate contamination in the fluid is reduced resulting in the following:

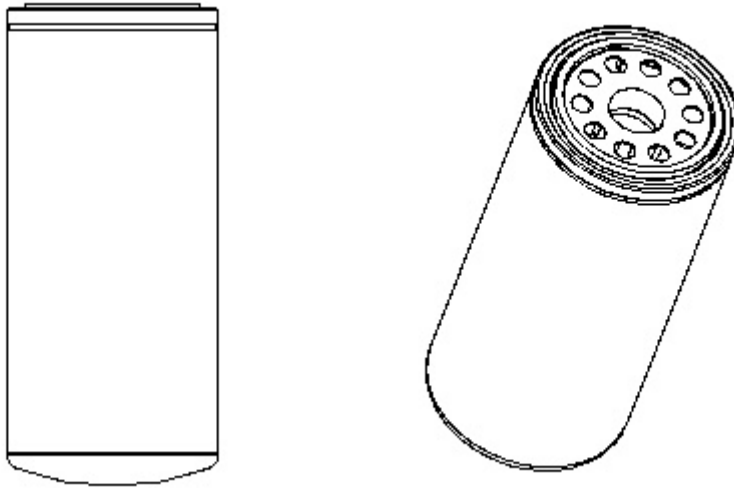
- Reduced component wear
- Protection of moving components and low interference with clearances
- Lower engine or machine downtime
- Enhanced performance
- Preservation of the reliability and life built into the engines or machine components

This section in this Special Publication provides a description of the construction and components of fluid filters and the measurement of the performance of filters.

Fluid filters available in the marketplace vary significantly in quality and performance. Knowing the quality of filters from visual observation is not possible. Cat filters are of high quality and hence offer improved value and protection for the machine. The initial cost of a high-quality filter is expected to be higher than a poor quality filter due to the amount of media, quality of media and overall construction of the filter. The overall value of the filter includes initial cost of the filter, value of equipment protection, reduction of downtime of equipment, and extension of equipment life. As a result, the lifecycle value of high-quality filters outweighs the initial difference in cost.

Cat offers two distinct types of fluid filters:

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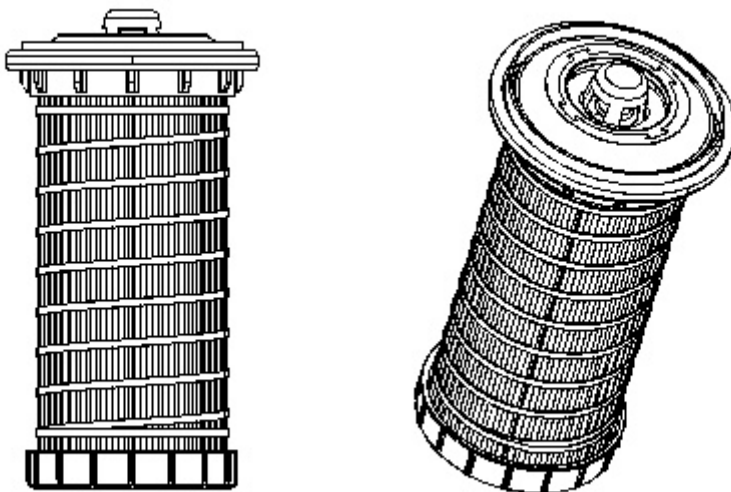
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Illustration 1

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Spin-on Filter

**Spin-on Filters** - A single filter part that is used once by spinning onto the filter base. The entire filter is disposed of at the end of the filter life. Spin-on filters are common and simple to maintain. In general, small Cat engines use spin-on fuel and lube filters. Some new small engines have moved to cartridge filter designs.



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Illustration 2

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Cartridge Filter

**Cartridge Filters** - Cartridge filters are composed of separate filter elements and housing unit. The housing is retained and used for the life of the vehicle and the filter element cartridge is changed at the end of each filter service life. Cartridge filters eliminate waste since only the filter element is disposed of and the metallic housing is retained and reused during filter maintenance. In general, large Cat engines use cartridge filters for fuel and lube applications.

Details are provided in this Special Publication, "Fluid Filters Components".

Caterpillar offers a variety of fluid filters for applications in all Cat machines and engines. This Special Publication provides guidelines for using the filters. This Special Publication also details the design and quality built into the various Cat filters.

