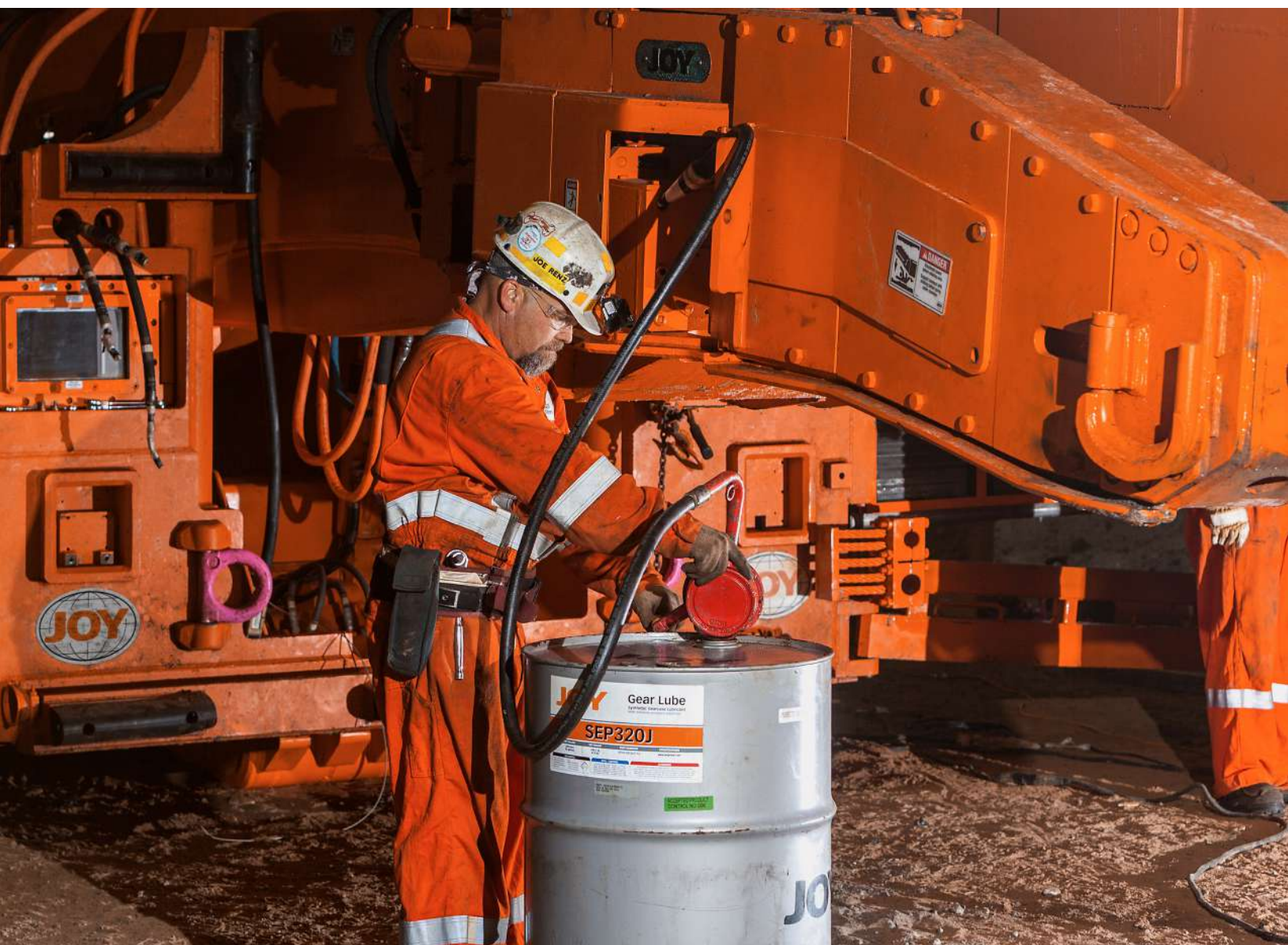


KOMATSU



JOY™ Fluids and Lubricants Analysis Program



Who we are:

Since 1921, Komatsu has stood for unrivaled quality and reliability. Our enduring global success stems from the principles of our founder, Meitaro Takeuchi, who envisioned a sustainable future built through globalization, quality first, technology innovation and talent development. These defining principles, along with an emphasis on safety and compliance, remain part of our Komatsu DNA. With each brand and company added to the Komatsu family, we expand our capabilities, leveraging our global teams to push beyond what can be done and create what can be imagined. We believe partnering directly with our stakeholders and being in the workplace (gemba) is the best way to gain insight into their challenges, win their trust and develop cutting-edge solutions.

