

MAINTENANCE EFFICIENCY IS KEY TO MINING OPERATION PRODUCTIVITY



Everything is a numbers game in the mining industry, especially when maintaining the fine balance between expense and time. Running lean requires operational efficiency reliant on a defined service schedule for vehicles that eliminates downtime and maintains vehicle productivity.

To better contextualize how granular mining operations can be tracked, let's take the example of an average open-pit goldmine with a 2 g/t Au grade. There is a reason that they call equipment at mine sites "earth movers" and not "gold movers" as 90,000,000 grams of earth yields around 180 grams of gold after extraction.

To move as much ore as possible, our hypothetical mine likely has around **60 haul trucks** and **4 excavators** with hydraulic shovels to move material. This excludes additional working equipment like dozers, loaders, graders and drilling rigs that make the final transport happen.

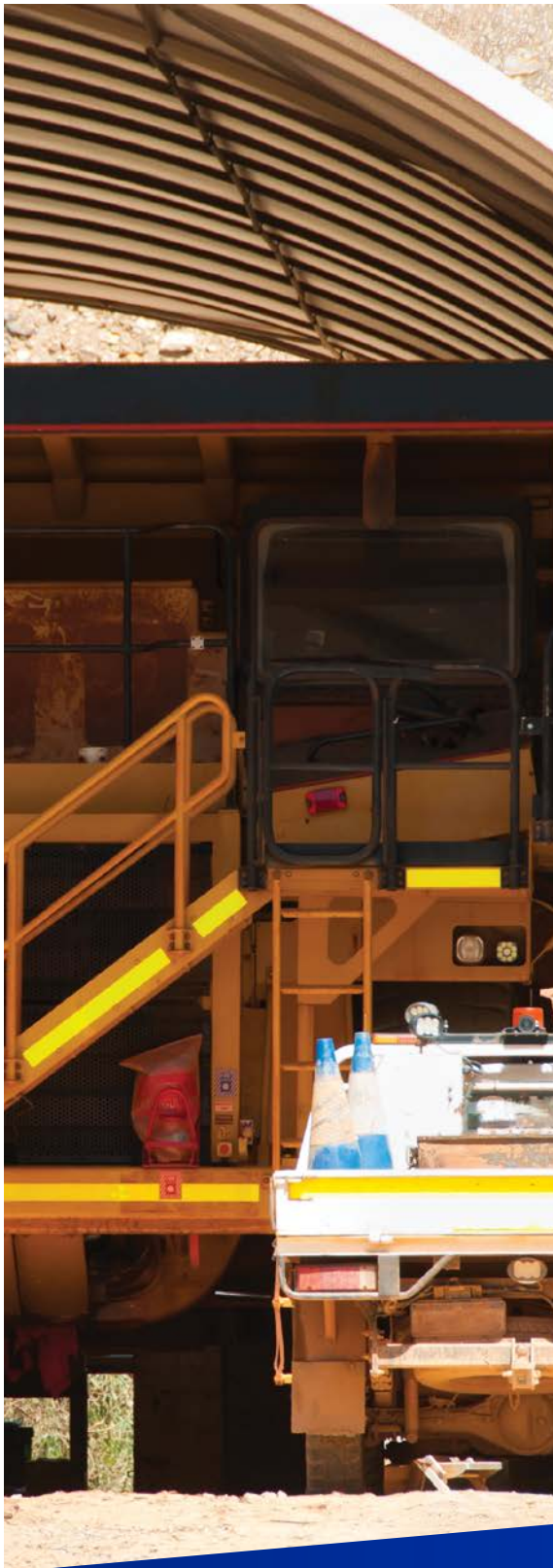
Each shovel loads 15 trucks with 4 full buckets each. On a decent loading surface, a good operator can fill a bucket, dump it into a truck and get back to the face in 30 seconds, which brings us to 2 minutes per truck and 1 minute between the trucks to drive at the spot. One full loading cycle of 15 haul trucks then will take around 45 minutes, and the drive to a dump area should be less than 45 minutes for a shovel to run without downtime. Shovels need to be kept in service to increase efficiency; the downtime cost of these shovels can be around \$60,000/hour and the downtime of a haul truck around \$3,000.



