



Managing Particle Contamination with Chevron ISOCLEAN® Certified Lubricants

It's the Small Stuff

Construction companies with new and older equipment in their fleets must make combating particle contamination of lubricating fluids a top priority—because it is the small stuff that stops equipment.

Particle contamination in lubricants is the No. 1 cause of lubricant-related equipment failure, according to industry experts at Noria Corporation. *Machinery Lubrication* magazine says particle contamination is the No. 1 cause of hydraulic system failures and estimates 82 percent of component wear is particle-induced, with abrasion wear accounting for two-thirds of that figure. Worse, particles in contaminated lubricants can stop equipment by damaging the individual components that keep equipment running. Money spent repairing the effects of particle contamination is money lost.

The solution? A new way to manage particle contamination that can maximize the life of equipment components, developed by Chevron Lubricants.

What is the Small Stuff?

Airborne particles. Dirt. Wear metal. Silicate. Paint. Water. Gunk. Common fluid handling procedures can introduce particle contamination into a contractor's storage facility and equipment. Even fresh fluid lubricants delivered are subject to contamination. Every time a lubricant is handled—when it is shipped from a lubricant manufacturing plant, trucked to a distributor's storage facility, pumped into the distributor's delivery tanker truck, transferred into the customer's storage tanks, or poured into the equipment's system—there is an opportunity for particles to creep into the oil.

Fluid contamination is measured by particle size and composition. As larger particles work through the equipment's systems, they can be crushed into smaller bits that can work into the machines' tight working clearances. One large particle can shatter into numerous smaller particles and increase the particle count. Depending on their composition, these smaller particles can have sharp edges that cause abrasion. And because the new particles expose surface areas previously hidden within the larger particle,

Chevron's ISOCLEAN Certified Lubricants are processed and certified before every delivery.



there is a larger cumulative surface area with which to make contact with surfaces. Particles are typically measured using a unit called a micron. One micron is one-millionth of a meter, or 25,400 microns in one inch. The human eye can typically only see particles larger than 40 microns. The particles in lubricants that typically cause the most damage are the clearance size particles in the two to 15 micron range.

As construction fleets replace older equipment with newer equipment, contamination control is even more vital. Hydraulic systems, transmissions, gearboxes, and engines on newer equipment are engineered with much tighter clearances to drive efficiencies. While clearance may be greater in older equipment, the same principles can apply in regards to wear created by particle contamination in lubricants.

Construction equipment requires precision component interaction and extremely small working clearances between moving metal parts, often ranging from zero to 6 microns. Operating conditions where metal-to-metal contact pressures sometimes exceed 20,000 psi and hot, dusty work environments put additional stress on components. While the number of contamination particles is important, the contaminating particle's makeup matters, too. For example:

- Dirt particles that generate multiple secondary particles can increase foam in lubricants and alter the oil's viscosity, causing the machine to run hot. Dirt particles can ambush lubricant additives and suppress the additive's efficiency.
- Metal particles cause contact friction and wear, creating more particles from other surfaces.
- Particle contamination can also affect the lubricant's ability to manage oxidation, which can result in varnish and sludge as well increase in viscosity reducing efficiencies.
- Particles of all kinds shorten the service life of lubricants, filters, and finely engineered components including hydraulic systems, transmissions, and gear drives.

The contamination cycle of abrasion, surface fatigue, and accumulating debris continues until the particles are either caught by a filter or flushed from the system. The longer the particles stay in the machine's system, the more damage they cause.

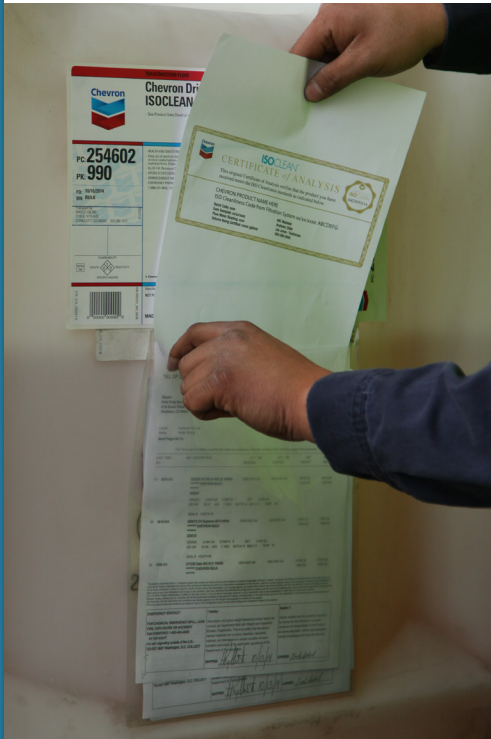
Lubricant Cleanliness

Lubricating oils are the lifeblood of construction equipment, and contaminated oils cost contractors downtime, parts, repairs and replacements, field service expenses, and their competitive business edge. Fluid particle contamination directly impacts the potential useful life of the machine and the contractor's capital investment.

