



Copper Concentrator

Reliability Enhancement Guide

- **Reduce Wear**
- **Increase Reliability**
- **Extend Equipment Life**
- **Lower Maintenance Costs**

FILTERMAG®

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SLFMCOG-050815

FilterMag Visual Results—Implementation on Ball Mill Trunnion Gear Lubrication System

Two sets of XT4s were installed in two staggered rings. All incoming oil “sees” a magnetic field in every filtration pass and has enough time to be caught and held against the inside wall of the canister.

Oil changes in transmissions and gear systems can leave behind 30-40% of particulate contamination. It usually becomes trapped on horizontal surfaces and in nooks and crannies. Over time this can become a serious problem. These pictures are typical.

FilterMag removes this contamination in a two stages:

Stage 1: As new oil is introduced, lingering and built-up contaminants re-enter the lubrication oil. The new oil is immediately compromised. FilterMag quickly captures this material as it passes through its strong magnetic fields.

Stage 2: Simultaneously with Stage 1, FilterMag captures new contaminants as they are generated. Over time the captured particle yield will be reduced to a maintenance level consisting of newly generated contamination. This will appear as outlines of FilterMag’s shielded magnetic structure on the inside of the filter canister as seen in the adjacent photo.

The normal wear photo shows hundreds of millions of particles. Really? See the Cashman Equipment Study on page 12 for an explanation.

Success of the clean-up will be visually obvious for the personnel regularly changing the filter cartridges.

Stage 1 Example: The collected debris that passed through the filter has been captured. The patterns of debris are in the dimension and spacing of the directed magnetic flux reaching into the filter housing. All of the materials in these photos are actually agglomerations of very small particles which, individually, cannot be seen with the human eye (visual limit of eye is 40µm).



Four FilterMag XT4s we installed on the cartridge filter of a trunnion gear oil system supporting a large ball mill.



Stage 2: Normal wear will show a light dusting of captured particles.



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Stage 1 Closeup—The Nature of Partical Stacking in a Magnetic Field

A close-up of the material shows particles building large streamer structures along the lines of magnetic flux propagation. Notice how they arc outward to the center of the oil filter. Each of these small structures furthers the magnetic flux into the oil flow enabling the collection of the particles that would have normally passed through the filter.

This amount of debris is atypical of a healthy system and is undergoing a FilterMag enabled clean-up. Once target cleanliness levels have been achieved, areas under the FilterMags will appear to be lightly dusted with captured debris (in the outline of the magnets). Once a maintenance level is attained, changes to the contamination levels will be visually obvious to those performing filter changes.

Reduce Wear • Increase Reliability • Extend Equipment Life • Lower Maintenance Costs

Extend life and reliability between rebuilds. FilterMag removes contaminants which pass through traditional filtration—they are the primary cause of wear. Stop these and you dramatically cut equipment degradation and increase reliability. It can literally be seen with your own eyes and measured with ISO4406 oil analysis.

Mitigate damage from failures. Costs due to lost production, parts and labor can be substantially reduced if the failure is caught before it becomes catastrophic. When systems fail, FilterMag slows the effects of failure and reduces damage by quickly removing contamination from the oil. Rapid geometric buildup of contamination is slowed—and the resulting damage.

Measurable and Predictable. FilterMag's aggressive clean-up of vital lubrication adds predictably longer life and greater reliability. A secondary benefit is the addition of a very simple visual method of early failure detection.

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Ball Mill Trunion Bearing ML03

- Install four XT4s in two stacked rings near the canister flange on each of the four filters.
- Eight XT4s required.



Filter Panel for 500 Gallon ML03 Sump

- Install four XT4s in two stacked rings near the canister flange on each of the four filters.
- Eight XT4s required.



Ball Mill Trunion Bearing ML02

- Install four XT4s in two stacked rings near the canister flange on each of the four filters.
- Eight XT4s required.