***The downtime of shovels can cost around \$60,000/hour
and the downtime of a haul truck can cost around \$3,000/hour***

PROVEN QUALITY. LEADING TECHNOLOGY.

To increase the equipment availability rate (the ratio of equipment in service to the total number of equipment on site), mining companies use the following tools:



SERVICE TRUCKS

A workshop on wheels, service trucks primarily serve the bigger shovels and excavators at a mine site. With the cost of machine downtime at so high a premium, these trucks are equipped to deliver high volumes of grease and increased flow rates of oil. These services minimize the service time of bottleneck machinery on site and help to optimize operational efficiencies.

LUBE PIT STOPS

While not quite hitting the speeds of the vehicles on a NASCAR or Formula 1 track, haul trucks come to a pit stop located at an open-pit at the site to make oil top-ups, refill grease reservoir, fuel up, and receive overall equipment inspections. Fluid management solutions play a crucial role in ensuring oil and lubricants are properly tracked.

MOBILE LUBE CONTAINERS

Much like a mobile triage might be set up for medical emergencies, mobile lube containers act like workshop islands around the open pit for quick maintenance solutions. Equipped to service a wide range of machinery, the pumps aboard mobile lube containers support varying lubricants and dispensing requirements.

MINING WORKSHOPS

The largest facility for mining maintenance operations, the main mining workshop has expanded capacity to fit larger haul trucks and other equipment inside for more thorough maintenance than is done out in the field. While most machines have planned maintenance that might require a trip to the workshop, the purpose of service trucks, pit-stops and mobile lube containers is to ensure machines enter the bays as infrequently as possible.

Using the right equipment in all maintenance-related tasks is very important. The equipment you choose to use in your mining operation could help provide faster maintenance, which will help eliminate the hours of downtime your equipment has, bringing in more gold to your processing facilities. Graco has you covered, producing a wide range of lubrication related products for regular maintenance and for the on-vehicle automatic lubrication systems.



A few items to consider when seeking to improve maintenance efficiency:

