Joy Fluids and Lubricants
Analysis Program
Joy Gear Lube, specifically selected by Komatsu for its compatibility with Komatsu’s underground mining systems and equipment, can help you optimize performance and reliability. 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.

### Why you sample
Joy Gear Lube, specifically selected by Komatsu for its compatibility with Komatsu’s underground mining systems and equipment, can help you optimize performance and reliability. 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:

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- Maximize asset reliability
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### 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 program 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 polyol ester (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.

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 services.

Fluid analysis sample kits

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

ISO 17025 A2LA accreditation

Quality to rely on...
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

<table>
<thead>
<tr>
<th>Account Information</th>
<th>Component Information</th>
<th>Sample Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Account Number:</td>
<td>Component ID: JM (M21) H</td>
<td>Tracking Number:</td>
</tr>
<tr>
<td>Company Name:</td>
<td>Secondary ID: M01</td>
<td>Lab Number: IAS243</td>
</tr>
<tr>
<td>Address:</td>
<td>Component Type: HYDRAULIC</td>
<td>Lab Location: Indianapolis</td>
</tr>
<tr>
<td>Phone Number:</td>
<td>Manufacturer: JOY</td>
<td>Data Analyst: JUK</td>
</tr>
<tr>
<td></td>
<td>Model: 12OM27C</td>
<td>Sampled: 25-Jul-2011</td>
</tr>
<tr>
<td></td>
<td>Application: MINING</td>
<td>Received: 27-Jul-2011</td>
</tr>
<tr>
<td></td>
<td>Sump Capacity: 72 gal</td>
<td>Completed: 28-Jul-2011</td>
</tr>
</tbody>
</table>

Filter Information

<table>
<thead>
<tr>
<th>Filter Type: FULLFLOW &amp; BYPASS</th>
<th>Miscellaneous Information</th>
<th>Product Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micron Rating: 5</td>
<td></td>
<td>Product Manufacturer: JOY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Product Name:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Viscosity Grade: ISO 68</td>
</tr>
</tbody>
</table>

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.

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.

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

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.
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).

<table>
<thead>
<tr>
<th>Sample</th>
<th>Iron</th>
<th>Nickel</th>
<th>Copper</th>
<th>Lead</th>
<th>Zinc</th>
<th>Manganese</th>
<th>Chromium</th>
<th>Nickel</th>
<th>Copper</th>
<th>Nickel</th>
<th>Copper</th>
<th>Lead</th>
<th>Zinc</th>
<th>Manganese</th>
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<td>0</td>
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<td>0</td>
</tr>
</tbody>
</table>

- 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

<table>
<thead>
<tr>
<th>Gear Reducer</th>
<th>SEP320J</th>
<th>S150J</th>
<th>S460J</th>
<th>SEP680J</th>
</tr>
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<tbody>
<tr>
<td>Shearers</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Ranging Arms</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haulage Drives</td>
<td>X</td>
<td></td>
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<tr>
<td>Lumpbreakers</td>
<td>X</td>
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<td>EP BP</td>
<td>X</td>
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<tr>
<td>Stageloader Cases</td>
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<tr>
<td>Tail Transfer Drive</td>
<td>X</td>
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<tr>
<td>Continuous Miners</td>
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<tr>
<td>Cutter Case</td>
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<tr>
<td>Gathering Head Cases</td>
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<tr>
<td>Gathering Head Pots</td>
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<tr>
<td>Traction Cases</td>
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<tr>
<td>Traction Planetaries</td>
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<tr>
<td>Rear Conveyor Drive Cases</td>
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<td>Chain Case</td>
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<td>Traction Primary Cases</td>
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<td>Wheel Unit</td>
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<tr>
<td>*Conveyor Cases (worn gears)</td>
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<tr>
<td>Battery Haulers</td>
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<tr>
<td>Traction Cases</td>
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<td>Elctric</td>
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<tr>
<td>Belt Drives</td>
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<tr>
<td>Traction Primary Cases</td>
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<td>Traction Secondary Cases</td>
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<tr>
<td>Lumpbreakers</td>
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<tr>
<td>Cooling Pump</td>
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<tr>
<td>Chain Haulage Systems</td>
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<tr>
<td>Conveyor Drives</td>
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<tr>
<td>Breaker Drives</td>
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<tr>
<td>Traction Cases</td>
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<tr>
<td>Frontal Haulers</td>
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<tr>
<td>Conveyor &amp; Breaker Cases (with helical gears only)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Conveyor &amp; Breaker Cases (worn gears)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traction Planetaries</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Contact your Komatsu Mining customer service representative for more information

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 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

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 these 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.
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