The WinnerWheel

10 ways to improve your Lubrication Reliability™ Program

2021-V2


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Introduction

10 ways to improve your Lubrication Reliability™ Program

Key factor of a World Class Maintenance Organization is the Lubricant Management. While Lubrication has for long time been seen as “another-job-to-do”, today a modern Lubrication Reliability™ Program is the only answer. Here are 10 ways to start or improve your Lubrication Reliability™ Program.

Lubrication is the bloodstream of your Machinery

It has been said many times before: while the bearing is the heart of your (rotating) machine, the lubricant is considered as the blood. The health of your blood is as “life threatening” as the quality of the lubricant – whether oils or greases – are. Bad lubricant quality is extremely harmful for the reliability of machine components. Quality does not only relate to type or brand, but to many more intrinsic aspects we will discuss later. Of course it all starts with the correct machine – lubricant combination in the design stage, but this we will not address in this article. Lubricant quality in the Lubrication Reliability™ Program is a matter of managing the selected lubricants in the best possible way bearing in mind the **6 “lubrication rights” :**

1. **Right Type**
2. **Right Time**
3. **Right Quantity**
4. **Right Place**
5. **Right Way**
6. **Right Condition**

It has been proven many times by independent organizations that bad lubrication is responsible for over 60% of bearing / machine failures: here asset maintainers have sinned against one or more of the 6 Lubrication Rights. Turning the bad practices into a Lubrication Reliability™ attitude will have a direct impact on fundamental machine health.

Aside from bearings, “best lube practices” should be applied to gear technology, hydraulics or basically all lubrication related technologies. Time for a maintenance culture change with an important Return-On-Investment.

Silent Phase in bearing life time – time to start Lubrication Reliability™

In a bearing service life we have 3 phases: the **Silent** phase, **Prediction phase** and **Breakdown** phase. **The initial silent phase** is that part of the life time where wear and eventual damage can occur due to inadequate lubrication or contaminated lubricants (6R’s).

Or adversely, when lubrication is managed in the proper way, internal wear can be reduced significantly and bearing life maximized. It is during this phase that prevention is most effective.

We call it “silent phase” because in the component life time no predictive techniques are able to capture any potential failures yet.

At a certain moment in time – point of no return – initial wear or damage is detectable by predictive methods (vibration, temperature, oil analysis, visual inspections, ultrasonics) .

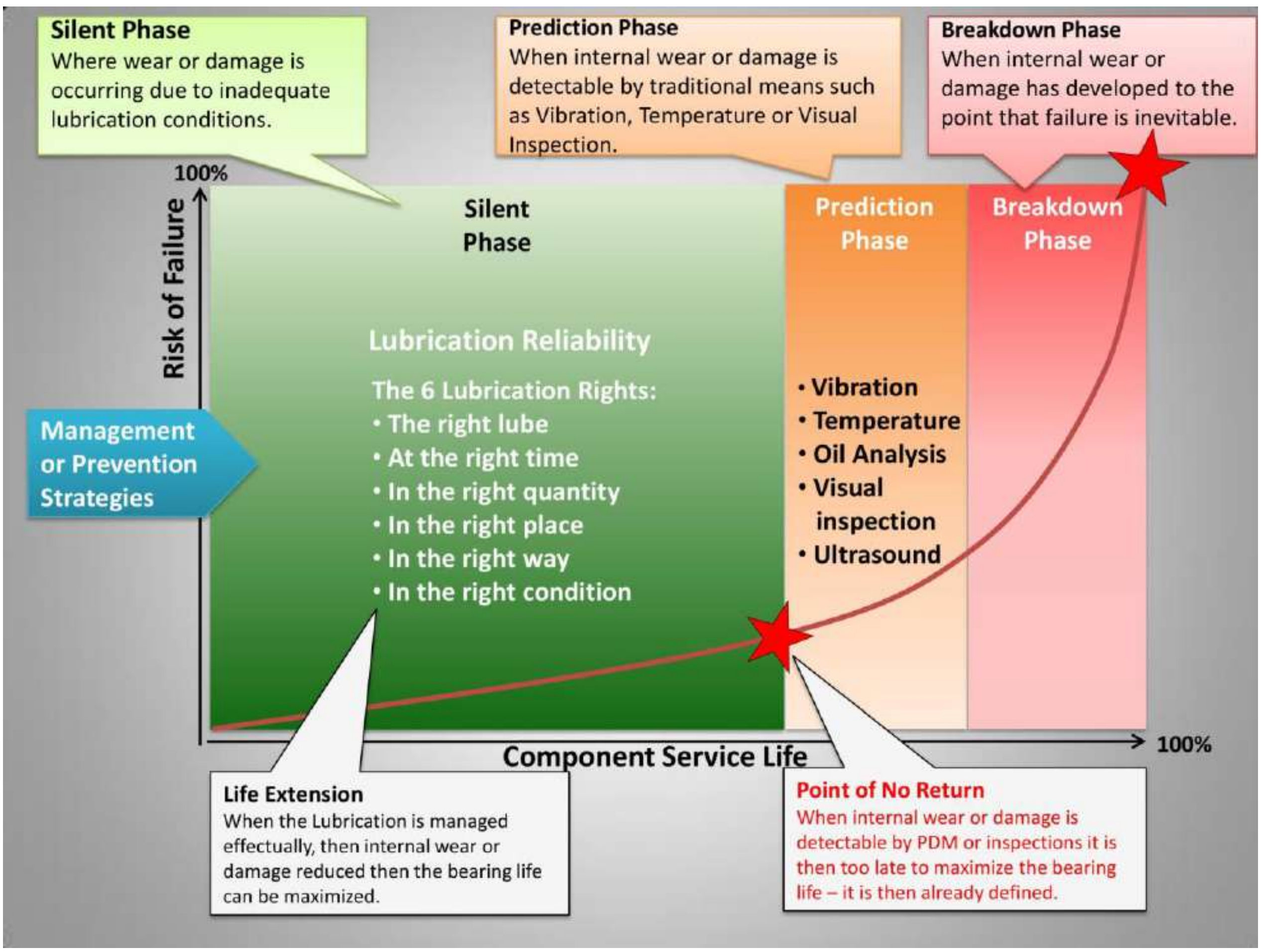
It is now too late to maximize the bearing life and the life time is now set beyond return. During the prediction phase it is only possible to <u>monitor</u> wear and damage by measuring abnormalties via - commonly called - Condition Monitoring.

One can understand that CM is changing the quality of lubrication but only measures its level.

Eventually the CM techniques will detect that a failure will occur. If in time, repair or replacement can be planned and implemented.

Silent Phase in bearing life time (cont'd)

Conclusion is imperative that Lubrication Reliability™ should be implemented at the start of the silent phase.



10 ways to implement Lubrication Reliability™

Lubrication Reliability™ is a combination of managing best practices, tools and strategies. In order to understand and implement it in an efficient way, we will explode LR in 10 separate components.

1. Assessment

To start a new LR strategy (or just implement one or more of its components) it is crucial to assess the actual lubrication management situation. Evaluation and benchmarking will disclose actual flaws in the organization and stress out the weak points in the fields of:

- Strategies,
- CMMS,
- Cleanliness & contamination control,
- Lube supply,
- Expertise, etc.

Actual status is categorized from Basic Level evolving to Best in Class.

Starting point

A report will be initiated from an order to assess the current lubrication practices and will suggest a plan to overhaul these practices and bring them to global best standard levels.

Report

The report will cover the following points:

1. Findings on lubrication strategy as applied in the plant when compared to best practice standards: a) Maintenance strategy and b) Lubrication processes.

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2. Lubrication storage area
3. Recommendations to improve the lubrication strategy, bringing it closer to best practice standards and also a strategy that will have the effect of reducing maintenance cost.

1a. Maintenance strategy

All lubrication assessments we conduct, we use a 6 question snapshot to gauge the effectiveness of one's lubrication strategy.

Based on our experience and also how the client perceives and answers the questions, we can gain an impression of :

- the importance of how the lubrication strategy is perceived within the plant
- an indication of bearing usage, be it high, reducing or at the lowest level and
- also the lubrication consumption, again be at high, reducing or at the lowest level.

The **most important question** in the assessment, which gauges the overall effectiveness of the program or strategy, is **to define the degree of application of the six lubrication rights (6 R's):**

Can we claim for every machine:

- Using the Right Lube
- Adding the Lube at the Right time

Can we claim for every machine (cont'd):

- In the right quantity
- In the right way
- In the right condition
- Maintaining the right condition

Overall Findings Maintenance Strategy

From the feedback from the maintenance staff and also what was gained from the plant tour, our view covering the lubrication component of the maintenance strategy will be reported.

1b. Lubrication Processes

Also in all assessments we endeavor to define where a company is with their overall Lubrication strategy.