Cat fluid filters are designed with optimized capacity and rating for Cat equipment. Cat offers fluids filters of three efficiency levels:

1. Standard Efficiency
2. Advanced High Efficiency
3. Ultra High Efficiency

Detailed information on the capacity and rating of the various fluid filters offered by Cat is given in this Special Publication, "Filter Capacity".

**Note:** Substituting a higher-efficiency filter than recommended is typically safe. Substituting a lower efficiency filter than recommended is not acceptable.

Caterpillar has introduced a "Plus" (+) designation for some filters. The "Plus" designation indicates an improved performance characteristic. Any of the three efficiency filter levels can also be designated as "Plus" if the filter has an improved characteristic. For example, a "Plus" Advanced Efficiency filter may have an improved characteristic such as better capacity or better flow restriction.

In order to choose the appropriate filter size, efficiency and capacity, refer to your machine or engine Operation and Maintenance Manual and consult your local Cat dealer.

Consult your Cat dealer for availability of Cat filters.

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## Fluid Filter Components

SMCS - 1261; 1308; 5068

Fluid filters are constructed of many components. The quality of each component is important to the overall quality of the finished filter.

The main components of fluid filters are:

## Filter Housing

Fluid filter housings, also called cans, are typically of metallic construction. Cat filter housings are high quality metallic one piece design. The filter housings are of optimal material thickness in order to withstand the pressure of fluid flow. Cat filter housings provide structural strength and anti rupture protection. Cat filter housings are constructed with precision threading to prevent leaks and to prevent unthreading due to vehicle vibrations and operation. The housings precisely fit onto the filter base to prevent leaks and ingress of contamination. Instructions on the assembly of the filter are printed on the filter housing. The housing may or may not be reused depending on the filter design

- The housing of a spin-on type filter contains the filter element as an integral part. This unit of housing and element are changed at every maintenance interval. Spin-on filter housings may display the filter part number and identification as well as critical assembly information in order to ensure proper maintenance practices.
- The housing of a cartridge type filter is separate from the filter element. At maintenance intervals, only the filter element is changed and the housing is reassembled on the machine with the new filter element.

Details of these two types of filters are discussed later in this Special Publication.

## Filter Media

The media is responsible for capturing contaminants in the fluid. Filter media can be made of natural material such as cellulose, synthetic material such as glass fibers, or of a combination of natural and synthetic material. Media material can also be filled or impregnated with custom

materials such as glass or resins to enhance strength and durability. Cat filter media is high-quality media and can be multiple layers with varying efficiencies for each layer, or one layer that is thick for increased depth filtration.

Cat filter media is of high quality. The media of Cat filters is of optimized thickness and area to withstand the fluid pressures and flows designed into Cat engines and compartments. The media material quality and construction allows the filter to resist flow spikes, cold start pressures, and extreme temperatures of the fluid. Cat filter media does not shed materials that add undesirable contamination into the fluid. The total area of the filter media is designed to capture the appropriate level of contamination for the designed life of the filter with specified system cleanliness. A note of importance is that the pores in the filter media are not uniform in size or in shape. As a result filters can be designed so that particles of various shapes and sizes can be captured or allowed to pass through the filter if desired.

Filter media is typically pleated to add surface area for effective filtration and service life. Pleating quality and density of the filter media is essential to the durability, structural integrity, and ability to remove contamination. The pleats should be equally spaced and densely constructed. The pleats in Cat filters are stabilized to eliminate bunching, to preserve the pleats spacing and to hold contaminants even under engine or machine vibrations.

In many Cat filters the media is stabilized with spiral roving that is wrapped and secured to the media with non-shedding long lasting adhesive. Acrylic beads are also applied to the media of many Cat filters. Roving and acrylic beads maintain pleat stability and spacing to eliminate bunching, prevent potential tearing of the media, and to hold contaminants even under engine or vehicle vibrations.

Quality media and roving allow for optimal filter efficiency and capacity, longer filter life, and better protection of engine or machine compartments.

## **Filter Inner Support**

The construction of the filter inner support, also called a center tube, including thickness and strength, is essential to the stability of the filter media and the overall quality of the filter. Center tubes can be metallic or non-metallic. Most Cat filters use a non-metallic inner support that provides strength without contributing contamination such as metallic burrs or corrosion products typically associated with metal center tubes. The strength of Cat center tubes prevent collapsing during pressure spikes and cold oil starts.

## **End Caps**

End caps are the enclosures that connect the media and center tubes and eliminate the gaps. Cat end caps are high quality and are typically one piece that is constructed of metallic, non-metallic or a combination material. Tight bonding of the end caps with the media keeps out contamination, eliminates leak paths, and contributes to the overall quality of the filter. The end caps used in Cat filters are precisely designed to fit the filter bases used on Cat engines and machines.