Filter Panel for 500 Gallon ML02 Sump

- Install four XT4s in two stacked rings near the canister flange on each of the four filters.
- Eight XT4s required.





Ball Mill Pinion Lube ML02

- Install four XT4s in two stacked rings near the canister flange on each of the four filters.
- Eight XT4s required.



Ball Mill Pinion Lube ML03

- Install four XT4s in two stacked rings near the canister flange on each of the four filters.
- Eight XT4s required.



FilterMag XT Installation

All canister filters in the Ray Mine Concentrator application require four XT FilterMags of various sizes. Proper mounting technique to the canister is very important. Once the XT has magnetically engaged the canister housing, it becomes a permanent installation. The installation procedure must be done right the first time.

Mount four XT4s opposing each other as close to top of each canister flange as possible without interfering with its operation. Photo shows two stacked rings of XTs mounted close to the opening of the canister.

This location of the XTs near the top of the housing makes it easier to clean collected debris when the filter cartridge is replaced. Clean the inside of the housing by wiping the accumulated debris with a clean shop towel. Finally, simply insert a new cartridge and reconnect the canister.

SAG Mill Trunion Bearing Lube

This 1650 gallon reservoir has issues that clearly cannot be handled by its multiple and very substantial systems already in place. Obviously the environmental conditions have exceeded the design parameters. Bringing particulates into control and then maintaining their proper levels will require the refurbishment of all existing systems as well as the addition of three small and permanent panel mounted kidney loop systems.

The impact will be similar to adding booster rockets to an overloaded cargo plane struggling to take off. You'll be surprised at how quickly the system will clean up for a relatively small cost - compared to redesigning the entire system to deal with the current requirements.

Each panel addresses a single partition in the main tank. The filtration strategy employed is the same as described on the hydraulic case study on page 3. The particle filter removes those $\geq 25\mu\text{m}$ and allows a much higher high flow rate compared to a traditional $10\mu\text{m}$ filter. The FilterMags capture particles below $25\mu\text{m}$. This combination provide for a quick clean-up, but also captures the vast majority of particles before they "reproduce" themselves through the normal wear

process. This fundamentally breaks the wear cycle enhancing reliability and prolonging equipment life.

Install three supplemental filter Panels. Each tank partition will be served with one Filter Panel.

- Install four XT4s opposing each other as close to top of canister flange as possible without interfering with operation.
- 24 XT4s (eight XT4s per panel) required.



The SAG Mill's two 16" diameter canister filters.

SAG Mill Pinion Lube

- Install four XT7s in two stacked rings near the canister flange on each of the four filters.
- Eight XT7s required.



SAG Mill Transmission Gearbox

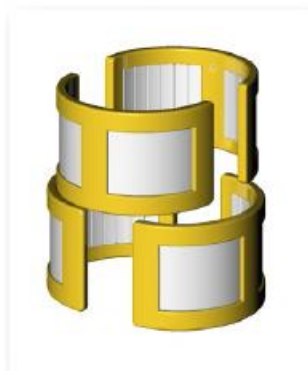
- Install four XT4s in two stacked rings near the canister flange on each of the four filters.
- Eight XT4s required





Hydraulic Conveyance Support System

- Install four CT3.2s in two stacked rings near the threaded end on each of the four filters.
- 12 CT3.2s required (for three systems).



Regrind Hydraulic System

- Install four XT8s in two stacked rings near the canister flange on each of the four filters.
- Eight XT8s required (for two systems).



CR2 Crusher Hydraulic System

- Install four XT4s in two stacked rings near the canister flange on each of the four filters.
- Eight XT4s required (for two systems).