The 4 key areas of best practices cover:

1 - the strategic part,

2 - the controlling cleanliness and contamination part,

3 - the data base management and reporting section and

4 - the lubrication knowledge and its application.

Also we endeavor to determined how advanced the lubrication strategy is when considered to 4 evolutionary steps:

1 - basic requirement,

2 - lubrication processes,

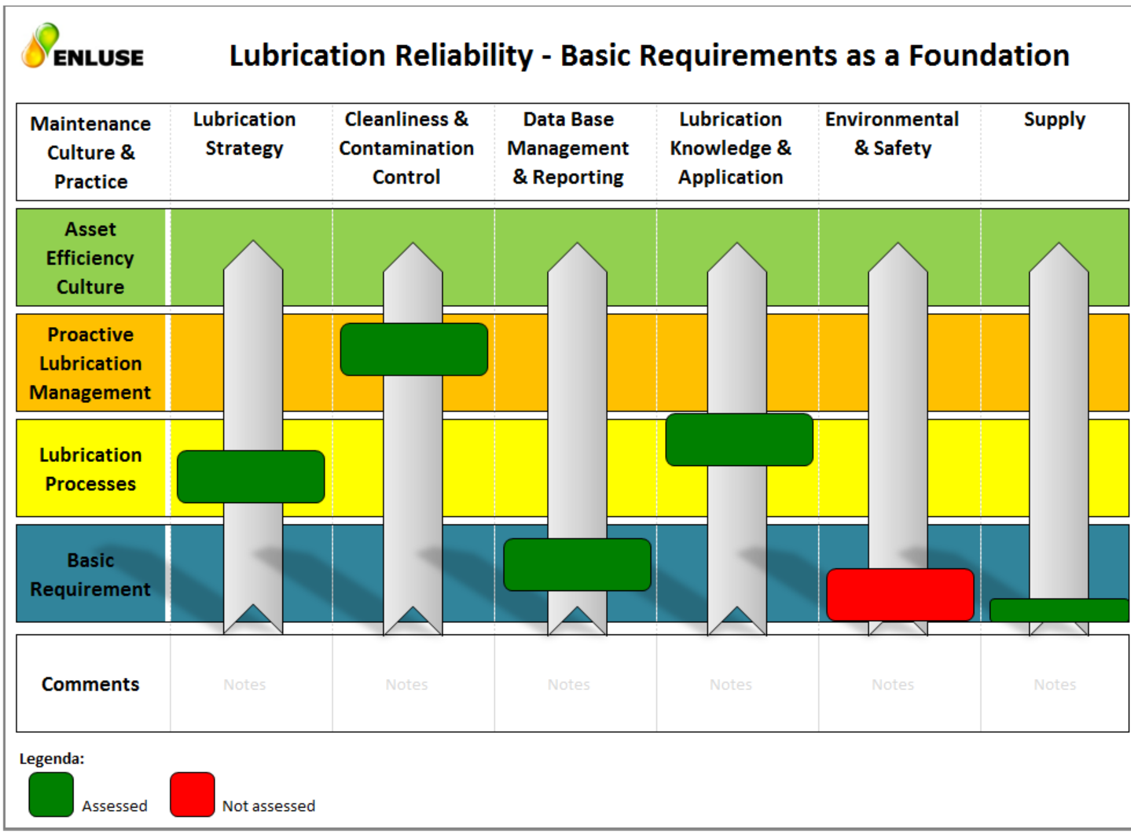
3 - proactive lubrication management and finally

4 - if it is part of the overall plant asset efficiency culture.

Base examples of each level are shown in the following graphic along with some important fundamentals for each component and maturity level. See graphic below: Lubrication Reliability base examples.

ENLUSE	Lubrication Strategy	Cleanliness & Contamination Control	Data Base Management & Reporting	Lubrication Knowledge & Application
Basic Requirements	Dedicated Resources	Lube Room Standards in place	Data Base Experience	Costs vs Investment in Uptime
Lubrication Processes	Instructions for the work	Procedures for Reducing Contamination	Maintenance Planning Controls	Trained staff on Lubrication
Proactive Lubrication Management	RCFA on all failed Parts	Oil Analysis and Evaluation	Dedicated Lube Software	Integrated in Reliability Programme
Asset Efficiency Culture	KPI's on Lube Effect to Reliability	Overall Plant Cleanliness Measurements	Integrated and Seamless to CMMS	Measurement of Activity Effectiveness

Another way to look at the development of the strategy is from the basic requirements as a foundation.



Overall Findings Lubrication Strategy

Based on the assessment findings, comments will be laid down

Recommendations

It is our opinion that an improvement in the management of the lubrication activity will have effect of lowering maintenance costs and prevent instances from occurring that may cause machine failure of damage. Based on above an overview will be given of recommended changes to improve the Lubrication Strategy.

Never underestimate the importance of an effective lubrication program. If you’re not using best practices lubrication, you’re experiencing unnecessary equipment downtime.

Enluse can help you understand your current lubrication practices and challenges, and determine what improvements can be made to improve your operational efficiency.

Next month the 2nd LR component will be discussed – **“Plan, manage and organize”.**

2. Plan, Manage and Organize

The discussion in the industrial maintenance world today is predominantly focused on plant and equipment reliability. The real meaning of equipment reliability is often hidden behind other terms like World Class Maintenance,

Asset Efficiency, Proactive Maintenance, Predictive Maintenance, Lubrication Management, Lean Manufacturing, TPM and even 5S (Sorting, Straightening, Systematic cleaning, Standardizing, and Sustaining). However, irrespective of what companies choose to call it, they all have fundamentally the same objective.

"Equipment Reliability is a maintenance strategy or culture which, when implemented successfully, will assist in reducing maintenance costs, improving equipment uptime and lowering the overall costs of production."

Many companies set out on the pathway to achieve the above conceptual definition(s) and invest in people and technologies as their defined processes require, however the lubrication component of the strategy, is more often than not, low on the appreciation scale and consequently their efforts do not always meet the expectations.

Our experience shows that companies at World Class or Best in Class levels, focus at great length on the management of their lubrication activities, because they understand the effect lubrication has on equipment life.

What is Lubrication Reliability™?

All investigations conducted today on why bearings fail, will reveal the alarming fact that over 60 % of the damages are lubrication- related. The bearing is the rotating core of the machine and if we can reduce the lube-related failures we will directly improve the equipment reliability, not to mention the resulting reduction in bearing consumption.

Measurement is the Key to Knowledge

The overall goal of Lubrication Management Software is to tackle three main objectives:

- Reference base (store lube-related activities)
- Increase employee productivity
- Cost associated with downtime (due to equipment failure)

However, traditionally the use of software tools in lubrication engineering has been broken down into two areas:

1. **Lubrication Management**

   Providing tools to manage the process (greasing routes, oil change intervals etc.).

2. Lubricant Analysis

Providing tools to manage lubrication testing and analysis

There is considerable overlap between lubrication and oil analysis information management systems. They both require details to be entered about the equipment, lubricants used and scheduling information Both maintain histories about the lubricants. Upfront costs to purchase and set-up these programs are expensive, as are the ongoing costs associated with running the software and managing changes in two independent systems.

Overview of Lubrication Management Systems

The purpose of the lubrication management system is to plan and schedule the deployment of lubrication to oil and grease lubricated machinery. It has been determined that inadequate or improper lubrication accounts for as much as 60% of all mechanical failures in industry. A lubrication management system should ensure that the correct grade of lubricant is delivered to the right place, in the right quantity, at the right time.

Following items should be included:

-Plant Audit of Lubricant Usage

- Create Daily/Weekly/Monthly Lubrication Routes

- Generate/Manage Lubrication Schedules

-- Management Reports of Lubricant Application/Usage

Overview of Lubricant Analysis Systems

The purpose of the lubricant analysis system is to administer the used oil analysis program. Used oil analysis is one of the most effective machine condition monitoring technologies available for rotating, reciprocating and hydraulic equipment. Lubricant analysis is used to monitor the wear rates of the machine itself, the level of contaminants in the lubricant and the condition of the physical properties of the lubricant. Software designed for managing oil analysis results (at the client site) should handle data produced by the most common oil analysis test types. This software should also be capable of retrieving oil analysis data in an electronic format, an option provided by most laboratories today. Lubricant analysis software programs commonly offer the following benefits:

- Help to Set Up an Appropriate Lubricant Analysis Test Regimen
- Generate/Manage Sampling Schedules (Print Labels)
- Acquire and Import Data Electronically from Lab
- Acquire/Enter Data from Onsite Oil Instruments
- Manage Rejection Limits (Alarm Levels) for Machines/Lubricants
- Management Reports of Machinery Condition Based on Lubricant Analysis

The final process for most lubricant analysis systems is the production of management reports. These reports come in two main categories - summary reports that cover the overall condition of many machines (usually all the machines that have recently been analyzed), and detailed reports that show trend graphs, tables of data and microscope images.

