6 STEPS TO CREATE A CHECKLIST FOR VISUAL LUBRICATION INSPECTION

DES-CASE

INTRODUCTION

How many lubrication related failures has your facility experienced? Of those failures, how many could have been prevented through basic asset inspections? Many companies struggle with addressing foreseeable lubrication related failures, due in part to a lack of understanding of what a lubrication related issue looks like, why it matters, and how to appropriately address it. Visual lubrication inspections expand the typical preventive maintenance inspection to include the condition points of the lubricant, which is the life blood of the asset. However, it is not just a matter of performing the inspection. It is also necessary to have a strategy for following up on the inspection results.

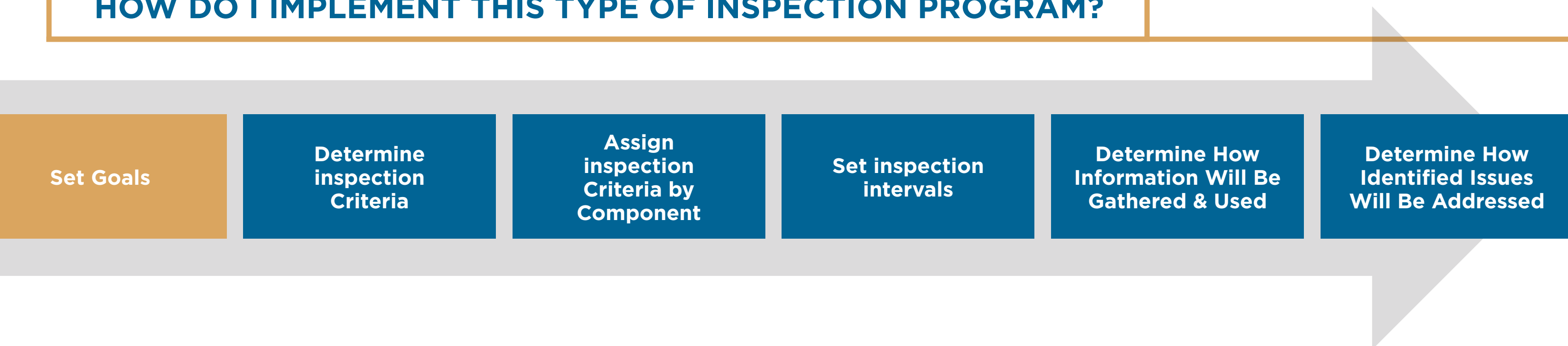
WHAT IS VISUAL LUBRICATION INSPECTION?

Visual lubrication inspection is a basic methodology for determining the condition of an asset or component's lubricant by simply using your senses. A visual review of a lubricated component might include the collection of basic information, such as asset condition (cleanliness, visible leaks, state of installed modifications), oil level, oil condition, amount of oil added, filter condition, breather condition, and temperature. The specific items to review are determined by the component type, sump size, how it is equipped, and preexisting conditions or concerns associated with an individual component.