What we do:

Komatsu is an indispensable partner to the mining, forestry, industrial and construction industries that maximizes value for customers through innovative solutions. With a full line of products supported by our advanced IoT technologies and global service network, we help customers safely and sustainably optimize their operations. Our **Komatsu, P&H, Joy** and **Montabert** equipment and services are used to extract fundamental minerals and develop modern infrastructure.

Why you sample

JOY™ Gear Lube, specifically selected by Komatsu Mining Corp. for its compatibility with Komatsu’s underground mining systems and equipment, can help you optimize performance and reliability.

What can the Gear Lube Analysis Program do for you?

Regular sampling of trams, traction reducers, gearboxes and hydraulic systems can provide you with the information needed to evaluate lubricant condition and identify wear and contamination so that you can:

Extend drain intervals

Monitoring the condition of the fluid optimizes drain intervals so that you get the most out of the fluid you’re paying for. Fewer oil changes help to minimize maintenance costs and maximize equipment uptime.

Increase equipment life

System cleanliness and filtration efficiency allow you to keep your equipment longer and significantly reduce replacement costs.

Identify minor problems before they become major failures

State-of-the-art fluid analysis program identifies dirt, wear particles and contaminants that can cause catastrophic failure, or significantly shorten equipment life.

Maximize asset reliability

JOY Gear Lube assists in maximizing the dependability and profitability of units.



Taking samples

Samples should be taken immediately after shutdown while the system is still at operating temperature and before wear metals and contaminants settle. Along with Komatsu’s recommended sampling intervals, a major consideration for determining sampling frequency is how critical a piece of equipment is to production, along with environmental factors such as hot, dirty operating conditions, extreme load variations and excessive idle times.

Determining sample intervals

Komatsu Mining Corp. recommends different sampling intervals depending on the cost and criticality of the gearcase to overall machine performance and availability.

Product	Every two weeks	Every month
Continuous miners		
Cutter gearcases	√	
Traction planetaries	√	
Longwall systems		
Shearer ranging arms	√	
Shearer haulage reducers	√	
AFC gearcases	√	
Others		
All other gearcases		√

Note - there may be instances when trending analysis indicates that a gearcase is beginning to become distressed, and more frequent sample draws may be justified. Komatsu service engineers can assist in deciding what the revised sample interval change should be.



Benefits of the analysis program

The ever increasing demands for larger and more powerful and productive mining equipment have created a need for a high-performance gear lubricant. To meet this need, Komatsu utilizes and now offers for sale to its customers, Komatsu's proprietary line of gear lubricants specifically selected to meet today's challenges.

Among the advantages, is that customers using JOY fluids may participate in this fluid analysis programs at no cost.* This can lead to better decisions about when to make a fluid change, while at the same time reducing the possibility of changing out fluid before such a change-out is needed. Komatsu's gear lubricants are fully-synthetic based on polyalphaolefin (POA) with proprietary polyolester (POE). The JOY line of gear lubricants, now used by Komatsu in all original and rebuilt underground equipment, also is available directly from distribution warehouses.

Synthetic lubricant advantages:

- Improved wear characteristics
- Extended fluid life - Improved shift efficiency
- Cooler operation resulting in more efficiency

Which lead to more production and higher revenue.

*Sample kits and lab analysis fees are covered by Komatsu.
Customer is responsible for the cost of shipping samples to the lab.



ISO 17025 A2LA accreditation
Quality to rely on...



Quality is the standard that drives laboratory operations every day. ISO 17025 A2LA accreditation is the highest level of quality attainable by a testing laboratory



Getting started

How to register

There are three easy ways to register for the fluid analysis program

1. Contact your local sales or service representative
2. Contact your local service warehouse and speak to a customer service representative
3. Call Komatsu Fluids directly at 1-866-288-3657 and talk to a lab representative

Requesting sampling kits

Sample kits for the testing program are stocked at all servicing Komatsu warehouses. Please contact your local warehouse and request part number 100410374. Each sampling kit contains 10 sample bottles, sample information forms, and mailing containers.

Sending samples to the labs

Instructions for mailing the samples to the laboratory are included in each sample kit.

Preparing samples

Easy to follow instructions...

