

Lubrication management

Elearning course transcript.

Welcome to this course, which looks at lubrication management. We hope you will enjoy learning with us, and that you'll find the material useful in your daily work.

Navigation tour

Use the Prev and Next buttons to move page by page within a module.

You can navigate through the course modules by clicking the links in this navigation menu.

Return to the start of the course at any time by clicking the home button.

By clicking the "Transcript" link you can download a copy of the course narration in document format.

Click the audio button to control the volume, or to mute the audio soundtrack.

Use the play / pause control to pause / resume playback of the current page.

Special notes for iPad users

This course plays in the "Articulate mobile player app", available free from the App store.

The app's library offers a download option for offline learning, but please note that an on-line connection is required to use any hyperlinks included in the course.

Please also note that, if you wish to be able to print your course completion certificate, then you need to be on-line when you take the end-of-course test.

Module 1: Introduction

We'll begin by reviewing the course structure, and the learning objectives. The course is divided into three main modules. Click on the module titles in the list for more detail.

1. At the end of module 1 you will be able to explain what is meant by the term "poor lubrication" and you will be able to discuss the impact that poor lubrication practices can have on a plant's costs and key performance indicators. You will also be able to list five issues relating to poor lubrication practices, that are commonly found in all industries and countries.
2. At the end the "program structure" module you will be able to list 10 aspects that need to be addressed by a well designed and implemented lubrication management program. You will also be able to discuss each of these aspects in general terms. Using some self-appraisal questionnaires provided you will be able consider and perhaps identify some weaknesses in your current situation.
3. After completing the "Conclusion" module you will be able to describe, in general terms, the five-step approach that SKF adopts when designing and implementing a lubrication management program.

At the end of the course you have an opportunity to take a test to see how much you learned. iPad users should note that you'll need an on-line connection if you want to be able to download and print your course completion certificate.

Module 2: The importance of lubrication management

In the first module we'll look at why good lubrication management is important.

SKF experience suggests that poor lubrication practices are responsible for around half of premature bearing failures. However, lubrication is typically not considered as a key maintenance activity. The reason for this might lie in the fact that the budget for lubricants usually represents only a very small fraction of the total maintenance budget. However, poor lubrication practices often have a significant impact on business performance, through lost production costs, increased labour costs, etc.

Poor lubrication practices may relate to lubricant selection, storage and handling, and lubricant contamination. Bear in mind that often, once the bearing has been properly installed and sealed, the only contact that it will have with the outside world will be by means of any lubricant that may be added from time to time. Therefore, providing clean and cool lubricant is key element of a maintenance program, if the life span of a machine component is to be maximised. Improper relubrication practices can also destroy seals, allowing the ingress of external contaminants. Based on these facts, and on the data presented on the previous slide, we can therefore claim that, with an effective lubrication management program in place, we could help to control about half of premature bearing failures!

Premature bearing failures can have a profound impact on the business, driving up costs, compromising product quality, and perhaps also having implications for plant safety and the environment.

Author John Moubray, in his discussions about reliability centred maintenance, describes how the condition of a given asset evolves over time. He describes a given point in time when an incident occurs and a failure begins. However, the failure can only be acknowledged some time later, when its symptoms become detectable by predictive maintenance techniques. This point is labelled point "P" in the graph here. From that point onward efforts may be made to slow down the evolution of the failure, but the deterioration process has already started. Furthermore, the investment in resources & technology to control the failure is typically much higher than the effort that would have been required to prevent the incident which instigated its onset. Lubrication management focuses efforts in the first zone of this curve, before the failure has started. Indeed, poor lubrication practices are often the problem which starts the failure, by introducing contamination, by damaging seals, or by generating elevated temperatures as a result of over or under lubrication, etc.

To illustrate how things can go wrong, let's review a typical example, based on a real case from a cement factory. This diagram shows the general process for cement production. The "raw mill" is a critical asset in this process. You can learn more about the raw mill by locating it in the process diagram and clicking on it.

The function of the raw mill is to grind the raw materials, which are then fed to a cement kiln, which transforms them into clinker. The clinker is then ground to make cement in the cement mill. The rawmilling stage of the process significantly impacts the physical properties of the finished cement, and greatly influences the efficiency of the whole process.