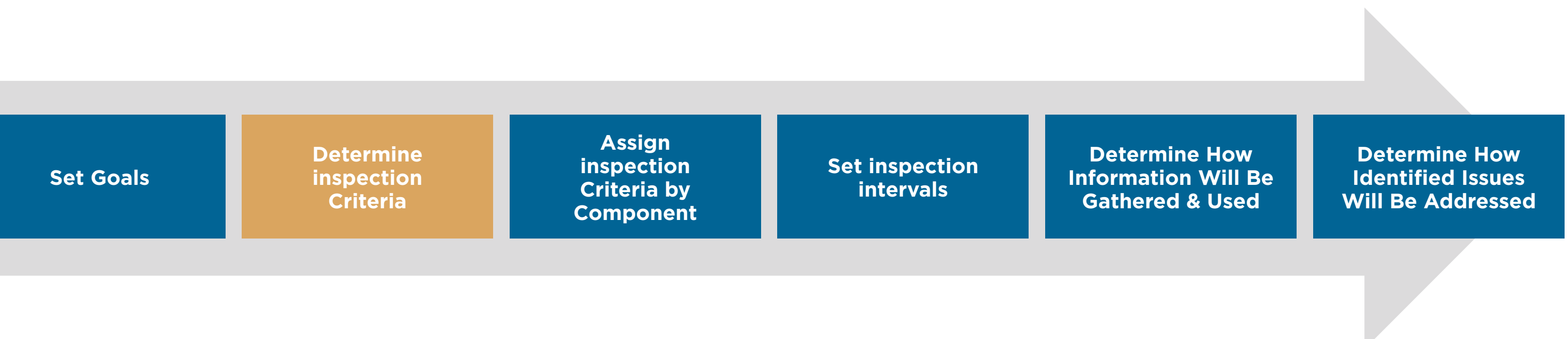
WHAT INFORMATION CAN IT PROVIDE?

Information collected during a visual lubrication inspection can be as extensive or basic as needed. It is dependent on what your maintenance goals are and how much time you wish to designate to the routine inspection process. Most importantly, the inspection depends on a designated follow-up procedure and practice for the information collected. At the most basic level, a routine inspection can provide information about the oil levels (leaks or increases), water contamination and potential sources, particle contamination, and oil condition. This information is determined based on the conditions observed during the inspection process, which are then translated into potential causes to be remedied.

HOW DO I IMPLEMENT THIS TYPE OF INSPECTION PROGRAM?



The first step to implementing a program is to determine what your goals are. A desire to move away from status quo operation and to implement planning and scheduling practices should exist. This should be the goal first and foremost from management and the maintenance team. Secondly, there should be a desire for a systematic approach to observing, documenting, and addressing lubrication issues before they become lubrication failures. Finally, there should be a goal to monitor progress with metrics over a reasonable timeframe. While some benefits can be readily recognized, long-term goals can take as long as 5-7 years to realize when it comes to changing the maintenance culture.



From a basic level, starting with the overall component or asset condition can give a high-level overview of the asset's health, but what conditions are you looking for? Perhaps, you may want to know if there are any visible leaks, broken components, or modifications that have been removed. Maybe you are also looking for housekeeping issues.

DES-CASE

Next, you can assess the desiccant breather. Is it partially or completely spent? Which end of the breather spent first? If the top is pink there is an internal moisture source from the reservoir headspace, but if the bottom turns pink first then there is an external moisture source from the outside environment. Did the desiccant turn amber or brown instead of pink? If so that points to the likelihood of oil misting. If the breather has turned completely pink then the desiccant is spent and the breather is at full water saturation.

BREATHER ADSORBING EXTERNAL MOISTURE

FULLY SATURATED AND SPENT BREATHER

OIL SIGHT GLASS WITH ACCUMULATED WATER

Next on the list is the oil level. Is the oil level at, above, or below the designated level? If below, how much oil needs to be added to bring it to level? The condition of the oil should also be assessed using elements of visual oil analysis. Does the oil appear cloudy, dull, dark, or foamy? Or does the oil appear bright and clear? Assessing oil condition from a visual perspective requires knowledge of how the oil appears before it is put into use, such as the initial color and clarity, because some oils start off darker and more opaque than others.

Filters are also important to check. A filter in bypass does little to remove contamination and wear metals from circulating in the oil, which can damage downstream components. Depending on the type of indicator available, you may want to collect the indicator color (red, yellow, or green) or the psid across the filter. For spin-on type filters, look for leaks around the filter seal.

Finally, perform a quick scan of the temperature. Temperature may be taken from a permanently installed thermometer or using a temperature gun. If using a temperature gun, a specific spot should be designated for collecting the reading. This will ensure a consistent temperature trend over time since temperatures can fluctuate across a sump or reservoir. It is important to establish baseline values for temperature so that high/low readings can be determined.