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## Particle Removal in Fluid Filters

SMCS - 1261; 1308; 5068

Fluid filter media can be of multiple layers of microscopic fibers. The media has to be continuous in order to prevent particles and contaminants from passing through. At the same time, the media has "holes" that allow the fluid to pass through. The size and shape of the holes in the media vary significantly. Additionally, the flow rate of the fluids passing through the filter media vary significantly depending on the loads and speeds of the machine or engine, and on the temperature at the start of the machine and engine. As the flow rate through the media changes, the holes in the media change shape, and the path through the media changes and may be compressed to become shorter.

Media quality, thickness, and fluid flow rate determine the size and number of particles trapped in the filter and number of particles that may be released into the fluid. The ratio of number of particles captured in the filter media to number of particles that pass through the media determines the efficiency of the filter.

Table 1

$$\text{Filter Efficiency \%} = \frac{\text{Number of Particles Captured}}{\text{Number of Particles Entering}} \times 100$$

**Note:** Early plugging of a filter does not indicate a "bad quality" filter. Early plugging can indicate higher than usual debris in the fluid. Early plugging indicates that the filter is performing as designed and capturing contaminants. Early plugging may occur in early hours of operation. If early plugging occurs inspect the system for potential causes.

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### NOTICE

**When installing a new fluid filter, never add the used fluid into the new filter to help the engine or the machine compartment start. The dirty fluid is added at the clean side of the filter and will contaminate the engine or machine compartment with dirty fluid. Follow all the**

**instructions for filter installation that are printed on the filter can or as described in your Operation and Maintenance Manual.**

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### Filter Performance

SMCS - 1261; 1308; 5068

Filter performance is indicated by the filter rating and the filter capacity. Cat high-quality filters are designed with the capacity and ratings that are suitable for the engine or compartment designs.

### Filter Rating

Filter rating is a measure of filter efficiency of removing and retaining particles of a certain size. Two factors must be specified when describing filter rating:

**Particle Size** - Particle size is measured in microns ( $\mu\text{m}$ ). This measurement is also called micron rating.

**Efficiency** - Efficiency is the number of particles of specific size or larger (also called rated size) that are captured in the filter, versus the number of the rated particles that passed through the filter. This measurement is also expressed as beta ratio.

Filters must be identified by the micron rating and the beta ratio. For example, if a filter is rated at 5 microns, the number of particles that can be trapped by the filter is not indicated. When a filter is rated at 5 microns and a beta of 200, this rating implies that of 200 particles entering the filter only one particle of 5 microns or larger size passes through.

**Note:** Designating filters by micron rating only without designating the beta ratio is not acceptable. The combination of micron and beta ratio provide a better description of the filter performance.

Table 1

| Example of Filter Beta Ratio |                      |                           |                                  |               |                |
|------------------------------|----------------------|---------------------------|----------------------------------|---------------|----------------|
| Filter Rating                | Particle Size        | Particles Entering Filter | Particles Passing Through Filter | Beta Ratio    | Representation |
| 5 $\mu\text{m}$              | $\geq 5 \mu\text{m}$ | 200                       | 1                                | $200/1 = 200$ | $B_5 = 200$    |

|       |         |     |   |             |                       |
|-------|---------|-----|---|-------------|-----------------------|
| 5 µm  | ≥ 5 µm  | 200 | 4 | 200/4 = 50  | B <sub>5</sub> = 50   |
| 10 µm | ≥ 10 µm | 200 | 1 | 200/1 = 200 | B <sub>10</sub> = 200 |
| 10 µm | ≥ 10µm  | 200 | 4 | 200/4 = 50  | B <sub>10</sub> = 50  |

## Absolute Rating

In addition to micron rating and beta ratio, Caterpillar rates filters with an "absolute" efficiency rating. The term absolute signifies a beta ratio of 75.

**Note:** All Cat fluid filters are rated at "absolute" (Beta 75) or higher efficiency. This rating implies that out of 75 particles in the fluid, the filter stops 74 particles of the specified size or larger.

The actual efficiency of a filter to trap particles is dependent on the particles passing through the filter. Efficiency of a Beta 75 filter is only slightly lower than the efficiency of a Beta 200 filter as demonstrated in Table 2 below.