Example 1 Root cause analysis

This incident was investigated as part of a Lubrication Management Audit. The mill had been subject to frequent, premature bearing failures which significantly limited the availability of the machine, generating numerous unplanned maintenance shutdowns, with associated lost production and repair costs. The financial impact was significant.

- The first step was to check the OEM recommendation: Glygoyle HE 460 (a Synthetic Polyalkylene Glycol (PAG) oil with 460 cSt).
- Then, the lubrication plan was checked in order to state what instruction was received by the lubrication technician. It was found that the lubrication routine specified an outdated designation for a different polyglycol oil.
- Then, looking at an oil analysis report from the laboratory yet another, different oil was mentioned, having a lower viscosity compared to the oil that was recommended by the OEM.
- Finally, an oil sample was taken from the plastic reservoir used to top up this machine. This showed less than 5% of the recommended viscosity. Even worse it showed contamination with almost 1000 ppm of iron!

Example 2 Root cause analysis

Let's take a look at another case now, this time from the beverage industry, involving a gearbox from a filling machine. The OEM recommended a synthetic ISO VG 220 gear oil. The machine's lubrication routine, however, specified a mineral oil.

Analysis of an oil sample revealed contamination with almost 10,000 ppm of water, and a viscosity of around 300 centistokes. (This would be expected, given the vast amount of water present). So although this gearbox might not fail suddenly, its service life will certainly be significantly reduced due to these poor lubrication conditions.

Common issues

Click the tabs here to learn about other issues that are commonly found in most industries / countries.

- "Contamination" refers to either ingress of solids, water, or even air.
- "Cross contamination", refers to the unintentional mixing of different greases.

Funnels, open reservoirs, open grease cans, and homemade tools are typical sources for contamination. Leakages not only represent loss of lubricant but may also have an environmental impact, and / or safety implications. Leaks can also create the risk of contamination. Lubrication tasks often require executions in hazardous locations or environments. Inadequate lubrication may lead to either product contamination or production losses due to machine damage.

Module summary

In this module

- we've learned what is meant by "Poor lubrication" and we've seen that it may be responsible for up to half of all premature bearing failures.
- We looked the impact of poor lubrication on a plant's costs and KPIs.
- We considered how failures evolve over time and realised that attention to good lubrication practices can be more cost effective than implementing measures to slow down evolution of the failure or to mitigate its effects.

Module 3 Lubrication management program structure

Let's now look at the various parts of a lubrication management program.

The objective of a lubrication management program is to ensure is that each point receives the right lubricant, in the right amount, at the right time, using the right method.

To do so, the program must cover ten facets, as listed here. Click on each of these facets to learn more.

Be sure to fully explore all the information that's offered here, before moving on.

Lubricant selection.

Just think about it: When was the last time that you checked the suitability of the lubricants you have in your plant? You might follow OEM recommendations, but, is your machine still working under the conditions that the OEM designed? Are you taking advantage of the latest available technologies in lubricants and lubrication systems? Are there possibilities for consolidation of lubricants? What if you have to select a lubricant? Is your team technically capable of doing so?

Bear in mind that lubricants are chemical compounds whose performance depends highly on the formulation and production procedure and its process control. Two lubricants might not have the same performance even if they look alike in their description. Therefore, a deep understanding of the performance tests is required. For a brief introduction to these concepts, review the "Lubrication basics" course.

So, when it comes to lubricant selection, here are some basic questions you might ask yourself to identify areas for improvement. Click the image to download and print a copy of the questionnaire for future reference.

Logistics and supply chain

Logistics is an important part of the program, because of the need to guarantee the quality of the lubricants acquired. First task to be performed relates to the consolidation of lubricants: Acceptance tests or control measurements should be implemented to make sure that viscosity & cleanliness level of oils is within acceptable limits, or that grease consistency is according to specification.

Efficient management of the lubricant stock is necessary to avoid lubricants remaining in storage beyond their recommended shelf life. Identifying the ideal stock level and pack sizes are important factors here, as well as ensuring that stock rotation follows a "first in first out" methodology. A clear and consistent labelling methodology will ensure that any person involved with lubricant handling can easily and unmistakably identify a lubricant by simply looking at its packaging.