8 • Application Summary

Applications	Filters Used, Qty.	Type/Dia. inches (mm)	Applicable FilterMag
Ball Mill			
Ball Mill Trunion Bearing ML03	Canister (2)	Cartridge, 4 (102)	XT4 (8 required)
Filter Panel for 500 Gallon ML03 Sump	Canister (2)	Cartridge, 4.5 (114)	XT4 (8 required)
Ball Mill Trunion Bearing ML02	Canister (2)	Cartridge, 4.5 (114)	XT4 (8 required)
Filter Panel for 500 Gallon ML02 Sump	Canister (2)	Cartridge, 4.5 (114)	XT4 (8 required)
Ball Mill Pinion Bearing ML02	Canister (2)	Cartridge, 4 (102)	XT4 (8 required)
Ball Mill Pinion Bearing ML03	Canister (2)	Cartridge, 4 (102)	XT4 (8 required)
SAG Mill			
SAG Mill Trunion Bearing	Canister (2)	Cartridge, 4.5 (114)	XT4 (8 required, 24 total)
SAG Mill Pinion Gear Bearing	Canister (2)	Cartridge, 7 (178)	XT7 (8 required)
SAG Mill Gearbox	Canister (2)	Cartridge, 4.5 (114)	XT4 (8 required)
Hydraulic Systems			
Crusher Hydraulic System	Canister (3)	Cartridge, 3 (76)	CT3.2 (4 required, 12 total)
Regrind Hydraulic System	Canister (1 per system)	Cartridge, 8.75 (222)	XT8 (4 required, 8 total)
Auxiliary Hydraulic System	Canister (1)	Cartridge, 4 (102)	XT4 (8 required)



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FilterMag CT Field Sizing and Placement Guide



Are they too large for the filter?

Although this looks like a good fit, it's not. This filter diameter is 4.3". CT4.9s require a minimum diameter of 4.4". That 0.1" in diameter difference prevents the FilterMags from making complete contact to the outside wall of the oil filter.

The best indicator of an incorrect fit is when two FilterMags are butting against each other.



Because the two CT4.9s are butting against each other, they create a diameter larger than the filter. This creates a gap between the FilterMags and the filter.

This 0.1" gap is very significant; it will severely limit the FilterMag's effectiveness, and reduce the magnetic bond securing the FilterMags to the filter.

Do the FilterMags appear to be too small for the filter?



FilterMag CTs and XTs are flexible over a range specified in the chart on page 13. Installing CT3.8s to this filter requires a slight push forcing the CT3.8s to flex and snap securely to the filter.

Push the FilterMag to cause it to flex and snap securely to the filter.



Proper installation will result in a space between two opposing FilterMags.

Proper Vertical Placement



FilterMags should be mounted approximately 1" below the threaded end of the oil filter. This ensures all oil flowing into the filter will be exposed to FilterMag's magnetic force as it enters the filter.

Incorrect Installation



All CT4.9s are installed at the bottom of each filter. Much of the oil entering and exiting the filter will have limited exposure to the magnetic filtration, greatly reducing efficacy.

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16-Cylinder Diesel Engine Case Study

FilterMag Captured Partide Determination

by Bruce Morton, Lab Manager, Ph.D. Chemistry,
Cashman Fluids Analysis, Reno, NV



An oil/solvent mix was prepared by using CAT DEO 15W40 and filtered kerosene in a 50/50 mix. After mixing well, and de-aeration in an ultrasonic bath, the solution was particle counted using a LaserNet Fines C instrument to establish a baseline.

A solution to wash the particles into a clean sample bottle was made from 50/50 15W40 CAT DEO and filtered kerosene. The particles were removed by pushing the particles into a 50-ml graduated cylinder with a Teflon spatula. A glass funnel was used to capture the particles. The walls of the filter canister were washed with the oil/solvent mix, as well as the sides of the funnel. The cylinder was brought up to a final volume of 50-ml that contained the particles and the oil/solvent mix. After mixing and deaeration, the sample was particle counted on the LaserNet Fines.

After particle counting, it was observed that there was a small amount of large particles that had settled on the bottom of the sample bottle. These particles were likely not counted in the analysis because of their size and rapid settling to the bottom of the container.