Table 2

| Beta Ratio | Particles Entering Filter | Particles Passing Through Filter | Filter Efficiency |
|------------|---------------------------|----------------------------------|-------------------|
| Beta 75    | 75                        | 1                                | 98.67%            |
| Beta 200   | 200                       | 1                                | 99.5%             |

The equation to convert the Beta ratio of a filter to efficiency number is:

$$\% \text{ Efficiency} = 1 - (1 / \text{beta ratio})$$

## Filter Capacity

Filter capacity is a measure of the mass of contaminants that can be trapped by the filter media. Filter capacity is dependent on the media type and the amount of the media. Cat filters are high-quality filters and hence offer an optimized filter media area to trap contaminants expected to be generated in a specific compartment. Filter capacity is expressed in a plot of "Delta Pressure" across the filter versus the mass of contaminants in the fluid.

When filters reach capacity, the filters start to plug. Some filtration systems are designed with a warning signal to indicate to the operator that the filter is plugged. The warning signal operates by measuring the pressure difference across the filter. If the designated pressure is exceeded, the signal is triggered. Filtration systems that are not equipped with a warning signal are designed to be changed at specific service intervals. Refer to this Special Publication, "Filter Bypass". Refer to the Operation and Maintenance Manual of your machine or engine for the filter service interval.

Cat fluid filters are designed with optimized capacity and rating for Cat equipment. Cat offers fluids filters of three efficiency levels:

1. Standard Efficiency

2. Advanced High Efficiency

3. Ultra High Efficiency

Table 3 provides the typical micron rating categories for fluid filters offered by Caterpillar.

Table 3

| <b>Cat Fluid Filter Options</b> |                                  |                                  |                                 |
|---------------------------------|----------------------------------|----------------------------------|---------------------------------|
| <b>Filtration Type</b>          | <b>Standard Efficiency</b>       | <b>Advanced Efficiency</b>       | <b>Ultra High Efficiency</b>    |
| Engine Oil Filters              | 27 - 40 $\mu\text{m}$ (absolute) | 10 - 27 $\mu\text{m}$ (absolute) | 6 - 12 $\mu\text{m}$ (absolute) |
| Hydraulic Filters               | 27 - 40 $\mu\text{m}$ (absolute) | 10 - 27 $\mu\text{m}$ (absolute) | 5 - 10 $\mu\text{m}$ (absolute) |
| Powertrain Filters              | 27 - 40 $\mu\text{m}$ (absolute) | 10 - 27 $\mu\text{m}$ (absolute) | 5 - 10 $\mu\text{m}$ (absolute) |
| Fuel Filters                    | > 10 $\mu\text{m}$ (absolute)    | 5 - 10 $\mu\text{m}$ (absolute)  | < 4 $\mu\text{m}$               |
| Fuel/Water Separators           | > 20 $\mu\text{m}$ (absolute)    | 10 - 20 $\mu\text{m}$ (absolute) | 5 - 10 $\mu\text{m}$ (absolute) |

**Note:** Substituting a higher-efficiency filter than recommended is typically safe. Substituting a lower efficiency filter than recommended is not acceptable.

In order to choose the appropriate filter size, efficiency and capacity, refer to your machine or engine Operation and Maintenance Manual and consult your local Cat dealer.

## Filter Bypass

When a fluid filter is full of contaminants to the designed capacity, the filter is called plugged and dirty lubricant will bypass the filter. The dirty lubricant will flow through the system without cleaning, if the system is equipped with a bypass valve. If equipped, an alarm is triggered when the filter plugs. Bypass is designed into filter bases so that engines and machine compartments are not starved of lubricants. Lubricant starvation can cause catastrophic failures of engines or machine components. The damage done by limited flow of dirty fluids can outweigh the catastrophic failure of lubricant starvation.

Fuel filters are not designed with bypass capability due to the detrimental impact of dirty fuel and due to the low tolerance for contamination in fuel systems.

## Filter Testing and Validation

The quality built into Cat filters is tested using standard industry tests and additional tests devised by Caterpillar.