Storage and handling

The main goal when setting up the storage room, and defining the relubrication tools required, is always to deliver clean, dry and fresh lubricant. A proper storage room should be equipped as a minimum with the following:

- Temperature and moisture control
- Fire control devices
- Personal cleaning areas
- Non-slippery floors
- Spillage control devices
- Lubricant analysis area
- Disposal area
- Storage area for short term consumption
- Properly identified and individual lubrication and transfer tools

Storing lubricants in exterior locations is not recommended, but sometimes it is unavoidable. Still, some measures can be taken to minimize the impact of the environment on the lubricant, like storing the drums upside down over wooden pallets, or at least tilted and covered with a canvas.

So, when it comes to lubricant storage and handling, here are some basic questions you may ask yourself to identify areas for improvement. Click the image to download and print a copy of the questionnaire for future reference.

Lubricant application

Regarding the handling of lubricants, care has to be taken in the selection of the lubricant transfer tools in order to ensure two things:

1. That the risk of cross contamination is prevented: That is the application of a given lubricant in a point intended for a different one.
2. That the risk of external contamination is minimized when transferring a lubricant (oil or grease) from its original reservoir to the final point.

Some techniques to achieve these goals are:

1. Colour coding of tools and points
2. Specific and closed transfer tools, for example to refill grease guns directly from the grease pail
3. Use specific types of connections for specific lubricants
4. Enhance the lubrication routes and tasks with all the details of the lubricant to be applied to a given point
5. Provide specific training to the personnel
6. Write procedures including verification steps

So, when it comes to lubricant application, here are some basic questions you may ask yourself to identify areas for improvement. Click the image to download and print a copy of the questionnaire for future reference.

Lubricant analysis

A lubricant analysis program should consider aspects like:

- Which are the assets whose criticality requires a lubricant analysis routine?
- Based on the type of asset and working conditions, which are the primary tests to be performed?
- What is the frequency with which those primary tests should be performed?
- What are the alarm and limit levels for those tests?
- Which secondary tests must be performed in the event that a given alarm or limit is reached?
- What are the recommended actions to be taken when an alarm condition is confirmed?
- Are the assets equipped with suitable sampling ports?
- Are there correct and complete procedures in place for sample taking?
- Are personnel trained in how to properly take a sample?
- Does the sampling equipment being used provide accuracy and repeatability?
- Is the laboratory providing reliable and prompt information?
- Is there a way to store and track all the information obtained from the analyses?
- Are there field tests in place that help to take fast decisions, especially in cases where the response time from the laboratory is not fast enough?

In any given asset, the tests performed must ensure we collect information regarding three different aspects:

1. Lubricant condition: Are the properties of the lubricant still within the permitted limits compared with the fresh lubricant? Some parameters to be controlled are, e.g. viscosity, acid number and additives' package
2. Machinery condition in order to identify wear signals. This can be done by means of measuring particles being generated, or by assessing the elements being present in the lubricant sample.
3. Contaminants: Solid particles and water are typical contaminants within an oil sample that need to be identified, quantified and controlled.

So, when it comes to lubricant application, here are some basic questions you may ask yourself to identify areas for improvement. Click the image to download and print a copy of the questionnaire for future reference.

Contamination control

Contaminants can be varied and come from many sources. In general, a contaminant could be defined as anything that is not supposed to be in the lubricant. Typical contaminants include dust, fluids, metallic particles, air and bacteria. There are three types of sources for contaminants:

1. inherent to the system, for example in the case of a brand-new machine that has burrs or fibers from its construction process.
2. External, when contaminants enter the system through defective seals or when lubricant is replenished.
3. Released, when a filter has yielded to pressure changes or to vibrations, releasing particles that had previously been trapped.

ISO 4406 defines codes to indicate the cleanliness of a fluid. The code indicates the number of particles per milliliter larger than 4,6 and 14 microns that are present in an oil sample.

Oil cleanliness certainly affects the life of Components. In the case of bearings, studies have found that reducing the cleanliness codes and the water content of the lubricating oil can dramatically extend the bearing life. Modern SKF bearing life calculations and models take these effects into account.