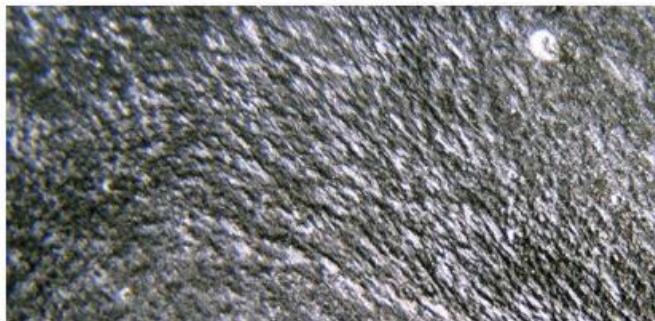
FilterMag Results:

Particle Size	4 μm	6 μm	14 μm	21 μm	38 μm	70 μm
Standard Test Solution	141	45	3	0	0	0
FilterMag Sample	672,735	165,535	6,891	1,476	117	5
FilterMag Sample	672,735	165,535	6,891	1,476	117	5
Less Oil/Solvent Mix	141	45	3	0	0	0
Net Average Particles	672,594	165,490	6,888	1,476	117	5
Net Average Particles	672,594	165,490	6,888	1,476	117	5
Less particles >21 μm	1598					
Total caught by CT4.9 in 1-ml of sample	670,996					
FilterMag Breaks the Wear Cycle						
Total caught in entire 50-ml of sample	33,549,800					
Number of oil filters:	4					
Total particles captured in 1 hour between 4 μ and 21 μm : 134,199,200						

FilterMag Breaks the Wear Cycle



Photo of particles caught by FilterMag on inside of filter canister.



45X microscopic photo of particles captured by FilterMag.

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CT for Spin-on Filters



Applications:

- Gas & Diesel Engines
- Rotating Equipment
- Hydraulic Systems
- Diesel Fuel Filtration
- For most spin-on filter applications

Order part # based on oil filter diameter

Pairs		Fits Spin-on Filter Diameters		Dimensions			
Part #	Qty.	Minimum	Maximum*	Height	Thickness	Arc (Max)	Weight
CT3.2PR	2-ea.	2.9 in (74 mm)	3.5 in (89 mm)	2.65 in (67 mm)	.34 in (8.6 mm)	360°	18 oz (.52 kg)
CT3.8PR	2-ea.	3.6 in (91 mm)	4.3 in (109 mm)	2.65 in (67 mm)	.35 in (8.9 mm)	360°	28 oz (.80 kg)
CT4.9PR	2-ea.	4.4 in (112 mm)	5.5 in (140 mm)	2.95 in (75 mm)	.36 in (9.1 mm)	360°	38 oz (1.08 kg)
Single Replacement—Special Order							
CT3.2	1-ea.	2.9 in (74 mm)	3.5 in (89 mm)	2.65 in (67 mm)	.34 in (8.6 mm)	180°	9 oz (.26 kg)
CT3.8	1-ea.	3.6 in (91 mm)	4.3 in (109 mm)	2.65 in (67 mm)	.35 in (8.9 mm)	180°	14 oz (.40 kg)
CT4.9	1-ea.	4.4 in (112 mm)	5.5 in (140 mm)	2.95 in (75 mm)	.36 in (9.1 mm)	180°	19 oz (.54 kg)

Operating Temperature Range: -40F to +302F (-40C to +150C) • Magnet Type: N42SH (High Temperature Nd-Fe-B alloy) with Ni-Cu-Ni plating

*Maximum size may be significantly less on Aluminum and Plastic Housings.