Set Goals → Determine inspection Criteria → **Assign inspection Criteria by Component** → Set inspection intervals → Determine How Information Will Be Gathered & Used → Determine How Identified Issues Will Be Addressed

From the most general stand point, you want to be able to gather asset condition, breather condition, oil level and condition, filter state, temperature, and the amount of oil added. However, not all these inspection items are apparent or relevant. The information you collect will be dependent on the component type and size, as well as how the component is equipped with lubrication modifications. In some instances, the asset's criticality could play an important role as well.

In terms of what information can and should be gathered, an inspection item like asset condition should be applied across the board to all assets. However, to determine what should be applied, start with the component type. In terms of gearboxes, there may not be a filtration system installed, so an inspection item to review the condition of the filter would not be possible. Of course, if we expand on this a little more, it is not abnormal to see larger gearboxes equipped with a filtration system, especially when the gearbox sump volume creeps into the 50 gallon or more range. Setting up inspection item templates based on the component type and size will ensure a consistent inspection approach for all components.

Modifications refer to how a component is equipped to perform lubrication related tasks. Modifications include parts such as desiccant breathers, quick connects for fluid transfer, dedicated filtration systems, visual level gauges and sample valves.

DES-CASE

As an example, the following could be applied to gearboxes of various sizes and modification setups:

Gearboxes < 1 gallon;
No modifications

1) Asset Condition
2) Temperature

Gearboxes < 1 gallon; With desiccant breather and oil sight glass

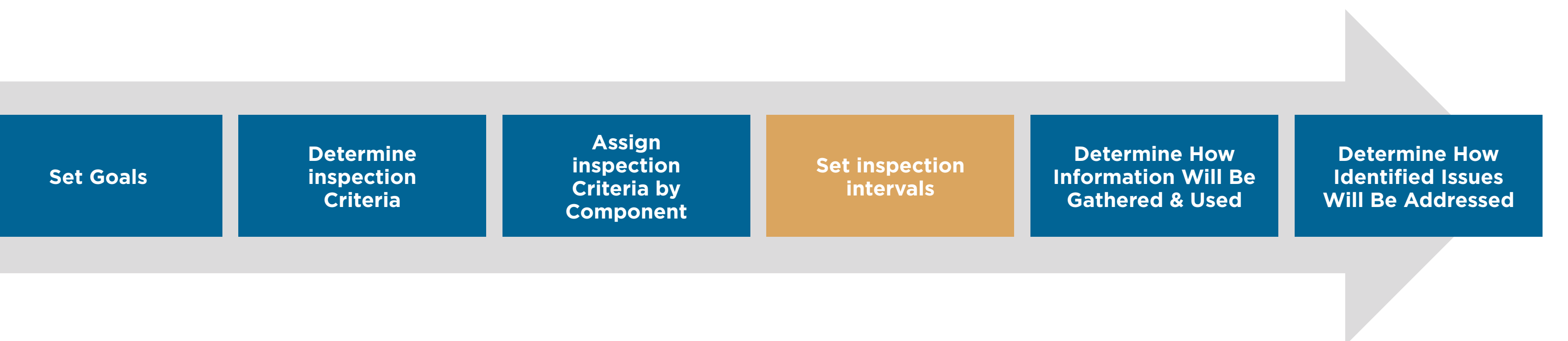
1) Asset Condition
2) Desiccant Breather Condition
3) Oil Level
4) Oil Condition
5) Temperature

Gearboxes > 10 gallons; With desiccant breather, external level gauge, oil sight glass

1) Asset Condition
2) Desiccant Breather Condition
3) Oil Level
4) Oil Condition
5) Temperature

Gearboxes > 100 gallons; With desiccant breather, external level gauge, oil sight glass, kidney-loop filtration system