While standalone lubrication management and oil analysis software programs have some merit, there are **substantial benefits in integrating lubrication management and lubricant analysis tools**.

Conclusion

Lubrication Management software is a powerful tool to schedule. Supervise and record a consolidated lubrication program. It exploits and complements oil analysis by collecting trend data and developing responsive lubrication schedules. By enabling maintenance managers and workers to schedule and record lubrication changes for specific equipment, lubrication software automates the lubrication management function.

At Enluse we know how important a comprehensive Lubrication Management Program is when it comes to maximizing machine health, productivity and ultimately cost-savings. That's why we partnered with **Lubrilys**. Lubrilys is a solution designed by maintenance professionals for maintenance professionals. It will add value instantly by reducing the risk of production stops, adding to equipments lives, saving energy, improving productivity and supporting controls. It will also help sustain lubrication best practices in the long run.

LUBRILYS, the optimal lubrication management software (Lube software).

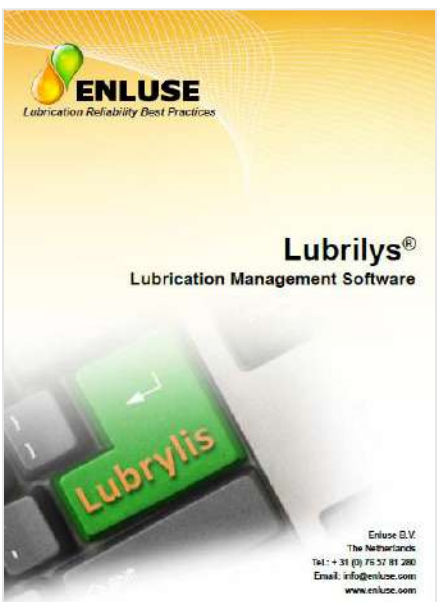
LUBRILYS has unique features:

It improves dramatically data reliability, enabling remote data entry (e.g. using tablettes to scan barcode on the lubrication point). It is a web designed application that can run on any IT platform and could be used in a Single-station or in a network environment. The software can also be used as an online application service (Cloud). Its interface is very intuitive and dynamic.

Watch the videos and see for yourself how your machines can operate at its highest level by regular monitoring and analyzing its performance.

The best way to do this is by using a computerized maintenance management system. You can track your machines'performace and oil usage, and set it to perform certain tasks at certain speeds under certain operating conditions. By having an automated system keeping your machines running at optimal performance, while also gathering data and monitoring your machine's health, you can greatly decrease the amount of wear on your machine, and maximize your output – providing significant cost-savings.

Visit our website for more information or download the brochure.



Source: Machinery Lubrication

3. Identification & Inspection

Identification

Lubrication points without proper identification are perfect source for errors with dramatic consequences: wrong oil or grease in a machine can cause sudden breakdown. Sometimes even small quantity cross contamination can result in catastrophic failure inducing.

To ensure that the right lubricant is added to a piece of equipment, a labeling system is needed. This is driven by the fact that in large plants multiple types of lubricants are used. Lubricants are complex chemical compositions and are often very incompatible, so to avoid errors of mixing lubes and to support industry standards, particularly in the food-grade industry, a good labeling system is necessary.

Labeling and color-coding of lubricants should be consistent and up to date throughout the program.

It can be a simple concept, but could prove to be difficult to implement and maintain. First step is to decide **where** to put the identification tags. Decide how to label each corresponding lubricant from bulk storage to the equipment it will be used in.

Identification (cont'd)

A few of the items that require identification tags:

- Gearboxes
- Funnels
- Bulk storage tanks/Totes
- Grease guns
- Drum pumps
- Transfer hoses
- Top-up devices
- Waste oil containers

It does not take huge investments to well identify or color code lubricants, dispensing equipment and lube points on machinery to avoid malicious cross contamination. A good tagging system is a key part of a world class lubrication program.

OilSafe has developed a comprehensive suite of industrial grade labels to suit your lubricant labeling program. Labels are available in a variety of sizes, materials and styles to provide the flexibility needed for the challenges that exist in industrial environments. Download the brochure or pay a visit to our website to learn more about Identification Labels.

Lubricant Inspection

While identification is imperative, lubricant inspection should be a continuous worry. It happens every day that machine components like gear boxes run dry of oil/grease. Oil Levels are overseen or too dirty to inspect or not even included in the technicians inspection route.

Or worse, no oil level indicator is installed on the machine making inspection impossible without opening the machine or draining it.

Visual Inspection

Many lube-related problems are not deep-seated, but are just basic errors of human judgment. As such, there are some basic, visual tools that are a powerful complement to the more sophisticated predictive maintenance technologies.

3-D sight glass

A reliable option for ensuring the proper oil level in pumps and small gearboxes is to use a **3D-sight glass**, which permits the oil level to be viewed from any angle.

Molded-in a hex nut means, that installing the 3D-sight glass is very simple and be done quickly.

Experts all agree that daily visual inspection is one of the most effective ways to ensure reliability.

Condition Monitoring Pod

Machine faults are faster detected with the Condition Monitoring Pod. This multi-parameter inspection pod lets you quickly observe oil level, color and clarity, oil aeration and foaming, corrosion, varnish, wear debris and much more. You will quickly identify root causes and symptoms of failure that would have previously gone undetected.

Level Gauge

When the housing does not have a sight glass port at oil level (to gauge the oil level inside large tanks, gearboxes, reservoirs etc.) a much better option is to use an external level gauge. Checking the oil takes a matter of seconds. The level gauges should be marked with level markers, showing the correct level when the machine is running and when it's down.

For more information see our brochure "Lubrication Monitoring and Inspection".

Oil Color

60-70% of all lubrication-related problems are caused by contamination. Visual analysis is a great tool to determine the presence of contaminants, particularly water.

Oil Color (cont'd)

A change in oil color can be a good indication of a problem. Change of color can be caused by thermal stress, oxidation, presence of wear metals or other debris. If observed color change, it is a good idea to extract a sample and perform an additional test. A change in color can also be caused by sunlight or other strong light sources.

Having a 3D oil sight glass and/or liquid level gauge is great for determining changes in oil color.

Conclusion

It is very important that visual leak checks are conducted. Sight glasses and level gauges give a great visual check as they are one of the easiest to observe. Any change in oil level, sight glass foaming, darkening, hazing or vanishing on that glass are all unwanted signs and indicators that there is a serious concern.

Inspection is crucial – don't just take lubrication for granted!

What is needed is an inspection culture:

Installation of oil levels on all machinery inducing regular monitoring?

4. Lubricant storage by cleanliness control

Did you know that 10 ppm of water in a bearing lubricant will half the bearings lifetime. This is the relative amount of two drops of water in a glass of great Belgian beer? Seriously!

Did you know that contamination is the cause of **more than 30 %** of lubrication related bearing failures?

Did you know that new oils have commonly a higher contamination level than recommended by the machine supplier?

Understanding Oil Contamination

The number one problem with lubrication today is contamination and this can be particle contamination or chemical contamination or both. A Lubrication Reliability strategy consistently uses three words.

These are **Cleanliness, Contamination** and **Control** and when combined they are generally used as **cleanliness control** and **contamination control**.

Cleanliness control is the processes and tools to ensure only clean lubricants are

added to the equipment whereas **Contamination Control** is the processes and tools to ensure only clean lubricants are ***operating*** in the equipment

So why the difference?

In lubrication management we spend a lot of time, effort and money to ensure the lubricants operating in our equipment are kept very clean, so why would we add dirty oil to an already clean system, it makes our work even harder, not to mention more costly.

Particle Contamination

The effects of particle contamination on bearing life is supported by a research project conducted by Doctor MacPhearson, which looked at the relationship between filter ratings and millions of bearing cycles to fatigue failure.
See figure 2.

This research and others conducted on the effect of contamination, conclude the same basic fact – the cleaner the lubricant the longer the machine life.