SNAP ON • SLIDE OFF • REUSE

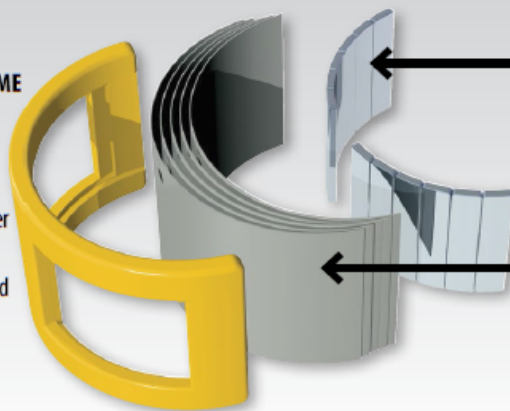


1. Install two or more FilterMags on each spin-on filter opposite each other near the threaded end.
Wear safety glasses.
2. Re-use FilterMags by sliding them off the old filter and snapping them on a new one when the filter is changed.
3. **Never attempt to pry off a FilterMag.**

FilterMag CT: Powerful—Focused—Magnetic Field Technology

1. RUGGED FLEXIBLE FRAME

encases and protects the elements of a FilterMag while providing enough flexibility to fit a range of filter diameters. Our proprietary design and materials are rated for temperatures from -40°F to +300°F.



2. POWERFUL, HEAT-RESISTANT NEODYMIUM ALLOY

MAGNETS are engineered to focus a magnetic field inside your filter. Specifically formulated to remain effective in the most extreme environments, our magnets are guaranteed to remove particles from oil operating at up to 300°F while most magnets start losing magnetism at 180°F.

3. PATENTED FLUXCON™ SHIELDING TECHNOLOGY stops magnetic flux which could damage electronic components. Not even a paper clip will stick to the outside of a FilterMag. Our FluxCon™ system also redirects a portion of that magnetic power back into the filter to increase filtration efficiency.

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XT[®] for Fixed Cartridge Filters



Applications:

- Rotating Equipment
- Hydraulic Systems
- Gas & Diesel Engines
- For most cartridge filters