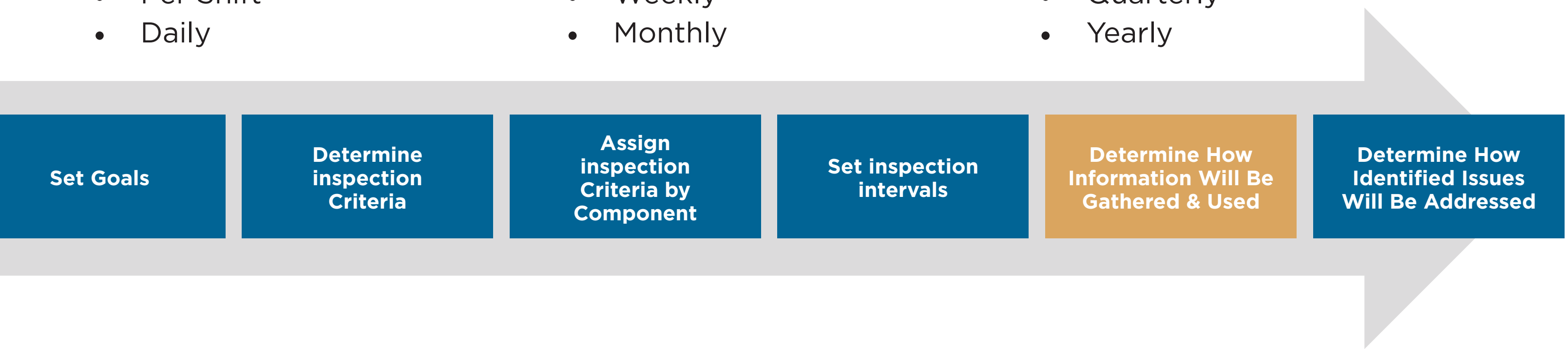
1) Asset Condition
2) Desiccant Breather Condition
3) Oil Level
4) Oil Condition
5) Filter Condition
6) Temperature



Similar to the idea that not all components need the same inspection tasks, not all components need to be inspected at the same interval. Here's where criticality and a general maintenance approach comes into play. If a component is considered "run to failure", the interval may be longer than a component that is considered highly critical based on its potential to shut down the process or other economic and commitment-based dangers.

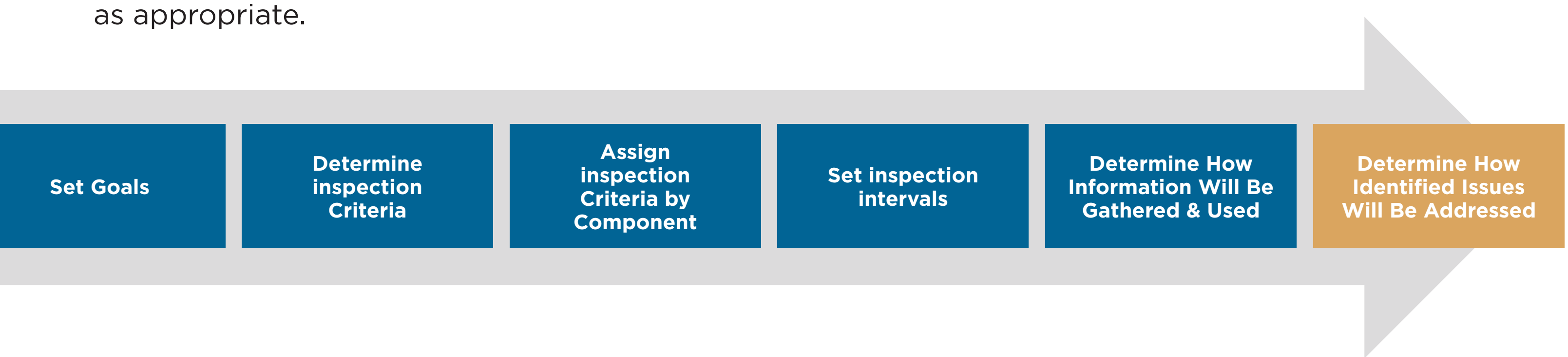
Typical intervals could include:

- Per Shift
- Daily
- Weekly
- Monthly
- Quarterly
- Yearly



There are a variety of methods for collecting inspection information. The method you utilize is dependent on the size of the facility and maintenance team as well as the access to different types of software packages. The most basic method for data collection is good, old fashioned (and reliable) pen and paper, which can be translated into electronic format or strictly managed on paper. Larger facilities with more advanced software programs might utilize electronic handheld devices to collect information, which puts the inspection information directly into an electronic format.