Points that have to be controlled in order to reduce contamination level are related to:

- First, Filters: where the Efficiency, mechanical rigidity and pore size are defined based on the working conditions.
- Secondly - Seals: Harsh environments might require special sealing solutions. SKF has a comprehensive range of products and services to help you improve your sealing applications.
- Next point for considerations is Leakage control: leakages not only lead to lubricant waste and environmental impact, they allow the ingress of contaminants too.
- Finally, lubrication practices: Once again, relubrication activities are a typical source for contamination. Proper tools, procedures & training will help to minimise this effect.

So, when it comes to contamination control, here are some basic questions you may ask yourself to identify areas for improvement. Click the image to download and print a copy of the questionnaire for future reference.

Management and procedures

Once the lubricants have been selected, frequencies and quantities specified, and tools carefully selected to minimize contamination, the next logical step is to schedule all the different tasks to be performed. In order to do so, a simple worksheet might be helpful, but certainly there are more advanced resources for such purposes.

A very basic one, suitable for small and medium size enterprises is the SKF Lubrication Planner. Conceived as a simple to use and free of charge tool, the SKF Lubrication Planner can help you to create a tree structure with all your lubrication points, and a description of the tasks to be performed at each of them. The SKF Lubrication Planner will then allow you generate, on a regular basis, a list of the various tasks that have to be performed in a given time frame. When the tasks are completed, simply go back to the software, mark the tasks completed and they will be automatically re scheduled for the next time they need to be undertaken. Furthermore, SKF Lubrication Planner will allow you to create tags with for each point, so you minimise the risk of cross contamination.

SKF TLAC 50 tags are designed for this purpose and provide a suitable cap for your lubrication point at the same time.

Regardless of the software you use, any selected system for information handling must allow you to go back in history and verify which task was performed, when and under what conditions, as well as providing the technician with all of the information that he needs to perform a given relubrication task. An instruction like "Lubricate bearing 123" is certainly not enough if you want to minimise the risk of bad practices. A suitable instruction must include at least:

- Point identification
- Procedure with instructions as a reference in case it's needed
- Reference to the lubrication card of the machine in case it's needed
- Lubricant to be applied
- Quantity to be applied or indication of the adequate filling level
- Tools required
- Any control point that has to be verified

Written procedures help to ensure that knowledge is retained for transfer to future generations. Not only this, experience says that as you write down what you do, you might realize improvement opportunities that can be implemented. When it comes to lubrication tasks, such improvements are normally related to opportunities to minimise external or cross contamination, for example:

- Which tools do you use to transfer the lubricant from the original reservoir to the final lubrication point?
- Do you have use oil ports to replenish a given oil sump or do you have to open a lid in a heavily contaminated environment?

Once the procedures are written, they should be communicated and made available to all the people involved in the execution of the lubrication program. Procedures might include:

- Documents describing how to perform a given task or process
- Lubrication cards: Including all the working parameters of a given asset for future reference
- Lubrication graphics: Describing all the lubrication points and making reference to the tasks to be performed in a given asset

So, when it comes to the program management, here are some basic questions you may ask yourself to identify areas for improvement

- Is the criticality of your assets defined?
- Do your lubrication routines follow those criticality parameters?
- Is the workload well balanced among the technicians?
- Do you keep track of the activities performed?
- Are all procedures well documented, implemented and kept up to date?
- If a new technician is hired, can he learned what needs to be done and how to do it, simply by reading the procedures handbook?

Click the image to download a copy of the questionnaire for future reference.

Automation policies

After realizing what a lubrication program encompasses, you might think that your available resources will never be enough to accomplish all of the tasks. This is where automatic lubrication takes a great importance. The main benefits of automatic lubrication are listed here:

- Allows relocation of resources in order to improve the lubrication or maintenance program.
- Helps to minimise the risk of lubrication points to be overlooked in a lubrication routine.
- Helps to minimise the safety risks that lubrication technicians might encounter while performing relubrication tasks.
- Helps to provide small and consistent amounts of fresh and clean lubricant on a regular basis thus minimizing the risk of over or under lubrication and optimizing lubricant consumption.
- Minimise the risk of contaminants ingress.

Single point lubricators as the name suggests, automatically deliver the correct amount of grease to a single lubrication point over a set time period. These units are most suitable for points involving:

- Frequent relubrication demand, which is time and labour consuming.
- Points which would otherwise require machine shutdown to allow relubrication to take place, and for points having safety implications, due to difficult access.