Order part # based on outside diameter of filter housing

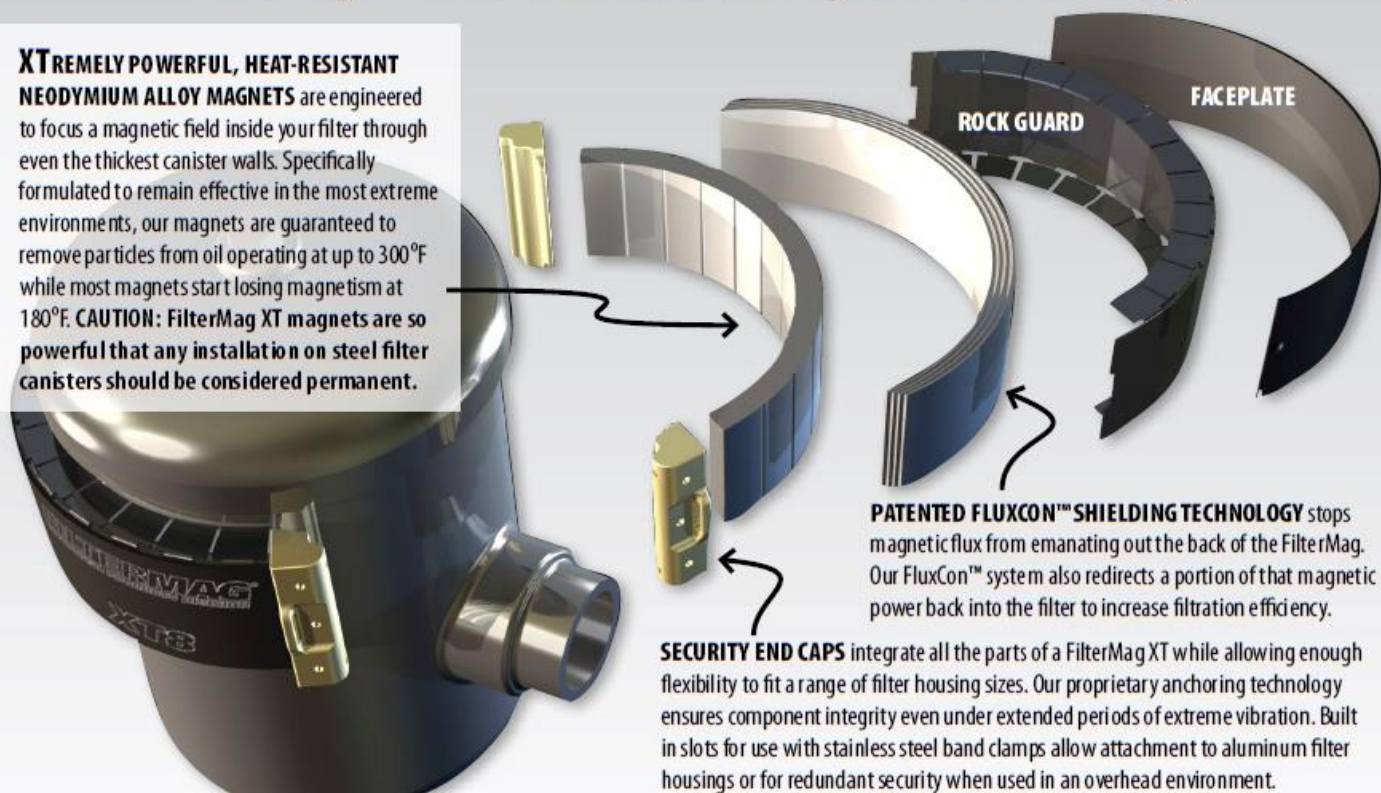
Pairs		Fits Outside Housing Diameters		Dimensions			
Part#	Qty.	Minimum	Maximum*	Height: Faceplate/Endcap	Thickness: Faceplate/Endcap	Arc (Max)	Weight
XT4PR	2-ea.	3.8 in (96 mm)	4.8 in (122 mm)	2.7" (68mm)/3.24" (82mm)	.9" (23mm)/1.4" (36mm)	330°	7.0 lb (3.2 kg)
XT5PR	2-ea.	4.8 in (122 mm)	5.8 in (147 mm)	2.7" (68mm)/3.24" (82mm)	.9" (23mm)/1.4" (36mm)	340°	9.0 lb (4.1 kg)
XT6PR	2-ea.	5.8 in (147 mm)	6.8 in (173 mm)	2.7" (68mm)/3.24" (82mm)	.9" (23mm)/1.4" (36mm)	344°	11.0 lb (5.0 kg)
XT7PR	2-ea.	6.8 in (173 mm)	7.8 in (198 mm)	2.7" (68mm)/3.24" (82mm)	.9" (23mm)/1.4" (36mm)	348°	13.0 lb (5.9 kg)
XT8PR	2-ea.	7.8 in (198 mm)	8.8 in (224 mm)	2.7" (68mm)/3.24" (82mm)	.9" (23mm)/1.4" (36mm)	350°	15.0 lb (6.8 kg)
Single Replacement—Special Order							
XT4	1-ea.	3.8 in (96 mm)	4.8 in (122 mm)	2.7" (68mm)/3.24" (82mm)	.9" (23mm)/1.4" (36mm)	165°	3.5 lb (1.6 kg.)
XT5	1-ea.	4.8 in (122 mm)	5.8 in (147 mm)	2.7" (68mm)/3.24" (82mm)	.9" (23mm)/1.4" (36mm)	170°	4.5 lb (3.0 kg.)
XT6	1-ea.	5.8 in (147 mm)	6.8 in (173 mm)	2.7" (68mm)/3.24" (82mm)	.9" (23mm)/1.4" (36mm)	172°	5.5 lb (3.5 kg.)
XT7	1-ea.	6.8 in (173 mm)	7.8 in (198 mm)	2.7" (68mm)/3.24" (82mm)	.9" (23mm)/1.4" (36mm)	174°	6.5 lb (2.9 kg.)
XT8	1-ea.	7.8 in (198 mm)	8.8 in (224 mm)	2.7" (68mm)/3.24" (82mm)	.9" (23mm)/1.4" (36mm)	175°	7.5 lb (3.4 kg.) [∞]

Operating Temperature Range: -40°F to +302°F (-40°C to +150°C) • Magnet Type: N42SH (High Temperature Nd-Fe-B alloy) with Ni-Cu-Ni plating

* Maximum size may be significantly less on Aluminum and Plastic Housings.