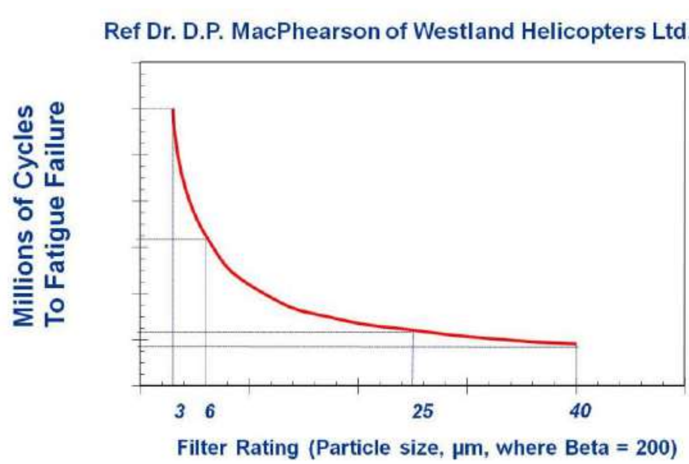


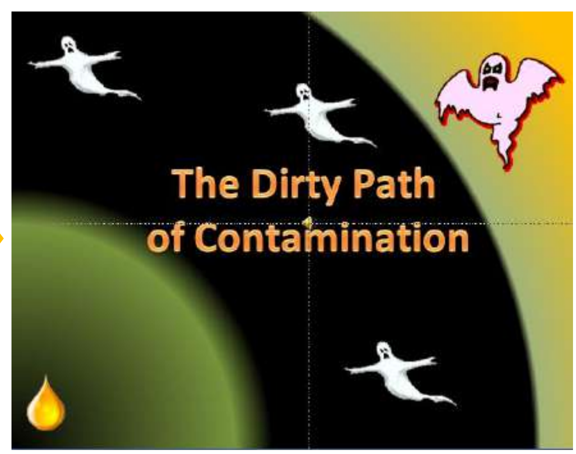
Figure 2

The International Organization for Standardization created the cleanliness code ISO 4406 to quantify particulate contamination levels per milliliter of fluid at three sizes: 4 micron, 6 micron and 14 micron and it is this code that is used by most companies to set their targets for lubrication cleanliness.

This ISO code is expressed in 3 numbers, for example 22/18/13. Each number represents a contaminant level code for the correlating particle size. Companies that are managing their lubrication contamination have ISO 4406 targets for different applications and set targets accordingly, depending on the criticality of the machine in their processes. Below are some examples of recommended target levels.

Hydraulics	15/13/10
Turbines	16/14/11
Engines	17/15/12
Gearboxes	18/16/13

Watch "The dirty path of contamination" video



Others have overall target levels set for the whole plants. In any case the key is to have a target level and then employ the actions to ensure the target is reached and maintained.

Organizations that are at Best Practice levels in managing their lubrication activities understand that oil can be contaminated in the process from when it is received at the store and when it is running in the machine. The following are some examples of how the lubricant can become contaminated along the way.

- Oil arrives on site (possible ISO 18/16/13).
- If a drum is left open.
- Dirty stick to check the drum level.
- Oil dispensed with dirty containers.
- Dirty hoses and funnels used.
- Machine running without air breathers.
- Wear debris is being generated in the machine and oil is not filtered (possible ISO 24/22/11).

The chart in figure 3 is an example of the reduction of the number of particles in a system if we can move from an ISO code of 24/22/19 to a best practice of 16/14/11. You will note that the number of particles in the oil is 250 times less, when the Best Practice level is achieved (fig. 3)

	4 µm		6 µm		14 µm	
ISO code	**More than**	**Up to & incl.**	**More than**	**Up to & incl.**	**More than**	**Up to & incl.**
24/22/19	80000	160000	20000	40000	2500	5000
18/16/13	1300	2500	320	640	80	160
16/14/11	320	640	80	160	10	20

250 times less contaminants from 24/22/19 to 16/14/11

The bottom line is that we need to ensure that only clean oil is added to the machine and is operating within it.

Managing Particle Contamination

There are 5 steps we need to consider in managing our oil cleanliness and contamination levels. These are:

1. Receipt of new oil.
2. Storage and conditioning of new oil.
3. Dispensing of the oil to the machines.
4. Stopping contaminants entering the machine.
5. Removing contaminants generated in the machine from wear.

1. Receiving New Oil

In step 1 it is important to remember that new oil is not necessarily as clean as we would like and if we are serious about our cleanliness standards then we should make sure it is conditioned before use to acceptable standards. If we store oils before use then this needs to occur in a dry and clean location. The drums should be preferably stored horizontally with the two entrances at 9 and 3 o'clock and to ensure they are not kept too long in storage then the first in first out process should also be employed.

2. Storage and Conditioning

Best Practice lube storage, is that all new oil is not only kept clean and dry, but the oil is also filtered before it enters the machine. Systems like the one shown in figure 4, filter the oil in three ways, when emptying oil from Drums into the storage tanks, over the storage containers and when transferring the oil to the dispensing container. High quality desiccant breathers prevent subsequent contamination to the fluid and flow meters measure and track the amount of oil dispensed.

Figure 4: Lustor™ - Lubrication Reliability System (watch the video)

If the right tools are used the oil will be kept clean!

3. Dispensing of the oil to the machine.

Several options exist for delivering oil to machinery:

a) Portable filter carts are effective tools for lubricant transfers and decontamination.

b) For applications with small sumps, oil transfer containers are used. Dispensing containers should meet certain criteria:
- sealable
- color-coded
- plastic
- be cleaned on a regular basis.
- be allocated for each type of oil

Figure 5

In addition to stopping contaminants entering the oil we also need to ensure that the right lube gets into the right machine and the standard practice is to use a color coded system of one color for one type of oil. The storage facility, the dispensing containers and the fill points all need to be **labeled.**

4. **Stopping Contaminants from entering the Machine.**

All oil reservoirs need to breathe, and unless they are protected this breathing process is a source of airborne contaminants entering the system. The fitting of Air Breathers on the systems preventing water, dust and dirt from entering the system.

Air Sentry introduced the Guardian desiccant type breather, manufactured with both particulate filters and desiccant, which is designed to help improve filter performance.

Watch the video about the working of the Guardian Desiccant Breather:

5. Removing Contaminants Generated in the Machine.

And the fifth step in the process is to filter the system in order to remove any contaminants generated from within, like wear debris for example.

ROI or Return on Investment.

A well structured lubrication strategy will require some investments. The costs are generally associated with the following activities:

• Dedicated lubrication management software.

• A remodeled or a new lube storage area.

• Oil dispensing systems.

• Air breathers.

• Filtering units.

• A labeling discipline.

• Oil Analysis tests

• Lubrication training for dedicated staff.

Conclusion

Lubrication practices within a plant have a direct effect on plant and equipment reliability. When the lubrication is working effectively, wear will be reduced and equipment reliability will be improved.

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5. Oil dispensing is an ART…!?

NO WAY !

It’s a question of using the right tools!

Oil storage and transfer containers are essential

Have you ever left your lubricants, that you depend on to lubricate your machines, open to dirt and moisture? Then no doubt you still use the old oil can with rags.

The reason that your expensive lubricants run the risk to get contaminated by dirt, water and other particulates. And even worse… your equipment get contaminated too. Since the smallest particulates can cause asset components to fail prematurely.

Cross contamination

Another problem with oil transfer and oil storage methods is incorrect lubricant usage or lubricant cross contamination.

OilSafe storage containers are the solution

Fully sealing units are the solution to prevent contaminants from getting into the oil. Sealable, reusable oil storage containers are easy to dispense without the need for tools like funnels. Another recommendation is integrating a color-coded system, which includes properly labeled containers to prevent cross contamination, so that contents are easily identifiable.

Lubrication Reliability with OilSafe storage and transfer containers!

Enluse can help you by supplying best practice lubricant storage and transfer container configurations. There are five lid types and five plastic oil storage body types to choose from. Lids are available in 10 colours so that you may maximize the visual identification aspect of this storage, transfer and handling tool.

Lubrication Reliability™

In our series of "10 steps to Lubrication Reliability" we are now halfway.

Maybe you think "this is a mission impossible".

In one GO, yes it is.

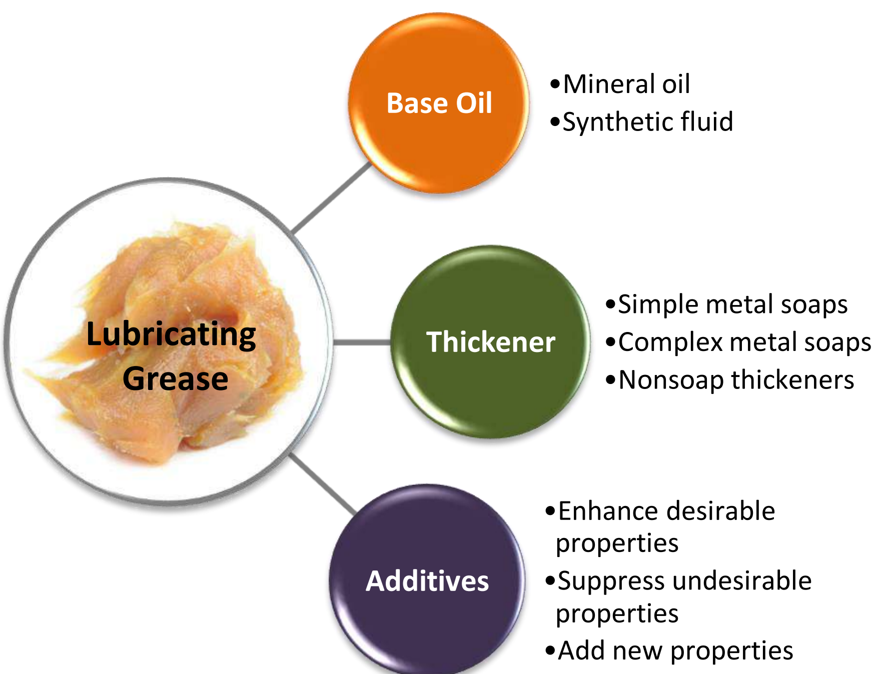
But gradually taken step-by-step and well planned in time: it is well feasible!