1

Automatic Grease Reservoir Capacity

2

Grease and Oil Refill Time

3

Oil Management

4

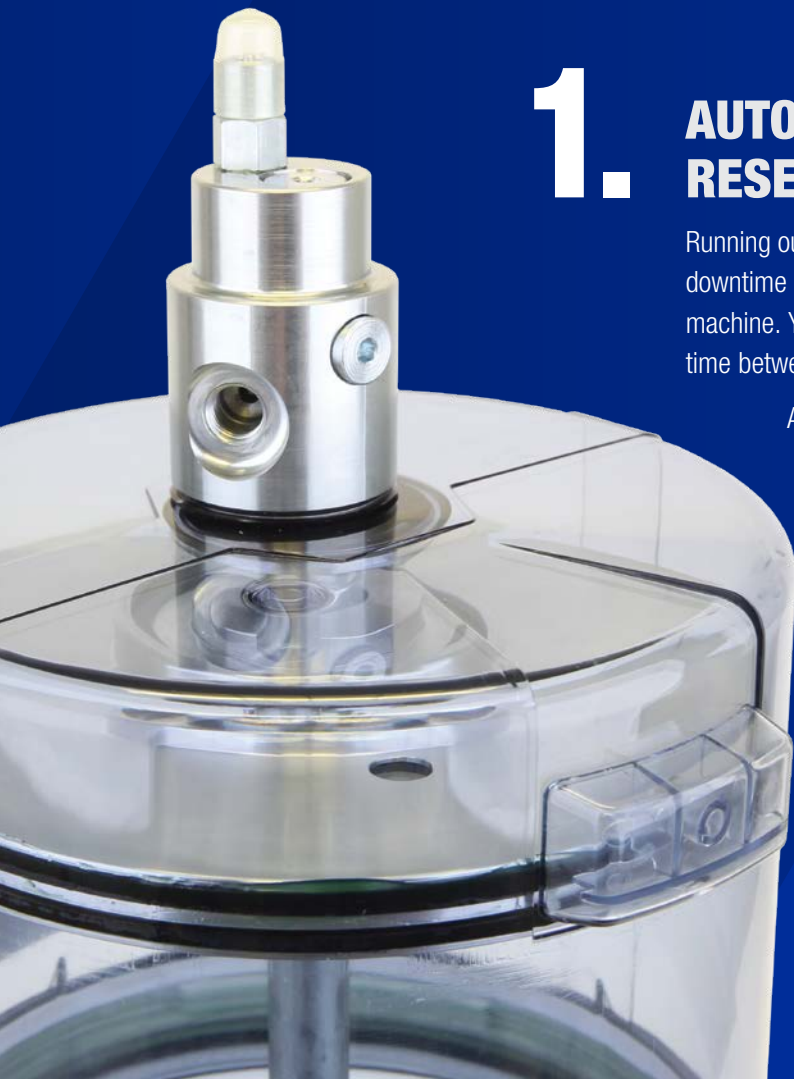
Safety During Maintenance

1. AUTOMATIC GREASE RESERVOIR CAPACITY

Running out of grease is a problem and automatic lubrication can only offset downtime if the solution is constructed to the specification required by the machine. Your auto lube grease reservoir should hold enough grease for the time between maintenance periods (i.e. engine oil changes).

A required oil change for a vehicle may vary from 250 hours to 500 hours depending on the lubricants used, fuel quality, engine crankcase capacity or the engine build itself. It is important that the auto lube grease reservoir is able to grease your equipment while it is running without extra refills.

Just by changing the size of your grease reservoir could result in a large amount of time saved.



2.

GREASE AND OIL REFILL TIME

As with any job, selecting someone (or something) with the correct toolset is the key to efficiency. For example, Lionel Messi is a phenomenal soccer player – but his stint playing professional golf showcases that not all successes are transferable. The same can be said for pumps.

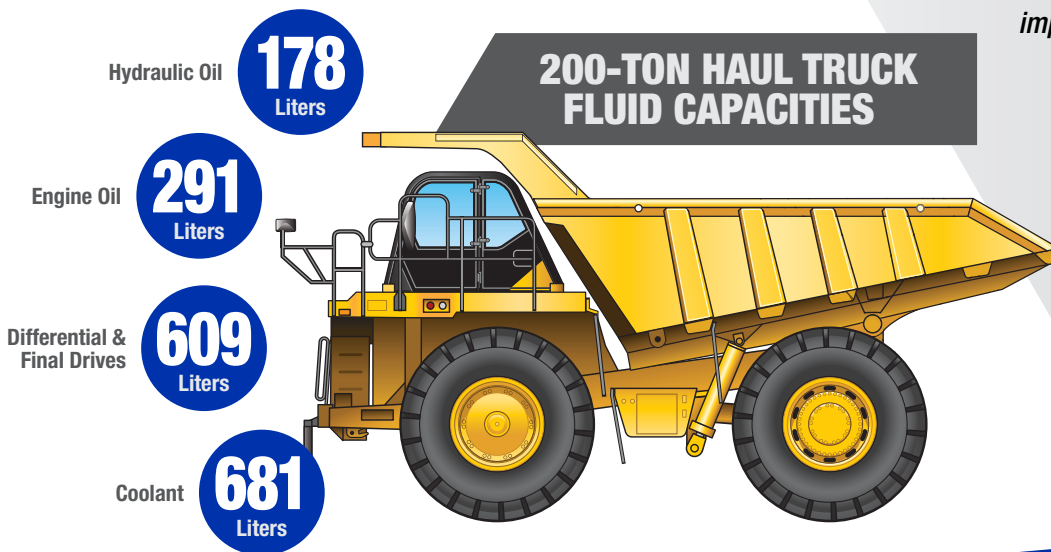
The Graco Fire-Ball® 425 50:1 is a world-class pump and excels at greasing zerks, but for grease transfer applications it simply isn't the best fit. Using the Fire-Ball to fill a 25 kg reservoir, it can take upwards of 25 minutes for a refill to be completed. The Graco GT 750™ 36:1, which has a flow rate of 14.5 kg/min, can do the same job in 5 minutes flat. If time is money, 20 minutes back at every fill-up is worth the investment every time.