FilterMag XT: Powerful—Focused—Magnetic Field Technology

XTREMELY POWERFUL, HEAT-RESISTANT NEODYMIUM ALLOY MAGNETS are engineered to focus a magnetic field inside your filter through even the thickest canister walls. Specifically formulated to remain effective in the most extreme environments, our magnets are guaranteed to remove particles from oil operating at up to 300°F while most magnets start losing magnetism at 180°F. **CAUTION:** FilterMag XT magnets are so powerful that any installation on steel filter canisters should be considered permanent.



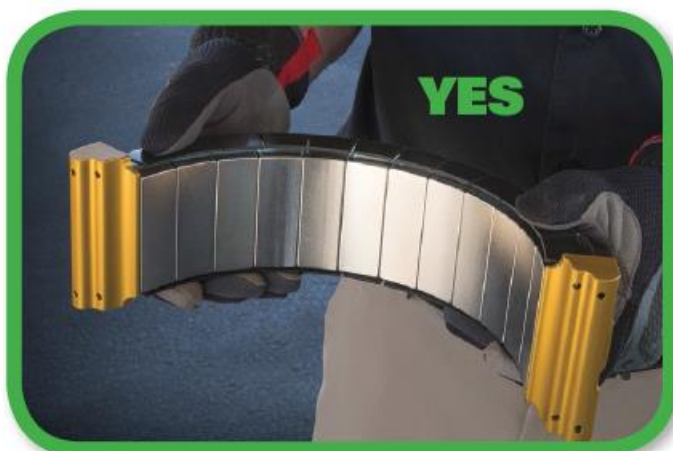
PATENTED FLUXCON™ SHIELDING TECHNOLOGY stops magnetic flux from emanating out the back of the FilterMag. Our FluxCon™ system also redirects a portion of that magnetic power back into the filter to increase filtration efficiency.

SECURITY END CAPS integrate all the parts of a FilterMag XT while allowing enough flexibility to fit a range of filter housing sizes. Our proprietary anchoring technology ensures component integrity even under extended periods of extreme vibration. Built in slots for use with stainless steel band clamps allow attachment to aluminum filter housings or for redundant security when used in an overhead environment.

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How to hold the XT during installation



Correct way to hold the XT during installation.



Don't let your fingers get between the magnets and the filter housing or serious injury could result.

1. The FilterMag XT Series is designed for **permanent installation** on cartridge



style oil filter housings with diameters from 3.8"–8.8" (96mm–224mm). **NEVER ATTEMPT TO PRY OFF A FILTERMAG WITH A SCREWDRIVER.**

2. Choose a location for installation near the open end of the oil filter housing. Installation location should be free of obstructions, debris and dirt.

WEAR SAFETY GLASSES.

3. Hold the XT by the edges as shown. Position the XT near the intended installation location. As you get close to the oil filter housing, the powerful magnets of the FilterMag will suddenly pull the XT onto the housing. **CAUTION! EXTREME MAGNETIC ENERGY! Objects, clothing, gloves, and fingers can become permanently trapped between the FilterMag XT and the oil filter housing during installation.**

4. **Aluminum Housings**—Use a band clamp through the slots on the XT's end caps to position and secure the XT to the housing.

5. **Clean Out**—When replacing the filter cartridge, reach inside the housing with a clean, lint free, damp cloth and wipe away the wear causing particles captured by the FilterMag XT.