1. Apply barcode to bottle
2. Submit sample info online OR complete form
3. Place form in mailer (unless sample info is submitted online) and ship
4. Receive report by email

Shipping instructions

When shipping multiple jars, place all sample information forms in the shipping container on top of the sample jars. If shipping samples individually, detach additional address labels from the sample information form and include it with the sample jar on the black mailer. Ship all samples by trackable delivery service such as UPS, Fedex or DHL.

Fluid analysis sample kits

Contents include...

Sampling kits are provided free of charge. Program participants can order sample kits (P/N 100410374) by contacting any customer service representative at their local servicing warehouse.

Each sample kit contains:

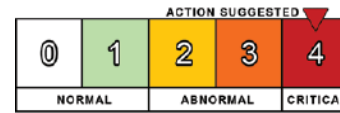
- 10 - 3oz sample bottles
- 10 - Sample bottle shipping containers
- 10 - Sample forms, shipping labels, and shipping instructions



How to read a fluid analysis report

The information that is submitted with a sample is as important to the reader of the report as it is to the analyst interpreting the test results and making recommendations. Properly document your equipment and share this knowledge with your laboratory. Implement a sampling process for every piece of equipment in your fluid analysis program that can be followed consistently each time the component is sampled.

Lubricant Analysis Report



Overall report severity based on comments.

Account Information	Component Information	Sample Information
Account Number: Company Name: Contact: Address: Phone Number:	② Component ID: JM (M21) H Secondary ID: M21 Component Type: HYDRAULIC ③ Manufacturer: JOY Model: 12CM27C ④ Application: MINING ⑤ Sump Capacity: 72 gal	Tracking Number: Lab Number: I-A53243 Lab Location: Indianapolis Data Analyst: JUK ⑥ Sampled: 25-Jul-2011 Received: 27-Jul-2011 Completed: 28-Jul-2011
Filter Information	Miscellaneous Information	Product Information
⑧ Filter Type: FULLFLOW & BYPASS Micron Rating: 5	Miscellaneous:	⑨ Product Manufacturer: JOY Product Name: Viscosity Grade: ISO 68

- Severity status levels:
0 — Normal
1 — At least one or more items have violated initial flagging points, yet are considered minor
2 — A trend is developing
3 — Simple maintenance and/or diagnostics are recommended
4 — Failure is imminent if maintenance is not performed
- Component ID is your opportunity to uniquely identify units being tested and their location. Component type should provide as much detail as possible. The type of unit can influence flagging parameters and the depth of analysis. Different metallurgies require different lubrication and can have a very significant impact on how the results are interpreted.
- Manufacturer and model can also identify metallurgies involved, as well as, the original equipment manufacturers' standard maintenance guidelines and possible wear patterns to expect.
- Application identifies the type of environment in which the equipment operates. This information is useful in determining exposure to possible contaminants.
- Sump capacity identifies the total volume of oil in which wear metals are suspended. This information is critical to trending wear metal concentrations.

Data management



When you provide the most accurate and complete unit and fluid information, your laboratory can deliver the most accurate and complete results and recommendations.



- Standard testing includes:**
- elemental metals by ICP
 - Water % by crackle
 - Viscosity @ 40°C or 100°C
 - total acid number
 - oxidation/nitration
 - particle quantifier

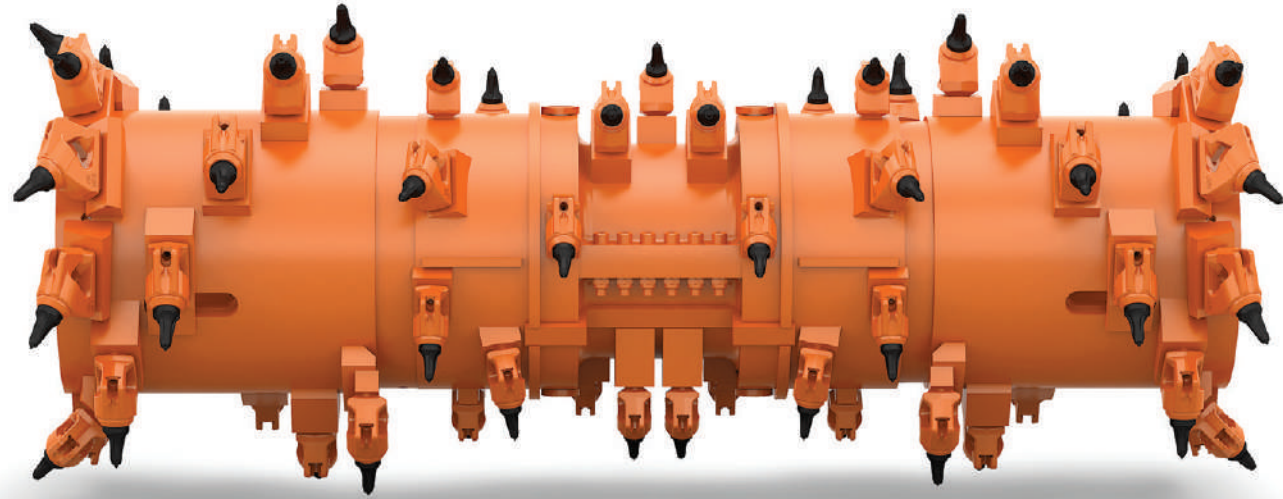
- Advanced testing available (at customer cost):**
- Analytical Ferrography – to pinpoint abnormal wear
 - Water by Karl Fischer, ppm – for determining water contamination