Typical applications include electric motors, fans, pumps, joints, chains, guides, elevators, conveyors, cranes, and bearing housings.

SKF MultiPoint Lubricators are designed to simultaneously feed several points within short distances with the same type of grease. These ready-to-use centralised lubrication systems can be installed without any additional assistance and require no special training to be configured.

Multi-outlet pumps supply the lubricant directly to the lube point without the use of extra metering valves. Each lubrication point thus has its own pumping element. SKF MultiFlex systems include a wide range of multi-outlet pumps from 1 to 32 outlets, and are able to withstand system pressures as high as 4,000 bar. SKF MultiFlex systems are designed for automatic re-lubrication as well as small circulating oil systems on applications in the machine-tool industry, oil and gas, and heavy industry – just to name a few examples.

So, when it comes to automatic relubrication, here are some basic questions you may ask yourself to identify areas for improvement. You can download a copy of the questionnaire for future reference, by clicking the image.

Environment, health and safety

Environment health and safety are aspects that are gaining more and more importance inside organizations. When it comes to the lubrication program, some aspects that must be considered include:

- Is there a potential for extending the relubrication intervals by either using better lubricants or even reconditioning lubricants in order to reduce the consumption?
- Is there a leakage control program in place?
- What do you do with used lubricants?
- Are you taking full advantage of automatic lubrication in order to minimize safety risks inherent to lubrication tasks?
- Are there specific regulations in your country that must be fulfilled?

People development

Environment health and safety are aspects that are gaining more and more importance inside organizations. When it comes to the lubrication program, some aspects that must be considered include:

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- Is there a leakage control program in place?
- What do you do with used lubricants?
- Are you taking full advantage of automatic lubrication in order to minimize safety risks inherent to lubrication tasks?
- Are there specific regulations in your country that have to be fulfilled?

Before you leave the “program structure” module, are you sure that you’ve fully explored all of the information presented for each of the 10 program facets?

Module 4: Conclusion

Let's now conclude by taking a look at the five-step approach which SKF takes when designing and implementing a lubrication management program for a plant.

A lubrication management program can be defined as the sum of all the activities performed in a given facility to help ensure the right lubricant is provided in the right quantity to the right point at the right time with the right method. The benefits of a world-class lubrication program are related with costs savings in:

- Downtime
- Spares
- labour and overtime working
- Energy consumption

These savings are achieved by addressing issues such as:

- Lubricant contamination
- Lubricant chemical degradation
- Wrong lubricant selection
- Insufficient or misleading knowledge

The SKF Lubrication Management program defines a structured process to build a strong lubrication program and to overcome those issues.

SKF Client Needs Analysis - Lubrication Management (CNA-LM) is an SKF tool used to assess and benchmark the maturity of the incumbent lubrication management practices. The tool uses 4 sets of 10 questions, each set reflecting a basic facet of SKF's Asset Efficiency Optimization process: Strategize / Identify / Control / Execute. Each of these areas is assessed and compared to industry benchmarks. The process highlights areas of strength and also identifies potential gaps for improvement. Please note that this service is intended for use under the guidance of a trained SKF facilitator. Please contact your local SKF representative if you would like to take advantage of this service.

When the facility's level of complexity is high, or when basic improvements towards world-class lubrication have already implemented, a thorough assessment is advised. This detailed study, conducted mostly on the plant floor, is normally a one-week activity providing a thorough understanding of all the different facets of the lubrication plan. It requires the involvement of the team in charge of lubrication in the given facility. The results of the audit provide all of the information that's needed for the third step of the SKF Lubrication Management process: the "Improvement proposal". Please note that this audit is undertaken under the guidance of a trained SKF facilitator. Please contact your local SKF representative if you would like to take advantage of this service.

After the required information is gathered, SKF specialists will formulate proposals for specific activities that will help to improve the facility's lubrication management program. Once discussed and agreed, SKF can then support the implementation of the improvement proposals. This support may be by means of equipment, training, consultancy services, or even execution of specific tasks. In order to measure the effectiveness of the improvements, a reassessment is advised. That will often open the door for further improvement opportunities.

Module 5: Test and certificate

Now it's time to see what you learned.

If you feel ready, then click the button to start the test.

If you successfully complete the test on-line then you will be able to download and print your own course completion certificate.