Remember, Lubrication Reliability is not a project, it is a continuously evolving program, or should we say culture, in which cleanliness control should be a continuous strive for excellence. Automatically, machine and component reliability follows. Many industries have proven it in the past; the door is now open for your plant.

6. Grease Lubrication

To understand why Greases are difficult to clean up once contaminated, first some background information on greases.

There are three components that form lubricating grease: oil, thickener and additives. The base oil and additive package are the major components in grease formulations, and as such, exert considerable influence on the behavior of the grease. The thickener is often referred to as a sponge that holds the lubricant.



Function

The function of grease is to remain in contact with and lubricate moving surface without leaking out under the force of gravity, centrifugal action or being squeezed out under pressure.

Applications suitable for grease

Grease and oil are not interchangeable. Grease is used when it is not practical or convenient to use oil. Based on the properties of grease, the following list describes situations where grease is the lubricant of choice:

1. Where leakage and drippage is present
2. In hard-to-reach places where lubricant circulation is impractical
3. Where sealing is required in a high-contaminant environment (i.e. water and particles)
4. To protect metal surfaces from rust and corrosion
5. To lubricate machines that are operated intermittently
6. To suspend solid additives such as moly during slow-speed, high-load sliding conditions
7. For use in sealed-for-life applications such as electric motors
8. To lubricate under extreme or special operating conditions
9. To lubricate badly worn machines
10. Where noise reduction is important

As with oil, grease displays its own set of characteristics that must be considered when being chosen for an application. Once the correct grease has been selected, it has to be applied properly with the right amount at the right frequency.

There are many different options for doing this. Ideally, a small amount should be applied more frequently. This is the advantage of using an automated system, such as single-point lubricators and centralized grease systems. The most common application system, though, is still the manual grease gun.

It is recommended to use techniques that avoid uncleanliness during storage and application: the lesser transfer of bulk grease the better. Use of **cartridges** or **automatic lubrication systems** are preferred.

In case bulk is used from drum, apply the right **follower plate, cover and pump**.

While it may be one of the oldest lubricants known to man, grease continues to be a vital part of any lubrication program. That's because the majority of bearings in a typical industrial plant are grease lubricated.

The importance of selecting the correct grease and applying it properly—*both in amount and frequency*—cannot be overstated. These activities are key factors in a world-class lubrication program. Getting them right is crucial in improving (and ensuring) the reliability of the equipment within your operations.

7. Contamination Control

Now once lubricants are applied to the machine the same strategy should be implemented:

avoid further contamination

and if possible

decrease existing contaminant levels.

Lube oil cleanliness is necessary for the reliable operation of machinery components such as bearings, gears and hydraulics. Failure to adhere to cleanliness standards can result in sluggish operation, excessive wear and premature failure.

Typical Contaminants

While oil contamination takes many forms, the following three classifications cover the majority of industrial problems:

Dirt - Dust and solid contaminants creep in from the surrounding atmosphere. Contaminants could include metal chips from machining, rust and wear products from seals, bearings and gears, core sand from castings, weld spatter from welding, paint flakes from painted surfaces and soot from diesel engines.

Water - The most troublesome sources are often condensation, cooler leaks, gland leakage and seal leakage.

Sludge - This forms primarily as a result of oxidation of the oil itself, especially at high temperatures. Accumulation of fine particles may also fill clearance spaces by silting, resulting in erratic operation and sticking of hydraulic system valves and variable flow pumps.

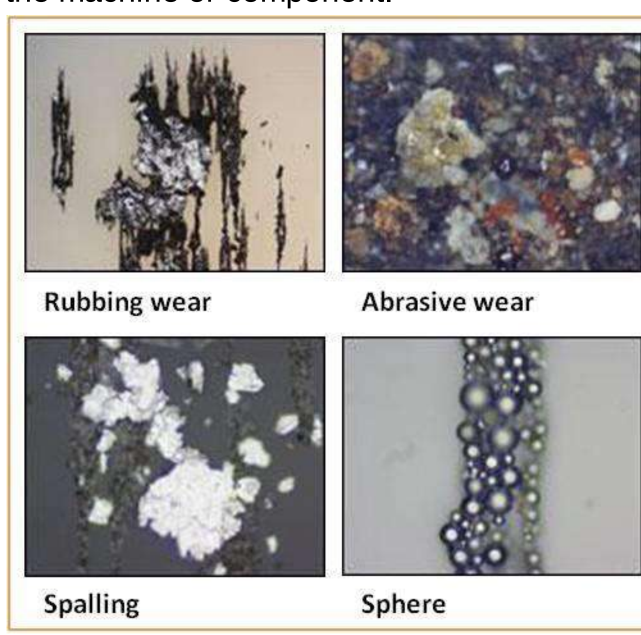
Different filtration specifications are required for each of these contaminants. With particulates, the maximum particle size should be kept below the minimum thickness of the fluid film.

With water, any free moisture may promote both rust and sludge by reacting with oil additives and metal surfaces. The critical limit of free water in the lubricant is the amount that causes the fluid film to fail in the load zone.

Once sufficient oil storage has been established, the next place for oil particulate contamination to occur is once the oil is in the machine or component.

This can happen in many ways. Open vents provide an easy means for dirt to enter machines. Faulty breathers are a common source of particulate contamination. Oil leaks or damaged seals are also culprits.

Remember, if oil is able to leak out of a system, contaminants are able to enter the system. Repair damaged seals or oil leaks as soon as possible.



Internal Contamination

Some form of internal particulate contamination is inevitable and can denote a problem with the machine/component. Internal particulate contamination includes any particles that contaminate the oil once it has been placed in the closed lubricated system - for example, wear particles, seal material, etc. When external particulate contamination is under control, a high particle count provides an early warning for an abnormal wear situation developing.

Particles, especially catalytic metal particles like copper, iron and lead, increase the oxidation rate. These particles also strip the oil of its anti wear additives, extreme pressure additives, rust inhibitors and dispersants. Numerous small particles in stable suspension can cause the oil's viscosity to increase and may promote foaming.

These particles are abrasive. As with all particulate contaminants, once in the oil, they accelerate the wear rate dramatically because abrasive wear can cause a chain reaction in lubricated machinery. The typical chain reaction is:

- Abrasive wear particles become work hardened.
- Work hardened particles produce more particles.
- New particles become work hardened.
- Chain reaction occurs until the particles are removed by filtration or the machine fails.

It is, therefore, imperative to monitor oil cleanliness and keep particulate contamination to a minimum. This is accomplished by implementing a contamination control program in these easy steps:

Contamination Prevention

After ensuring oil is free from contamination, consider the times when servicing the machine becomes necessary. When component changes or work is performed on the machine, make sure that all new components are free from contamination and that further contamination does not enter the machine during servicing. Ensure that all seals and breathers remain intact to prevent contaminant entry.

Contamination Removal

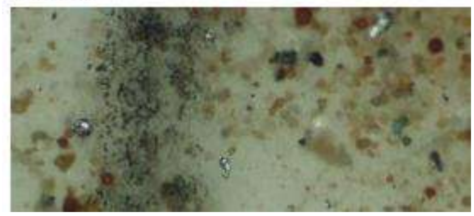
Contamination removal is accomplished with filters and filtration systems or oil draining and discarding. Each application must be evaluated when deciding which option is more cost-effective.
Using filters to achieve target cleanliness levels does not always require the best or most expensive filter. A cheaper filter used correctly may produce the desired results at a lower cost.
The effectiveness of a filter or filtration system can be tested by taking representative oil samples from before and after the filter.

Controlling the contamination of oil inside the equipment is critical. The international standard for measuring this is ISO 4406. Online and offline filtering systems are used to clean up the oil, while breathers or air conditioners are utilized to protect the lubricant.