For oil, the Graco Fire-Ball 425 can pump nearly any oil at long distances with low temperatures, overcoming pressure drop in the system while retaining a high flow rate.

For example, a larger haul truck has the following service refill capacities:



Larger mining equipment is equipped with Service Boxes for a quick access to technical fluids: engine oil, transmission oil, hydraulic oil, coolant, etc. The technician connects a female coupler at the oil meter to a male coupler for the required fluid in a service box. Meaning the Fire-Ball 425 can complete refills far more quickly than average, which in turn saves you time and improves operational efficiency.



3. OIL MANAGEMENT

Let's return to our average open-pit mining site and discuss oil consumption. Oil, like cash in pocket, spends quickly and in large amounts if not managed. Looking just at our fleet of 60 haul trucks, we'd see the following consumption in a year.

SIXTY 100-TON HAUL TRUCK FLEET



OIL USAGE (Liters) PER YEAR

$$\frac{8k \text{ Hours Per Year}}{250 \text{ Hours Service Intervals}}$$

$$32 \text{ Services Per Year, Per Truck} \times 110 \text{ Liters Crankcase Capacity} \times 60 \text{ Trucks} = 211,200 \text{ Liters Per Year}$$

OIL LOSS (\$) PER YEAR

$$211k \text{ Liters Ordered Per Year} \times 12\% \text{ Loss Industry Average}$$

$$25k \text{ Liters Lost Per Year} \times \$2 \text{ Per Liter} = \$50,600 \text{ Lost Per Year}$$

While already a substantial expense just quoting for the haul truck fleet, we can logically extrapolate using these numbers to see the magnitude of oil expense across a mining site's heavy equipment. The loss of oil, which amounts to 12% of the initial purchase volume, amounts to a tremendous waste of capital that can be reinvested into the business.

While a number of contributing factors can account for oil loss, the most common challenges with oil management would be:

- Over-dispensing of oil
- Oil theft
- Leaks, spills or mismanagement
- Equipment malfunctions
- Incorrect fluid dispensing

Solving all these issues at once might seem to be a tall task, but implementing a Fluid Management System leaves little room for unanswered questions regarding your maintenance routine. Graco's Pulse® Pro Fluid Management System answers all of the following questions:

- What fluid was dispensed?
- Why and how much fluid was dispensed?
- Who performed the dispense?
- When did the dispense occur?
- Where in the facility did the dispense take place and to what equipment?

With full end-to-end confidence that oil inventory is properly tracked, the Graco Pulse Pro system offers an immediate return on investment, particularly for mining locations where oil inventories have historically been mismanaged or gaps in tracking have occurred.



4.

SAFETY DURING MAINTENANCE

Until this point we've been focusing on efficiency and speed of maintenance, but ensuring that safety isn't sacrificed for the sake of expediency is equally important to completing work more quickly. It is important to invest in equipment that makes operator safety a priority by design rather than simply being a footnote in a packed away manual.

You can expect attentiveness to maintenance safety procedures when using any Graco automatic lubrication pump, which come optionally with auto-fill shut-off (AFSO) technology to ensure safe reservoir refills. Coupled with a remote-fill manifold (RFM) on the machine itself, equipment operators can easily connect a grease hose at ground level without additional maneuvering or climbing.

If a pump is not equipped with AFSO technology, it is required to have an overfill port, which enables excess grease an escape route to avoid over pressurizing the reservoir. Relying only on an overfill port without AFSO technology, refilling a grease pump becomes a two man tango to both run the pump and watch for excess grease pouring out of the port.

Graco's automatic lubrication pumps, when equipped with both AFSO and RFM, enable operators to start the procedure, leave to work on other tasks, and return to simply relieve any excess pressure by pulling a knob on the RFM. It really is as simple as that.



OTHER MINE SITE CONSIDERATIONS: INTRODUCING THE PROCESSING PLANT

Thus far we have discussed mobile equipment, but what about stationary equipment? While there is a lot out on wheels at a mine site, we've neglected to mention some of the most important equipment that takes our ore and unearths the gold within. At the end of the day, we need to get that 180 grams from each truck and a mine's processing plant is where the magic happens.