Equipment conditions from particle contamination can include:

- Frequent hydraulic leaks and blown hoses. A hydraulic system that includes a lubricant with particle contamination is just like sandblasting the insides of hydraulic systems and hoses. This deteriorates the hoses and seals, leading to leaks and system failures.
- Uneven movement or loss of swing power on a hydraulic excavator can be attributed to particle contamination. Prior to failure, this erratic motion can result in loss of haulage and production. This could also lead to an increase in fuel consumption in relation to work ratio.
- If one track on a bulldozer moves slower than the other track, the cause may be particle contamination. Uneven track operation decreases production and creates a possible work hazard.
- Particle contamination in cranes and hydraulic man lifts can cause unstable operating movements, which can damage equipment and materials and increase the risk of accidents.

In support of managing lubricant cleanliness, the International Organization for Standardization (ISO) developed the standardized ISO Cleanliness Code 4406:99 that is the primary piece of reporting data



Every delivery of an ISOCLEAN Certified Lubricant includes a certificate of analysis on the ISO Cleanliness code.

used to measure fluid lubricant cleanliness. The code defines how contaminating particles are sized and counted. The Noria Corporation offers well-accepted charts that compare current contamination readings with potentially cleaner target readings, showing a potential increase in available useful service life for the machine by maintaining better fluid oil cleanliness. Here is an example:

A sand and gravel hauler using hydraulic systems on end dump trailers is replacing four pumps per year at a cost of \$2,400 each for parts and oil, labor, and lost revenue. By changing the ISO Cleanliness Code of the hydraulic fluid from 24/22/19 to 21/19/16, the hydraulic pump life doubles, saving the company \$9,600 each year.

Diesel engine and heavy equipment manufacturers also recognize that their machines need clean lubricants for peak performance and wear protection. OEMs include fluid cleanliness recommendations in their equipment manuals. However, not all end users are aware of their equipment's cleanliness specifications. Those that do may not have fleet support facilities to gauge their contamination levels. It is only after the user has done a fluid analysis that the contractor discovers the particle contamination in the oil.

For construction companies looking for a better way to manage particle contamination and ensure they are meeting equipment manufacturers requirements, it just became as easy as reading a label.

The Chevron ISOCLEAN Certified Lubricants Program

Over the past year, Chevron has taken significant steps to help its construction equipment customer's purchase and protect their company's productivity. This is important because OEMs estimate that expensive levels of particle contamination can cause a machine's efficiency to drop 20 percent. Lost productivity translates into higher operating costs and lighter bottom lines.

Chevron's new nationwide ISOCLEAN Certified Lubricants Program combines a new lubricant product line and an innovative *first-in-industry* fluid cleanliness certification program to help customers reduce particle contamination in new lubricants. Starting with a certified lubricant meeting the equipment manufacturer's fluid cleanliness requirements is the vital first step in maximizing equipment life. It doesn't make sense to add lubricant with high particle contamination to a clean system. Instead, adding certified lubricants like Chevron ISOCLEAN Certified Lubricants will, over time, help customers improve the fluid cleanliness in their current systems and maximize their equipment life.

Guaranteed and Certified

Chevron's ISOCLEAN Certified Lubricants Program starts with industry-leading formulated lubricants that are certified to meet the OEM's specified ISO cleanliness recommendations.

Chevron then certifies its lubricant's ISO Cleanliness at the customer's point of delivery. How? Before ISOCLEAN Certified Lubricants are delivered to customers, Chevron ISOCLEAN Certified Lubricant marketers process, test, and certify every batch that they sell—every batch—meets ISO cleanliness specifications.



Chevron's Certification Process

Jason Gerig, Chevron's Americas Marketing ISOCLEAN coordinator, explains the Chevron certification procedure: "Prior to our marketers becoming an ISOCLEAN Certified Lubricant Marketer, they go through an extensive training program to ensure they are compliant with the stringent handling and delivery methods required for the ISOCLEAN Certified Lubricants Program. ISOCLEAN Certified Lubricant Marketers have installed the computerized ISOCLEAN filtering system at their location. Prior to delivery, each product goes through a specific filtration processing procedure performed according to the required cleanliness specifications. Every batch of ISOCLEAN Certified Lubricant then goes through a rigorous testing process before it is certified. When the multiple test reports confirm the lubricant meets the required ISO Cleanliness Code, an ISOCLEAN certification of analysis backed by Chevron is attached before the ISOCLEAN Certified Lubricant is delivered."

Gerig sees a change coming in the industry on how typical products are handled and says Chevron's new program will drive the next generation of products and delivery. "This is truly a solution that is needed in the industry. It can be very difficult for contractors and fleet managers to develop their own filtration system without the technical knowledge of either the system or products. You can filter out additives in lubricants and this knowledge is typically not known by the end user," he says.