The method you utilize for gathering the information isn't nearly as important as what you do with the information. An advanced software program doesn't perform any better than pen and paper if there is no plan for who will follow up on the information and how it will be carried out. Make sure someone is designated to review the data collected and has the authority to issue work requests as appropriate.



It is also necessary to develop standards for how certain findings will be addressed. This will create a consistent approach to address potential lubrication related failures.

The following is an example outline of typical findings with general follow-up items and how to address them:

INSPECTION ITEM	WHY IT MATTERS?	COLLECTION NOTES	FOLLOW-UP TASK
COMPONENT CONDITION			
No Problems Found	Sets baseline for documenting the next time an issue should occur		
Installed Modifications Requested (level gauges, quick connects, etc.)	If steps are being taken to modify equipment for proper lubrication management, why are they being removed?		Install missing modifications. Track down reason for modification removal and address through awareness training.
Cleanliness- Excessive Product Build Up	Excess product build up on a component can trap heat causing the component to operate at an elevated temperature which can shorten the life of the lubricant		Clean affected assets
Cleanliness- Excessive Water or Moisture	Excess moisture exposure can lead to potential ingress into the component and subsequently into the lubricant		Assess sources of moisture exposure and implement measures to reduce exposure
Oil Leaks	Fluid leaks not only increase the amount of lubricant consumed at a facility which means increased money spent, but leaks can also have safety ramifications causing slips, trips, and falls as well as environmental impacts that could lead to fines		Identify source of leaks and schedule repairs
BREATHER CONDITION INSPECTION			
No Color Change Observed	Sets baseline for documenting the rate of color change		
Partially Saturated – Water	Denotes an issue with moisture exposure	It is important to document the saturation direction. From the top means internal moisture and from the bottom means external moisture	If changing from bottom, plan for breather change out. If changing from top, compare to oil level. Is the fluid level increasing? Check for source of water in system.
Saturated – Water	Denotes an issue with moisture exposure	It is important to document the saturation direction. From the top means internal moisture and from the bottom means external moisture	Replace breather
Saturated – Oil	Denotes an issue with oil levels or oil misting		Compare occurrence to documented oil level. If oil level is high, perform a partial drain and replace breather (especially in hydraulic reservoirs, where oil level is constantly fluctuating). If oil level is normal or low, determine source of oil in the breather.
Particulate Indicator Activated	Indicates the particulate filter is plugged. Even though the desiccant may be unsaturated, the breather is no longer allowing the component to breathe.		Replace breather
Broken/Damaged/ Missing	In any of these instances, a path of contaminant and moisture ingression is created where the component is not breathing through the breather but through the path of least resistance.		Replace breather