ISO 4406 code

The ISO cleanliness code is used to quantify particulate contamination levels per milliliter of fluid at 3 sizes 4 µ ©, 6 µ ©, and 14 µ ©. The ISO code is expressed in 3 numbers (i.e. 19/17/14). Each number represents a contaminant level code for the correlating particle size. The code includes all particles of the specified size and larger. It is important to note that each time a code increases the quantity range of particles is doubling.

Photo 1



ISO 4406 Chart		
Range Code	Particles per milliliter	
	More than	Up to/including
24	80000	160000
23	40000	80000
22	20000	40000
21	10000	20000
20	5000	10000
19	2500	5000
18	1300	2500
17	640	1300
16	320	640
15	160	320
14	80	160
13	40	80
12	20	40
11	10	20
10	5	10
9	2.5	5
8	1.3	2.5
7	0.64	1.3
6	0.32	0.64

Sample 1 (see photo 1)

Particle Size	Particles per ml*	ISO 4406 Code range	ISO Code
4µ[c]	151773	80000~160000	24
6µ[c]	38363	20000~40000	22
10µ[c]	8229		
14µ[c]	3339	2500~5000	19
21µ[c]	1048		
38µ[c]	112		

Sample 2 (see photo 2)

Particle Size	Particles per ml*	ISO 4406 Code range	ISO Code
4µ[c]	492	320 ~ 640	16
6µ[c]	149	80 ~ 160	14
10µ[c]	41		
14µ[c]	15	10 ~ 20	11
21µ[c]	5		
38µ[c]	1		

To

Mo

Photo 2

Monitoring Cleanliness Levels

For effective monitoring of the oil, check for cleanliness levels in the machine as well as at several other points, such as new oil sources, bulk tanks or stored lubricants, or oil in service in equipment.

To monitor the level of contamination, test the oil and obtain a particle count.
Oil analysis is uniquely suited for proactive measurements such as the testing of incoming lubricants, contamination control, measuring water and dust in oil, and determining when oil is deteriorated or unfit for use.

More about oil testing in part 8 “Oil Testing” next month.

Reference: Machinery Lubrication.com

8. Measure Quality by Oil Analysis

Lubricant condition can be detected by means of oil analysis.

Designing a World-Class Oil Analysis Program

The impact oil analysis can have in helping improve equipment reliability and maintaining production uptime is huge. From providing a predictive early warning of impending failure, to seeking a proactive root cause solution, there can be little doubt that oil analysis is an **effective condition-monitoring tool**.
What exactly is involved in designing an oil analysis program that provides maximum payback?

Five Steps to Designing a World-Class Oil Analysis Program

Developing an effective oil analysis program requires careful planning. The program should be developed with a careful game plan in place based on a stated series of reliability goals. There are five basic steps to developing an oil analysis program (Table 1 next page).

FIVE BASIC STEPS TO DEVELOPING AN EFFECTIVE OIL ANALYSIS PROGRAM			
Step	Description	End User	Laboratory
STEP 1:	OIL ANALYSIS PROGRAM DESIGN		
	Select components to be sampled	x	
	Select the correct tests based on component type	x	x
	Select the correct tests based on failure history, RCM and FMEA	x	
	Select the correct tests for reliability goals (condition-based oil changes, extend MTBF, etc.)	x	
	Select the correct test metods based on desired limits	x	x
STEP 2:	SAMPLING STRATEGY		
	Select appropriate sampling location(s)	x	
	Select sampling frequency	x	
	Deploy correct sampling procedures	x	
	Use appropriate sampling tools and hardware	x	
	Ensure sample bottles are clean	x	x
	Provide appropriate sample information (lube type, hours on oil and/or machine, component manufacturer, etc.) for data logging and interpretation	x	
	Ensure samples are sent to the lab in a timely fashion	x	
STEP 3:	DATA LOGGING AND ANALYSIS		
	Log sample information into lab computer database correctly		x
	Provide up-to-date new oil sample for accurate base lining or data	x	
	Ensure lab is using correct procedures (ASTM, ISO, etc.)	x	
	Ensure test instruments are appropriately calibrated		x
	Ensure test procedures are accurate, documented and followed		x
	Ensure appropriate QC samples are run for all tests and appropriate action taken for all nonconforming QC samples		x
	Ensure correct exception tests are deployed when necessary	x	x
	Ensure samples are analyzed with 24 to 48 hours		x
STEP 4:	DATA DIAGNOSIS AND PROGNOSIS		
	Compare fluid properties (viscosity, acid number, etc.) with new oil reference and apply appropriate limits based on industry standards		x
	Evaluate wear debris data and flag according to OEM limits, statistical limits, trends, etc.		x
	Provide reliability goal-based limits for contamination control	x	
	Evaluate fluid cleanliness/dryness data relative to goal-based limits		x
	Review all sample data and make initial interpretative assessment		x
	Carefully review data in combination with maintenance activities and data from other CBM	x	
	Make appropriate CBM decision based on data, experience, reliability goals and objectives	x	

STEP 5:	PERFORMANCE TRACKING AND COST BENEFIT ANALYSIS		
	Use oil analysis to ensure oil condition targets are being met	x	
	Use oil analysis to track compliance with contamination control targets	x	
	Use oil analysis data in conjunction with asset management information to evaluate cost benefit of oil analysis	x	
	Continually review and improve oil analysis program to reflect reliability goals and to optimize oil analysis CBA	x	

Tabel 1

To maximize the opportunities for success, these steps should be performed in this order so that the program is developed on a sound footing.

Step No. 1. Initial Program Setup

The overall structure and foundation of an oil analysis program should be based on **sound reliability engineering goals**. These goals should guide the end user through the process of designing and implementing the program.

While the lab's experience in developing effective oil analysis programs can be used to support the design process, it is ultimately the end user's responsibility to ensure the program meets the company's goals and reliability objectives. In particular, attention should be paid to the types of test procedures used by the lab under different circumstances.

Program design - including test slate and procedure selection - is dependent on end user defined goals.

Step No. 2. Sampling Strategy

Of all the factors involved in developing an effective program, sampling strategy has perhaps the single largest impact on success or failure. With oil analysis, the adage "garbage in, garbage out" definitely applies. While most oil analysis labs can provide advice on where and how to sample different components, the ultimate responsibility for sampling strategy must rest on the end user's shoulders.

While bottom sampling can be useful in determining the presence of unusual levels of water, sludge and other debris, it is unlikely to yield any meaningful data from an oil analysis lab. Of course, sample strategy involves more than just sampling location. Sampling method and procedure, bottle cleanliness and hardware all factor into the sampling equation.

Perhaps second only to location in importance, is the provision of collateral information when the sample is submitted to the lab. For industrial equipment, as few as one sample out of 10 is submitted to the lab with appropriate information about oil type, hours on the oil, filter changes or the addition of make-up oil. Without suitable information, oil condition parameters such as viscosity or acid number cannot be compared to the new oil and trend analysis cannot be performed effectively.

Without exception, it is the responsibility of the end user to ensure that any and all pertinent information that can be used by the lab in the analysis and interpretation of the data be sent to the lab with each and every sample. Failure to do so simply means that the lab is guessing at whether or not any of the data is significant and should be flagged for attention.

Step No. 3. Data Logging and Sample

Analysis

Assuming the sampling strategy is correct and the program has been designed based on sound reliability engineering goals; it is now up to the lab to ensure the sample provides the necessary information.

The first stage is to make sure the sample, and subsequent data, is logged in the correct location so trend analysis and rate-of-change limits can be applied. That is the lab's responsibility.

Once the sample has been properly set up at the lab, the actual sample analysis is next.

This is an area where end users are definitely at the mercy of the lab and its quality assurance (QA) and quality control (QC) procedures.