The collected earth is initially moved from our haul trucks to a crusher where, true to its name, ore is broken down into a smaller, more workable size. The material is then transported by conveyors to the main processing plant.

From the conveyor, ore comes to a grinding mill, where ore is ground into small particles. From its exterior, the grinding mill looks like a big concrete mixer, but instead of containing sand, water and cement powder, there are large and heavy steel balls inside. That is why sometime people call grinding mills by another name: Ball Mills.

This grinding mill is continually rotating and has extremely high loads. The most popular type of a grinding mill is a mill with an open gear driven by a pinion gear. This open gear should be lubricated very well in a dusty and heavy-duty environment.



STORY FROM THE FIELD

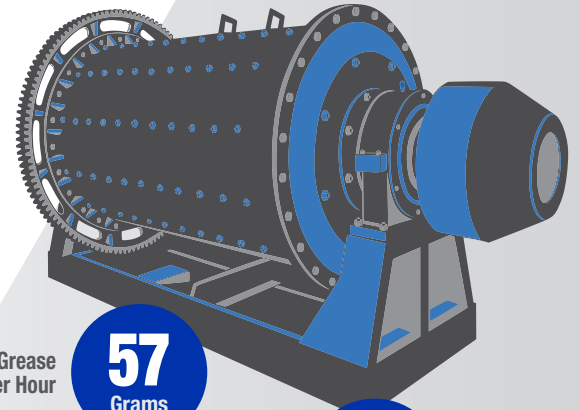
GRINDING MILL MAINTENANCE

On average, due to the poor lubrication technique, this customer had to replace the ball mill's pinion gear every 62 days. Replacing a pinion gear is an expensive and labor intensive operation, and the customer knew they had to stop the bleeding. They decided to go for an Automatic Open Gear Spray System. An Open Gear Spray System sprays lubricant (grease with solid additives or extremely high viscosity oil) every 5 minutes to maintain even distribution of the oil film thickness to provide much better protection. As a result, the life of a pinion gear increased from roughly 2 months to over 8 months. With four times longer equipment life and four less agonizing installations, you'd better believe the customer was incredibly happy with their solution!

Graco is a world-known leader in fluid handling solutions, we spray, measure, dispense, control and transfer fluids. Graco provides a complete solution for Open Gear Spray Systems, and can help save you a lot of money on the maintenance of your grinding mills, which are critically important in the processing of a gold ore.

In line with open gear spray systems, we also provide auto lube for your conveyors (belt pulleys), crushers and any other equipment which require regular greasing, including your vehicles which may be outfitted with stock systems that don't perform adequately.

BALL MILL
23' INNER DIAMETER / 23' LENGTH



Grease
Per Hour

57
Grams

Grease
Consumption
Per Year

500
Kilograms

Processing plants are massive and mostly automatic, being run from a dispatcher room. With not many people attending to equipment, it is best to make sure that the most remote and inaccessible places on your equipment have auto lube to be sure they continue to operate without needing additional maintenance.

As a feature of some of our most advanced controllers, you can gain a full understanding of lubrication cycles without checking the machines themselves. With the controllers wirelessly transferring pump data you can download the Graco Auto Lube App for your smartphone to see how your auto lube systems are performing, which pumps may be at fault and how to troubleshoot your automatic lubrication system on the equipment. All it takes is for the controller to be within a proximate distance to the pump itself to establish a Bluetooth connection and transmit data wirelessly.

For a processing plant, where operations are nearly all automatized, ensuring that equipment is functioning as intended and maintenance technicians are called only when truly needed is beneficial to both your bottom line and to prioritizing the work of your skilled labor.

Some of the data stored on Graco's most advanced auto lube controllers, like our GLC™ X, includes:

- How many lubrication events you have had
- Lubrication run time
- How many and which alarms you have had
- How long the pump has been in alarm mode
- How many times the pump has been activated
- How many times the operator pressed Manual Run Button
- Average lubrication time
- Interval time settings
- Pump current statistics
- Temperature statistics



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