INSPECTION ITEM	WHY IT MATTERS?	COLLECTION NOTES	FOLLOW-UP TASK
OIL CONDITION			
Bright, Clear, Filled to Level	Sets baseline for documenting the changes to the oil level and condition		
High, Above Fill Mark	High fluid levels can do just as much damage as low levels. High fluid levels in some components can generate heat and decrease the expected lubricant life.	Check last date and amount fluid was added. If a hydraulic system, it is important to have a fill mark for when the hydraulic cylinders are actuated and retracted since fluid levels fluctuate greatly within the reservoir.	Verify source of high level. Was too much top-up lubricant added? Is water or other liquid leaking into lubricated system? If not, drain off excess fluid.
Low, Below Fill Mark	Low fluid levels can starve critical parts of much needed lubrication which exacerbates component wear.	Check last date and amount fluid was added. Were leaks also noted?	Add required type and amount of fluid to system. If necessary, plan repair for leaks.
Foam Present	Can indicate the presence of air which can cause cavitation	If foam does not dissipate when the equipment is not running, then document it. Otherwise, it is not a concern. High/low fluid levels can also affect the formation of foam.	Verify fluid levels are correct. If so, plan to check from loose piping joints that may be allowing air to be suctioned into the system.
Oil Milky	Can indicate the presence of water which decreases the lubricant's life	When equipment is not running and has cooled, water will sometimes separate out and can be drained out of the system using an oil sight glass.	While component is cool, drain off free water. Inspect for water ingression points and make necessary repairs including cooling water systems. Look into installation of water removal filters for small amounts of moisture.
Oil Dark/Discolored	Can indicate a severe change in the lubricant properties through oxidation, thermal breakdown or contamination		Submit an oil sample to verify lubricant properties are within specified limits. Prepare for oil change if necessary.
Visible Debris	Indicates either severe contaminant ingression or wear metal generation. Both can have catastrophic effects on the component and lubricant.		Submit an oil sample to determine debris source. Install and run filter cart on component.
FILTER BYPASS INDICATOR			
Green	Sets baseline for documenting changes in the filter		
Yellow	Indicates the filter is approaching the end of its useful life		Begin planning for filter change
Red	Indicates filter is in bypass and the oil is not being filtered		Change filter
Not Installed	Indicates there is no monitoring device installed for the component filter		Plan for installation of bypass indicator that is appropriate for, and similar to, other indicators used in the facility.
RECORD TEMPERATURE OF COMPONENT	High temperatures can be an indication of inappropriate lubricant viscosity and fluid levels	Baseline operating temperatures would need to be determined, followed by target temperature ranges. For example, a temperature that is 10° F above the normal operating temperature may be considered high. Temperature should always be collected from the same point of the sump or reservoir.	Verify fluid is at correct level. If temperature does not decrease, submit an oil sample to verify proper lubricant is installed. If equipped with heat exchanger, verify proper function of heat exchanger.
RECORD AMOUNT OF LUBRICANT ADDED	Provides information that can eventually be used for inventory planning. However, initially it provides information on the lubricant consumption rate of the component.	Amounts that exceed 10% of the equipment's lubricant volume should be considered excessive and require follow up. Were oil leaks noted? If not, leaks could be potentially entering other parts of the system that are not visible.	Check for and plan to repair leaks. Nonobvious leaks may require special measures.

Once a follow-up task has been completed, it is always important to perform a QA/QC review to ensure the issue has been remedied. If the issue persists, additional measures may be warranted.

CONCLUSION

Incorporating visual lubrication inspections into your reliability program can provide many benefits, including:

- Increased quality and a decreased number of errors due to the new standardized procedures and practices improvements
- Ability for more staff to easily detect lubrication flaws
- Fewer shut-downs and emergency equipment repairs or maintenance
- Faster troubleshooting
- Reduced inventory
- Increased plant safety

Many lubrication-related problems can easily be avoided with low-cost, simple procedures. By implementing routine visual lubrication analysis practices, any abnormalities can be addressed before costly repairs are required. Furthermore, inspections provide essential information to an asset's health and efficiency. Visual lubrication inspection is an easy change, especially with clear goals and program guidelines in place.

References

Bloom, Neil. "Chapter 3." Reliability Centered Maintenance (RCM): Implementation Made Simple. New York: McGraw-Hill, 2006. N. pag. Print.

Kotter, John P. Leading Change. Boston, MA: Harvard Business School, 1996. N. pag. Print.

Barnes, Mark. "Inspect for Success with Visual Oil Analysis." Uptime Magazine Oct.-Nov. 2014: 40-41. Web.