FilterMag Limited Industrial Product Warranty

We warrant this FilterMag to be free from manufacturing defects for a period of five years from the date of purchase for CT or XT Series products or other FilterMag products specifically designated for use in industrial applications. All implied warranties are only valid for the same periods. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. At our discretion we will repair or replace, at no charge to you, any FilterMag found to

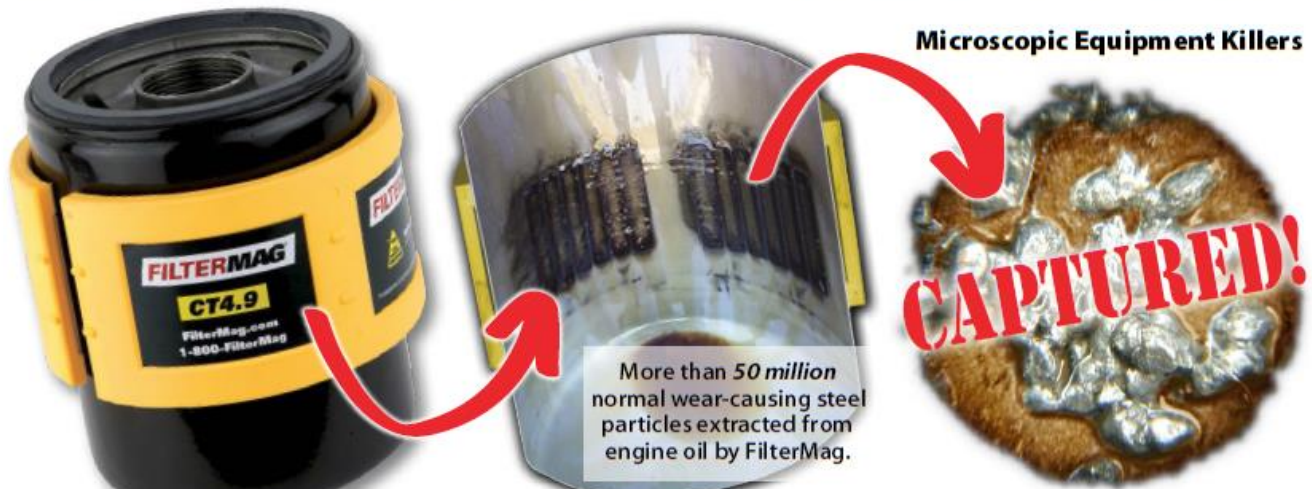
be defective in materials or workmanship within the specified coverage period. This warranty does not apply to damage from improper handling resulting in damage to the plating of magnetic surfaces. This warranty does not apply to damage resulting from accident, abnormal use, misuse, abuse, neglect, or failure to follow the manufacturer's instructions. We specifically disclaim all warranties whether implied or expressed when FilterMag industrial products are used in consumer

or personal use applications. We will not be liable for damages whether incidental, consequential or otherwise, resulting from a defective FilterMag. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from state to state. To file a warranty claim please contact us.

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MERLIN®

If Lubrication Were Perfect, Nothing Would Ever Wear Out.



Microscopic Equipment Killers

CAPTURED!

More than 50 million normal wear-causing steel particles extracted from engine oil by FilterMag.

FILTERMAG[®] RESULTS
Outside— Inside

Magnified view of damaging steel particles small enough to pass through any standard filter.
All captured by FilterMag.

Within the tight tolerances of today's equipment, normal wear generates tiny steel particles that remain suspended in your oil. These particles are so small they even pass through the most advanced oil filters. When the oil circulates back into the engine, these same particles are carried into every lubricated space. This particle laden oil will continue to lubricate, but it will also cause an exponential increase in wear while it circulates. The longer oil remains in the system, the greater the wear.

FilterMag extracts normal, wear causing, steel particles from your oil with its powerful, focused, magnetic field technology.

These particles are permanently trapped on the inside wall of the filter and are thrown away when you change the filter. Slide the FilterMag off the old filter; snap it onto a new one and it goes right back to work protecting your engine.

FilterMag's multi-patented technologies have been shown to reduce wear, increase reliability, lower maintenance costs, and extend equipment life by 30%, 60% or more.



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