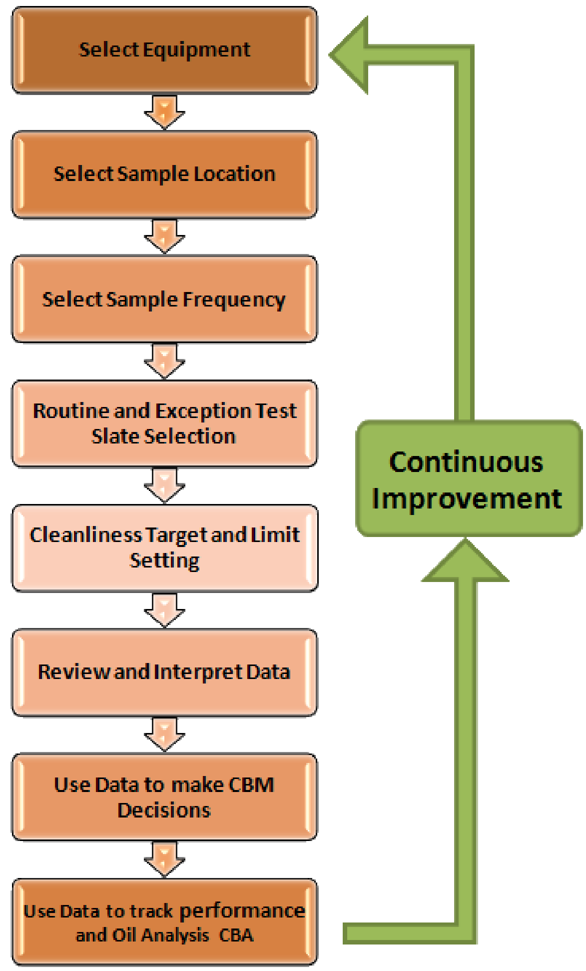


Figure 2. Oil Analysis Program Design

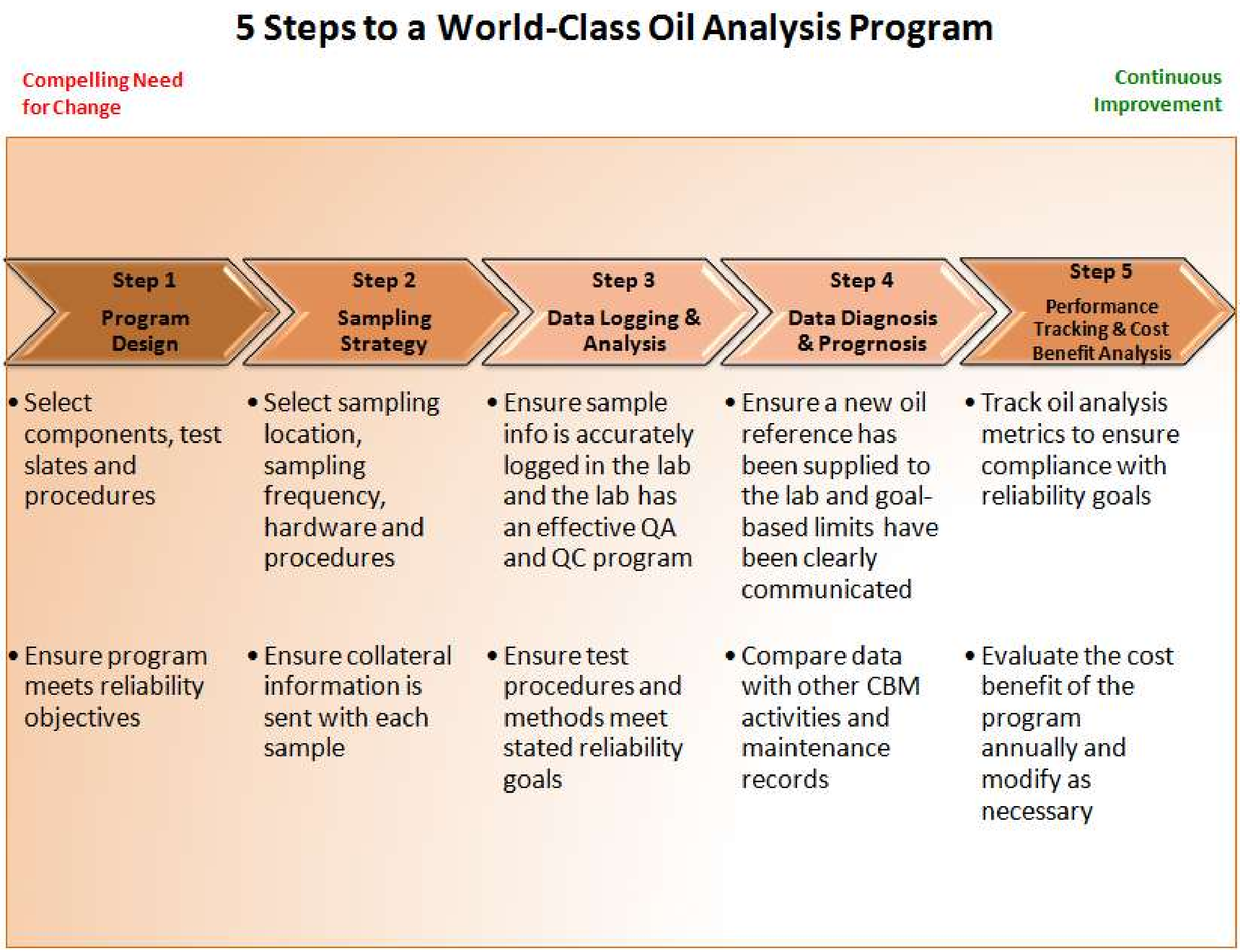


Figure 3 Steps to a world class Oil Analysis Program

Step No. 4. Data Diagnosis and Prognosis

Diagnostic and prognostic interpretation of the data is perhaps the step where the most antagonistic relationship can develop between the lab and its customers. For some customers, there is a misguided belief that for a ¤10 oil sample, they should receive a report that indicates which widget is failing, why it is failing and how long that widget can be left in service before failure will occur. If only it were that simple!

The lab's role is to evaluate the data so that complex chemical concepts such as acid number or the presence of dark-metallic oxides makes sense to people who may have many years of maintenance experiences, but haven't taken a high school chemistry class in many years. The lab cannot be expected to know - unless it is specifically informed - that a particular component has been running hot for a few months, that the process generates thrust loading on the bearings, or that a new seal was recently installed on a specific component that is now showing signs of excess water in the oil sample.

Evaluating data and making meaningful condition-based monitoring (CBM) decisions is a symbiotic process. The end user needs the lab diagnosticians' expertise to make sense of the data, while the lab needs the in-plant expertise of the end user who is intimately familiar with each component, its functionality, and what maintenance or process changes may have occurred recently that could impact the oil analysis data. Likewise, evaluating data in a vacuum, without other supporting technologies such as vibration analysis and thermography, can also detract from the effectiveness of the CBM process.

While the end user must bear some responsibility for correctly evaluating the data, the lab does have some culpability.

Step No. 5. Performance Tracking and Cost Benefit Analysis

Oil analysis is most effective when it is used to track metrics or benchmarks set forth in the planning stage. For example, the goal may be to improve the overall fluid cleanliness levels in the plant's hydraulic press by using improved filtration. In this case, oil analysis - and specifically the particle count data - becomes a performance metric that can be used to measure compliance with the stated reliability goals. Metrics provide accountability, not just for those directly involved with the oil analysis program, but for the whole plant, sending a clear message that lubrication and oil analysis are an important part of the plant's strategy for achieving both maintenance and production objectives.

The final stage is to evaluate, typically on an annual basis, the effectiveness of the oil analysis program. This includes a cost benefit evaluation of maintenance "saves" due to oil analysis. Evaluation allows for continuous improvement of the program by realigning the program with either preexisting or new reliability objectives.

Summary

There can be little doubt that oil analysis is an integral part of any condition-based maintenance program. When used effectively, it can warn of impending failure, direct us to the root cause of a problem, or point to areas of opportunity we perhaps didn't know existed. However, just like you wouldn't buy a used car without checking under the hood, taking it for a test drive and kicking the tires, don't merely assume that filling the sample bottle with oil and sending it to the lab will produce the desired results.

Some years ago Enluse B.V. And Polaris Laboratories started a partnership in Europe. Regardless of where your machines are located, we are ready to assist you in analyzing lubricating oils, hydraulic fluids and lubricating greases. The business model used is unique in the world of analyzing liquids and oils. It provides you with reliable test results and recommendations.

We are pleased that we can offer you this additional service. The importance of proper lubrication can not be emphasized often enough. It's the most important factor for a long and trouble-free life of your machines. Oil analyzes play a major role in reducing machine failure. A precise picture is obtained of what is happening in your gearboxes, hydraulic systems, generators, etc. In addition, the analysis provides crucial information about the oil condition. Unplanned production failures and risks of damage to expensive installations are prevented by effective oil controls.

Enluse can provide you with economical and easy-to-use oil sampling kits. The samples can then be sent to the laboratories; The default processing time is 24 to 48 hours after receipt. The laboratories are accredited with ISO 17025 and have the latest, automated equipment.

In addition to the partnership, we also launched our own private label - **FanPro ™** (Fluid Analysis Program).
For detailed information visit our website www.FANPROTESTING.COM.

Oil analysis is an essential part of a successful reliability program. An extensive oil analysis can help you check total maintenance costs by anticipating interruptions or extending service life.

If you are interested in our analysis services, please contact (tel. +31 (0) 76 57 81 280) or send an email to info@enluse.com.

Reference:

Noria Corporation - Machinery Lubrication

ENLUSE

9. Environmental Control

If spilled, lubricants can contaminate the environment.
Therefore, most maintenance strategies today work to prevent
such contamination from occurring. This is also a key ingredient in world-class manufacturing standards.