"More filtration is not always better and can harm the lubricants and cause catastrophic damage," Gerig adds. "We have seen many cases where results are not being achieved by either the system design or lack of product knowledge. Controlling contamination all starts with using a certified lubricant that meets equipment manufacturers' ISO Cleanliness specifications. At Chevron, we have the knowledge and capability to provide customers this solution at a much lower cost than they can typically do on site."

Chevron ISOCLEAN Certified Lubricant Marketers also work with customers to help them manage their particle contamination by using better handling methods. "We show our customers where contamination can occur during their daily routine. We pull samples from their current fluids and run tests on site, as well as lab tests that shows the particle count," Gerig says. The site assessment can vary depending on the size of the customer's operations.

"We also look at things like the breathers on the storage tanks, if they have a filtering system on their mobile service trucks, and how they are opening their tanks. We take the sample test data and the site assessment to create a report showing where the customer stands now and suggestions on how the contractor can improve their contamination management methods," Gerig says. "We like to do business reviews where we periodically pull samples from our customer's tanks and track the progress."

"Controlling contamination on site will only help maximize the benefits. However, just starting with a certified lubricant will give construction companies a head start even if contamination controls are not perfected on their end. Cleaner lubricants in a system are always better than using a lubricant with typical contamination."

Construction equipment fleet managers understand how important particle contamination management is to their companies. Chevron ISOCLEAN Certified Lubricants make contractors and fleet managers confident they are getting verified, consistently high-quality lubricants meeting their equipment manufacturers' fluid cleanliness specifications. ●

Understanding ISO Cleanliness Codes

The International Organization for Standardization (ISO) developed a cleanliness code to measure contamination levels per milliliter of fluid at three sizes: 4 microns, 6 microns and 14 microns. Each number represents a contaminant level code for the correlating particle size including all particles of the specified size and larger. It is written as XX/YY/ZZ where:

- XX = total number of particles > 4µm
- YY = total number of particles > 6µm
- ZZ = total number of particles > 14µm

In this example, the particles measured at the given micron levels are assigned a code based on where the value falls in the table. For this example, the ISO code would be 20/17/13.

	Particles/ml	ISO Code
>4 µ	9,721	20
>6 µ	1,254	17
>10 µ	326	
>14 µ	73	13
>21 µ	12	
>38 µ	5	
>70 µ	0	
>100 µ	0	

More than 9p/ml	Up to and including (p/ml)	ISO Code
80,000	160,000	24
40,000	80,000	23
20,000	40,000	22
10,000	20,000	21
5,000	10,000	20
2,500	5,000	19
1,300	2,500	18
640	1,300	17
320	640	16
160	320	15
80	160	14
40	80	13
20	40	12
10	20	11
5	10	10
2.5	5	9
1.3	2.5	8

Some programs or equipment guides may report under the old two-number system. In this case, simply drop the first number: */16/13.

The Noria Corporation publishes charts to calculate how much additional component life an owner can expect by taking steps to improve a machine's particle component score. Here is an example of the Noria Corporation's life extension chart for hydraulic systems and diesel engines:

HYDRAULIC SYSTEMS AND DIESEL ENGINES

		New Cleanliness Level										
		22/20/17	21/19/16	20/18/15	19/17/14	18/16/13	17/15/12	16/14/11	15/13/10	14/12/9	13/11/8	12/10
Current Machine Cleanliness	28/26/23	5	7	9	>10	>10	>10	>10	>10	>10	>10	>10
	27/25/22	4	5	7	9	>10	>10	>10	>10	>10	>10	>10
	26/24/21	3	4	6	7	9	>10	>10	>10	>10	>10	>10
	25/23/20	2	3	4	5	7	9	>10	>10	>10	>10	>10
	24/22/19	1.6	2	3	4	5	7	8	>10	>10	>10	>10
	23/21/18	1.3	1.5	2	3	4	5	7	9	>10	>10	>10
	22/20/17		1.3	1.6	2	3	4	5	7	9	>10	>10
	21/19/16			1.3	1.6	2	3	4	5	7	9	>10
	20/18/15				1.3	1.6	2	3	4	5	7	>10
	19/17/14					1.3	1.6	2	3	4	6	8
	18/16/13						1.3	1.6	2	3	4	6
	17/15/12							1.3	1.6	2	3	4
16/14/11								1.3	1.6	2	3	
15/13/10									1.4	1.8	2.5	

Source: Noria Corporation, Fundamentals of Machinery Lubrication, Noria Skills Training

By reaching and maintaining the example machine's new cleanliness target level of 17/15/12 from the current 20/18/15 level, Noria's chart indicates the component's life can last two times longer.

NOTE: Equipment manufacturers also produce estimated wear limit tables based on their research and testing, but because every contractor's application is different, these tables are useful as guidelines. In actual use, the type of equipment, task, environment, oil age, and operator skills affect real wear. Each piece of equipment should be assessed on its own terms.