The following are tests conducted by Caterpillar to validate Cat filters:

- Filter efficiency and capacity are validated by a multipass test per "ISO 16889" standard. In this test a specific amount of standard-size dirt is passed through filters at specific a flow rate. Particle counters are used to measure particles into and out of the filter to determine the filter efficiency and the amount of debris the filter is subjected to before reaching pressure limits determines the capacity of the filter.
- The filter flow capability and resistance to pressure pulses is determined by the Flow Fatigue test. This test determines the maximum flow that a filter can support by exposing the filter to fluid flow pressures that surpass those pressures expected in the actual application. Passing the flow fatigue test ensures media integrity and resistance to pressure flow, pressure spikes, cold temperature fluids, and cold starts.
- Vibration resistance is tested using specially designed vibration test to simulate the worst conditions the filters can be exposed to during operation. This test ensures that the filters withstand the vibration expected on engines and machines. The knowledge Caterpillar has of the vibrations expected on machines allows the design of robust filters that can surpass the expected vibrations.
- Filter burst pressures are determined by the Burst Test. This test ensures that the filter can withstand pressures the filter will see in application and not rupture or leak fluid.
- The ability of the filter to withstand pressure delta across the media is determined by the Collapse Test. This test ensures that the filter will not rupture internally and allow debris that has been caught to pass through the filter due to a tear in media or inner tube collapse.

In order to choose the appropriate filter size, efficiency and capacity, refer to your machine or engine Operation and Maintenance Manual and consult your local Cat dealer.

Features of most of the Cat fluid filters include:

Table 4

| <b>Technology Features</b>   | <b>Benefits</b>   | <b>Results</b>  |
|--|---|---|
| One-piece aluminum base plate  | Added reinforcing to prevent ruptures due to cold starts  | Protects against leaks and the introduction of contaminants for longer component life               |
| One-piece urethane end caps  | Tighter bond with filter media  | Eliminates gaps, keeping contaminants out of components for added protection, eliminates leak paths |
| Spiral roving and acrylic beads  | Maintains pleat stability and spacing to eliminate bunching and holds dirt under vibration conditions | Maximum efficiency and capacity, better protection, and longer component life                       |
| Non-metallic center tube to prevent collapsing during pressure spikes and cold oil start-ups | Stronger and cleaner than metal designs   | Eliminates scored bearings and damage to other critical components                                  |
| Resin-impregnated filter media   | Custom blended media  | Maximizes performance and life  |

|                                 |   |   |
|---------------------------------|---|---|
| One-piece, heavy gauge canister | Provides structural strength and anti-rupture protection  | Durability and structural integrity             |
| Full range of media options     | Engineered to meet specific operating conditions, equipment requirements, and economical considerations | Filtration matched system and performance needs |

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### **Engine Oil Filters**

#### **SMCS - 1308**

Engine oils acquire a significant amount of wear metals from moving parts of the engine and soot from the combustion process. Most Cat engine oil filters are designed of robust construction, high-quality filter media, roving to ensure filter media stability, and capacity that allows the filter to operate for the designed service life. Refer to your Operation and Maintenance Manual for the service life of the engine oil filter.

Cat engine oil filters are available in Standard, Advanced, and Ultra High efficiency filtration. In order to choose the appropriate filter for your machine, refer to your Operation and Maintenance Manual and consult your Cat dealer for the availability of filters.

Particle count of engine oils to determine cleanliness is not recommended. Additives in engine oils and soot (after use) interfere with particle counting. Filtering of the oil is recommended that is filled into the engine through Advanced or Ultra High Efficiency filter to ensure cleanliness of the oil.

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Product: EXCAVATOR  
Model: 311D LRR EXCAVATOR AKW  
Configuration: ISJ HEX COMMONALITY CHART AKW00001-UP (MACHINE)

## Operation and Maintenance Manual Caterpillar Filters Recommendations

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## Hydraulic Oil Filters

### SMCS - 5068

Hydraulic oils acquire wear metals and contaminants from hydraulic cylinders, motor seals, and hydraulic hoses. Dirt can also enter the hydraulic system through vent filters in vented systems and through seals of the hydraulic cylinders. Cleanliness of hydraulic oils is critical for the operation of hydraulic system, in particular the operation of hydraulic valves that are typically of very tight tolerances. Cleanliness of the hydraulic oils is especially important to modern hydraulic systems. These systems are built with close tolerances and precise designs that require low level of contamination and appropriate filter performance. Follow the recommendations in the Operation and Maintenance Manual of your machine.

Cat hydraulic filters are available in Standard, Advanced, and Ultra High efficiency. Fire resistant hydraulic filters of Ultra High Efficiency are also available.

Particle count of hydraulic oils to determine cleanliness is recommended. Filtering of the oil that is filled into the hydraulic system is recommended to achieve a cleanliness level of the oil of "ISO 16/13". Refer to this Special Publication, "Contamination Control" for details on the contamination requirements and ISO code information.

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