AS I SEE IT

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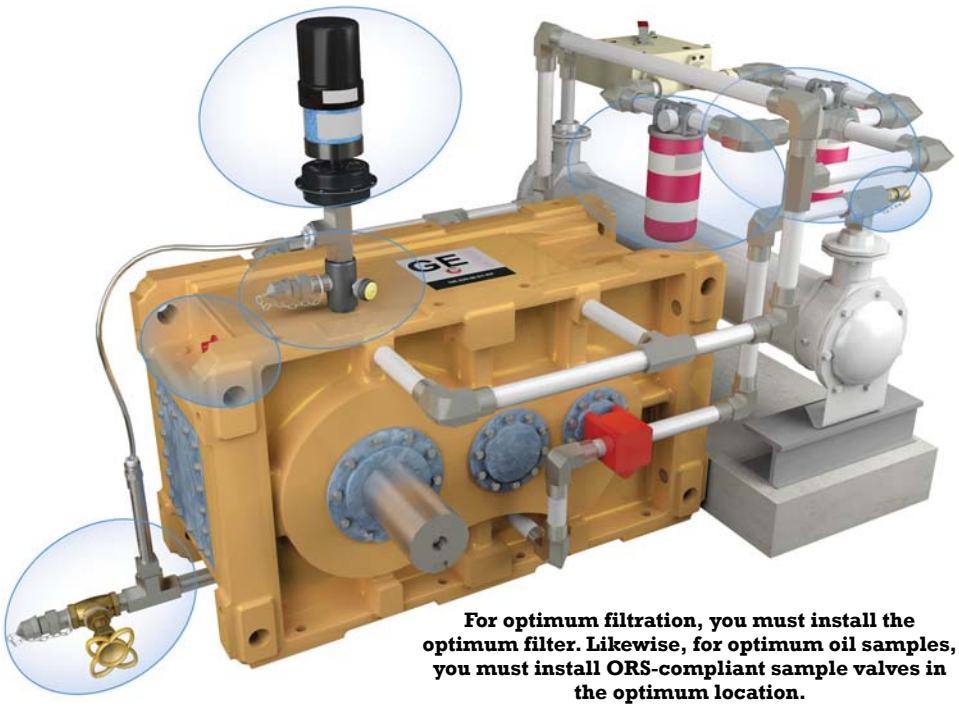
LINKING ENHANCED RELIABILITY to the STATE of LUBRICATION

The lubricant Optimum Reference State (ORS) is a critical concept in the journey to world-class lubrication and enhanced machine reliability. In short, it is the prescribed state of machine configuration, operating conditions and maintenance activities required to achieve and sustain specific reliability objectives. Lubrication excellence is achieved when the current state of lubrication approaches that of the Optimum Reference State. If you don't understand the ORS, you probably don't understand the most fundamental concepts in machine reliability.

Companies must reinvent and modernize lubrication to create a state of preparedness and condition readiness that enables lubrication excellence.

Lubrication attributes of the ORS are not widely known by equipment builders, lubricant suppliers and maintenance organizations. Many user organizations falsely conclude that their machines are already fitted with the necessary accessories and components that enable reliability to be achieved. Sadly, of the hundreds of machine service manuals I've seen in recent years, it is rare to find practices described close to the ORS. In a typical plant, it is equally rare to see machines fitted with ORS-compliant lubrication components and technicians performing ORS-compliant lubrication.

There are many different attributes of the Optimum Reference State. These attributes relate to people preparedness, machine preparedness, precision lubricants, precision lubrication and oil analysis. Achieving the ORS almost always involves change or modifications. For instance, you can't get optimum filtration unless you install the optimum filter. You can't have optimum oil samples unless you install ORS-compliant sample valves in the optimum location. Then, of course, you need to pull the sample using ORS-compliant procedures at ORS-compliant frequencies.



For optimum filtration, you must install the optimum filter. Likewise, for optimum oil samples, you must install ORS-compliant sample valves in the optimum location.

Critical ORS Tactics

If you carefully analyze the influence of lubrication on reliability and maintenance costs, you will notice a few consistent themes. Most importantly, it becomes evident what needs to be changed to substantially enhance reliability and reduce costs. These changes define critical tactics

Contamination is the **No. 1** cause of lubricant-related machine failure.

that will eventually detail the Optimum Reference State.

First, let's look at the six factors used to tally the costs.

1) **Machine reliability and performance issues:** lost production, downtime, business interruption, productivity, etc.
2) **Maintenance costs:** labor costs, replacement parts, disposables, etc.
3) **Lubricant costs:** price per gallon and lubricant consumption rate (gallons needed per year)
4) **Filter costs:** filter cost and filter change frequency
5) **Safety costs:** financial and personal costs when workers get injured or there is loss of life
6) **Environmental costs:** financial and humanity costs related to tailpipe emissions, energy consumption, oil spills, etc.