Gradually more and more companies are becoming aware of the effects of lubricant disposal and the impact on the environment. Within the company there should be an understanding of lubrication best practices. The use of quality lubes will go a long way in keeping equipment running longer, smoother and with greater efficiency. Good lubrication keeps equipment from ageing prematurely. Studies have shown, that well-oiled machinery consumes less electrical power, and this savings can help finance proactive maintenance.

Making good environmental lubricant choices does not have to compromise equipment reliability or functionality. In fact, appropriate environmental decisions can be part of a first-rate, cost-effective design. The design aspects include the equipment itself, maintainability, economic life span, ergonomics, operation and eventual removal. Removal does not necessarily mean disposal, because there may be some recoverable value left in the machine.

For example**:**
Oil in equipment should not be changed unless it has reached the end of its useful life. This is typically not the case, because the oil is often changed based on an

arbitrary time criteria or because of contaminants such as water or dirt. These contaminants can normally be removed with the proper equipment.

A longer oil lifecycle not only contributes to less liquid waste, but there are other benefits as well: cost savings because labor can be used more effectively elsewhere, and fewer shutdowns for oil changes. These added costs can amount to at least five times the price of the oil alone. In addition, not having to drain the old oil, move it for disposal and bring in new oil also means less chance of spills. Spillage can often occur when a pail is knocked over or a drain valve breaks off.

The effect of lubricants on the environment is proportional to the amount used, so minimizing consumption is a major component to conserving natural resources. Therefore, anything that can be done to minimize consumption is worthwhile to your lube management program.

Product Effectiveness

For a lubricant to be most effective, a number of correct decisions must be made throughout its service life, such as the following:

Initial Selection

Selecting the proper lubricant is important to sharply reduce long-term costs. The best-fit product selection can mean longer lubricant life, reduced machine wear, reduced incipient power losses and improved safety. Suitable base stocks and additives reduce environmental impact. This is important because there will be leaks, spills and eventual disposal.

With the right lubricant, there is a greater likelihood that a product can later be used elsewhere in less demanding applications. The correct choice might be synthetic lubricants, lubricants with different additives, or biodegradable products and/or products with less environmental impact. The best product selection for each application varies, depending upon the equipment specifics.

Equipment Design

Eliminating conditions such as hot spots and air entrainment, as well as providing a good ergonomic design, will reduce the stresses on the lubricant. Proper and effective maintenance is the key for maximum performance from both the equipment and the lubricants.

Equipment should have adequate seals to prevent the ingress of contaminants and reduce lubricant loss. Breathers should have adequate provisions for filtration to remove particulates and contact-type shaft seals should be selected based on lifecycle and durability. These kinds of features help extend the life of the lubricant and the equipment. Proper component selection and configuration can also mean lower temperatures and possibly less auxiliary equipment such as coolers or heaters.

Reducing Liquid Waste and Cost

Industrial lubricant lifecycles can be extended dramatically from typical annual lifecycles if the lubricant is managed effectively in the sump. To get maximum value from the oil-lubricated components, keep the oil cool, clean and dry. For self-contained sumps this can simply mean ensuring that make-up oil is added properly, that the breathers are adequate and operational, and that any cloudiness is corrected. For circulating oil systems, ensure that the make-up oil is not a source of contaminant. In most cases, side-stream filtration, either continuous or intermittent, can be deployed to control these factors.

Condition Monitoring

Lubricant condition monitoring (oil analysis), is critical for safe lifecycle extension.

Analysis serves three main purposes:

First, it ensures that the right lubricant is in place.

Viscosity, additive content and acid number are all telltale indicators of lubricant mixing. Some types of cross contamination become immediately evident. For example, even a slight amount of combustion engine oil mixed into the turbine circulating oil will destroy the turbine oil's ability to shed water. Extreme pressure additives may be necessary in some cases, while the same additive may be detrimental in others. Generally, they shorten service lives or present additional considerations for materials such as for the plastic cages in bearings.

Secondly, machine condition monitoring, when done in conjunction with lubricant condition monitoring, provides a long-term view into the health of the production asset. An advantage of lubricant-based analysis is that it detects machine problems in the oil before the problems are manifested in the equipment. Other analysis methods, while certainly beneficial, measure for damage that already exists at a level which almost always requires repair. This is important, as the goal is not to save the oil, which is typically inexpensive, but rather to prevent damage to and extend lubricant component lifecycles. Even an inexpensive shaft bearing will require taking that equipment out of service to be replaced.

Lastly, oil testing determines what is required to keep it in good condition. This can be purification or additive supplement through sweetening (bleed and feed). When contamination exists, it is usually an advantage if the lubricant can be treated while still in the equipment so an outage will not be required.

Recommendations

- Know the products and equipment and use them wisely.
- Know what you are using, and know how to track it from cradle to grave.
- Have financial objectives in place that actively support the use of energy-saving

green and/or cost-saving products.

- Do not compartmentalize the decision-making process so much that initiatives die. Let a champion go with getting support or direction as required.
- Talk to industry/government resources before embarking on new project. Do not do the wrong thing for the right reasons. It is beneficial to use existing technology and resources.

From the perspective of environmental impact, managing your lubricant consumption can be a challenge!

Ref.:
Machinery Lubrication – K. Brown

10. Feed the brain & train

When lubricant is the lifeblood of your equipment,
good lubrication practice includes several elements. Nine of them have been discussed in the foregoing chapters. Today step 10 will be looked upon: Training and Education.

Around the world lubricant is added to machines every day. This to prevent failure and preserve the lubricant function, i.e. overcome friction. If friction is the enemy to reliability, an effective lubrication program is absolutely essential.

Educating the work force is a fundamental element of a good lubrication program. The people who lubricate the equipment need to be Machine Lubrication Technician (MLT) trained and certified. The days when lubrication was performed by everyone and anyone are gone.

Machinery Lubrication level I*
You will learn proven industry methods for selecting, storing, filtering and testing lubricants to boost reliability and generate lasting results in machine efficiency/maintenance. You will also gain better understanding of oil analysis, so they can align their efforts with those of maintenance professionals or oil analysis experts.

Machinery Lubrication Level II*
If you have already scratched the surface of the amazing improvement and resource-saving potential in good lubrication practices, ML II will round out your

perspective with excellent preventive maintenance techniques. You will learn how to identify wear patterns, degraded lubricants, and those small but significant leaks that can spell disaster over a period of time.

It is also a good idea to have at least one person certified as a Machine Lubricant Analyst (MLA). MLA certification is a step beyond or above MLT; the Analyst is trained to collect as well as analyse lubrication samples.

Oil Analysis Level II*

Lubricants can serve as a wellspring of information for preventive maintenance. If you find yourself wanting to bring the valuable benefits of on-site fluid testing to your workplace, Oil Analysis II will equip you with everything you need. You will learn what to look for when sampling and performing your own on-site oil tests – detecting harmful particle and thermal stressors that degrade lubricants before they do serious damage.

Oil Analysis Level III*

If your dream is to reach high levels of diagnostics, analysis and even program design, Oil Analysis Level III is the most advanced course. You will learn the more detailed aspects of fluid analysis, technologies associated with it, and even how to go a step further from simply performing on-site tests to launch a strong oil analysis program at your workplace.

The International Council for Machinery Lubrication (ICML)

ICML is a vendor-neutral, not-for-profit organization founded to facilitate growth and development of machine lubrication as a technical field of endeavor. Among its various activities, ICML offers skill certification testing for individuals in the fields of machine condition monitoring, lubrication and oil analysis. (http://www.icmlonline.com/about_us.aspx)

Make Your Lubrication Programme Visible!

Even though the vast majority of your lubrication programme will not be completed by your MLTs and MLAs, your lubrication programme will typically need to become more visible. All lubrication points should be documented, put into lubrication routes, and labelled for the correct type and amount of lubricant.

Lubrication sight glasses should be clearly labelled with a green area showing the correct level, and red areas that clearly indicate too much or too little lubricant. Lubrication points can be colour coded to match the colour of the lubrication dispenser to help make clear that the correct type of lubricant is being added.

Operator Lubrication Tasks

Operator Care and Total Productive Maintenance (TPM) can be very powerful tools to help improve the reliability of your assets. The key here is to ensure that tasks are transferred at the correct level; operators should only be performing lubrication tasks on equipment they are responsible for operating and the tasks they perform should be required each day or each shift.

Those who start out with good intentions train people, transfer the tasks, and audit for a short time, but the next thing they know, three new operators who have never been trained in how to properly perform the task are running the equipment. In no time at all, there is a rash of lubrication-related equipment failures.

All who make this step be certain that you take the time to think through how you plan to manage the programme on a daily, weekly, monthly, quarterly, and annual basis. Make sure to include up front how you will manage changes in personnel in terms of operators, MLTs and MLAs.

Ref.: *Noria*
MaintWorld-Lubrication Excellence

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