- Lab Location indicates the laboratory at which the testing was completed. A lab number is assigned to the sample upon entry for processing and should be the reference number used when contacting the lab with questions, concerns or feedback.
- "Sampled, Received and Completed" indicate the date the oil sample was taken, the date the sample was received by the laboratory and the date the analysis was completed. Turnaround issues may result from storing samples too long before shipping or shipping service problems.
- Filter Type and its micron rating are important in analyzing the particle count — the higher the micron rating, the higher the particle count results.
- Product Manufacturer, Product Name and Viscosity Grade identify a lubricant's properties and its viscosity. This information is critical in determining if the right lubricant is being used.

Recommended actions

A data analyst's job is to explain and, if necessary, recommend actions for rectifying significant changes in the lubricant or the unit's condition. Reviewing comments before looking at the actual test results will provide a road map to the report's most important information. Any actions that need to be taken are listed first in order of severity. Justifications for recommending those actions immediately follow.

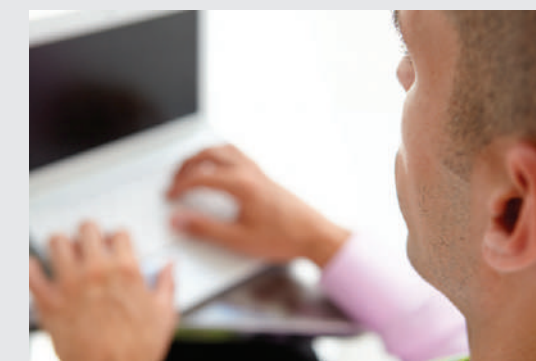


On-line access

Track samples and test result...

Participants can track all samples and test results at the url shown below. Users can identify trends, create custom reports, receive email notifications, and access historical records. Access records to specific machines or see multiple mines or locations.

www.joyglobalfluids.com



Elemental analysis

Elemental analysis, or spectroscopy, identifies the type and amount of wear particles, contamination and oil additives in your test sample. Determining metal content can alert you to the type and severity of wear occurring in the unit. Measurements are expressed in parts per million (ppm).

Sample #	Wear Metals (ppm)										Contaminant Metals (ppm)			Multi-Source Metals (ppm)					Additive Metals (ppm)					
	Iron	Chromium	Nickel	Aluminum	Copper	Lead	Tin	Cadmium	Silver	Vanadium	Silicon	Sodium	Potassium	Titanium	Molybdenum	Antimony	Manganese	Lithium	Boron	Magnesium	Calcium	Barium	Phosphorous	Zinc
1	2	0	0	1	0	1	0	0	0	0	3	0	0	0	0	0	0	0	4	1	19	0	243	270
2	2	0	0	0	1	0	1	0	0	0	3	0	0	0	0	0	0	0	3	1	10	0	260	301

- Combinations of these **wear metals** can identify components within the equipment that are wearing. Knowing what metal a unit is made of can greatly influence an analyst's recommendations and determine the value of elemental analysis.
- Knowledge of the environmental conditions under which a unit operates can explain varying levels of **contaminant metals**. Excessive levels of dust and dirt can be abrasive and accelerate wear.
- **Multi-source metals** and **additive metals** may appear in test results for a variety of reasons. Molybdenum, antimony and boron are additives in some oils. Magnesium, calcium and barium are often used in detergent/dispersant additives. Phosphorous is used as an extreme pressure additive in gear oils. Phosphorous, along with zinc, is used in anti wear additives (ZDDP).

Test data

Test results are listed according to the age of the sample—oldest to most recent and top to bottom—so that trends are apparent. Significant changes are flagged and printed in the gray areas of the report.

- Samples are listed by date received in the lab — oldest first. They are also assigned a lab number for easy internal tracking.
- Important to note is whether or not a lube change has occurred since the last sample was taken.
- Water in oil decreases lubricity, prevents additives from working properly and furthers oxidation. Its presence can be determined by crackle or FTIR and is reported as a percentage of volume. Water by Karl Fischer ASTM D1744 determines the amount of water present. If you have ordered advanced testing these results appear in the special testing section of your report.
- Viscosity measures a lubricant's resistance to flow at temperature and is considered its most important physical property. Depending on product grade, it is tested at 40°C and/or 100°C and reported in centistokes.
- Particle count is a cumulative range between 4 and 100 microns. This test is valuable in determining large particle wear in filtered systems.



Recommended applications

	SEP320J	S150J	S460J	SEP680J
Gear Reducer				
Shearers				
Ranging Arms	X			
Haulage Drives	X			
Lumpbreakers	X			
AFC				
EP, BP & Stageloader Cases	X			
Tail Transfer Drive				X
Continuous Miners				
Cutter Case	X			
Gathering Head Cases	X			
Gathering Head Pots	X			
Traction Cases	X			
Traction Planetaries	X			
Rear Conveyor Drive Cases	X			
Shuttle Cars				
Traction Primary Cases	X			
Wheel Units	X			
Conveyor Cases (worm gears)			X	
Battery Haulers				
Traction Cases		X		
Fct				
Belt Drives	X			
Traction Primary Cases	X			
Traction Secondary Cases	X			
Lumpbreakers	X			
Cooling Pump*				
Chain Haulage Systems				
Conveyor Drives	X			
Breaker Drives	X			
Traction Cases	X			
Feeder-Breakers				
Conveyor & Breaker Cases (with helical gears only)	X			
Conveyor & Breaker Cases (with worm gears)			X	
Traction Planetaries	X			

*Contact your Komatsu Mining customer service representative for more information

JOY Gear Lube	Pails* (part #)	Drums* (part #)	Totes* (part #)	Bulk* (part #)
SEP320J	100362711	100362712	100362723	100362710
S150J	100362726	100362727	NA	NA
S460J	100362724	100362725	100474074	NA
SEP680J	100362728	100362729	NA	NA
	*24 pails - pallet	*4 drums - pallet	*270 gallons	*min. 500 gallons

Komatsu fluids contact information

Available 24/7, 365 days a year

Laboratory toll-free – US and Canada:
1-866-288-3657

laboratory local:
1-317-396-4435

Websites:
www.mining.komatsu
www.joyglobalfluids.com

Smart Solutions

Integrated Smart Solutions help solve customers' toughest challenges using data-driven intelligence, collaboration through partnership and experience-based service execution. They are a way of partnering with customers to help reduce costs and increase productivity, in line with customers' operating and financial goals.

Komatsu service facilities have given world-class service a new home.

Smart Service Centers are strategically located around the world in order to conveniently serve our customers. With each new service center built, Komatsu products and people are becoming more connected, allowing for expanded benchmarking. Located strategically in zones of mining activity, each service center brings local support that is world-class. Services offered are structured to fulfill the lifecycle of mining equipment, optimizing equipment for productivity and safety.

Our commitment to world-class service is delivered through world-class processes and metrics. Our Joy OpEx processes bring operational excellence by prioritizing the elimination of waste, simplifying processes, automating and removing people from harm's way. We leverage those principles throughout our network, with the ability to rapidly customize locally, helping customers work smarter, worldwide.



Smart Solutions are integrations of smart connected Komatsu products and systems, advanced analytics and direct services customized to solve customers' toughest challenges.

Smart Solutions at work:

Costs

- Lower cost per unit produced by reducing overall parts and consumables expenditures
- Optimize costs for power/fuel, labor and rebuilds

Safety

- Automate processes and controls
- Increase awareness through training and standard setting

Productivity

- Improve system availability, performance, utilization and consistency
- Leverage extensive Komatsu engineering knowledge to solve problems



Smart Solutions

Komatsu Mining Corp. Group

mining.komatsu



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