Why do these things happen, and why are these costs incurred? Answering these questions is like doing a root-cause failure

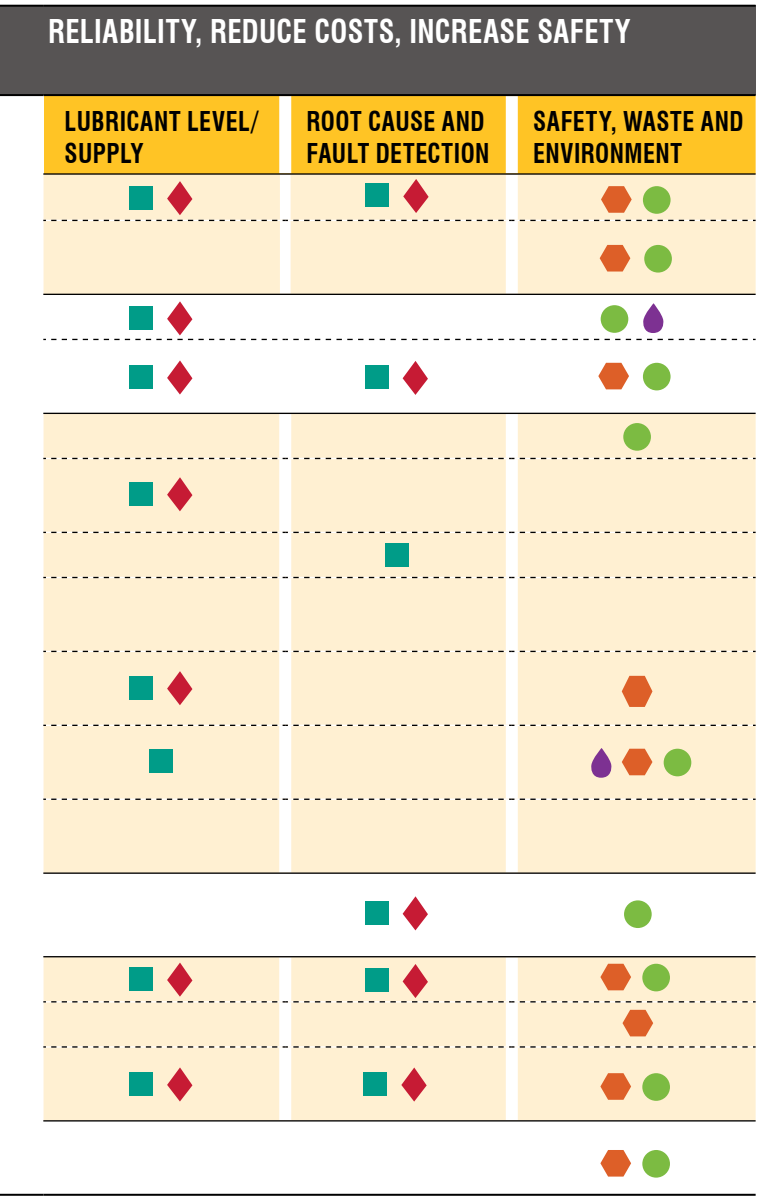
BENEFITS KEY

- ■ = Machine Reliability Benefit
- ◆ = Maintenance Labor and Material Cost Savings
- ● = Lubricant Consumption/ Costs Savings
- ▲ = Filter Consumption/ Cost Savings
- ⬢ = Enhanced Safety
- ● = Environmental Benefit

ORS PERFORMANCE ATTRIBUTES		OPTIMUM REFERENCE STATE (ORS) TACTICS THAT ENHANCE AND HELP THE ENVIRONMENT		
		LUBRICANT SELECTION	LUBRICANT HEALTH	CONTAMINATION CONTROL
Lubricant Attributes	Optimum lubricant products and supplier selection	■ ◆ ● ●	■ ◆ ● ●	■ ◆ ▲ ●
	Lubricant reception, labeling, packaging, storing and handling	■ ◆ ● ●		■ ●
Lubrication Attributes	Optimum selection of oil change and regrease intervals		■ ◆ ●	
	Optimum selection, documentation and use of lubrication and oil analysis PMs, tasks and procedures		■ ◆ ●	■ ◆ ▲ ●
Machine Attributes	Proper selection and location of filters		■ ●	■ ▲ ●
	Correct selection and location of oil level gauges and inspection sight glasses		■ ●	■
	Correct selection and location of sampling valves			■
	Optimum selection of breathers and headspace management devices		■	■
	Correct machine relubrication and flushing hardware and tools		■	■
	Optimum selection and use of seals and leakage control devices			
	Optimum selection and use of seals to control contaminant ingression		■	■ ▲ ●
Oil Analysis Attributes	Oil analysis program design and execution	■ ◆	■ ◆ ●	■ ◆ ▲ ●
People & Program Management Attributes	Awareness training, skills training, competency testing	■ ◆	■ ◆ ●	■ ◆ ▲ ●
	Optimum use of lubrication program metrics and KPIs	■ ◆	■ ◆ ●	■ ▲ ●
	Optimum program management, data management, work management systems		■ ●	■ ●
Other	Proper lubricant waste and disposal hardware and practices			

analysis. You have to ask the "repetitive why." The ORS Benefits Grid illustrates how lubrication plays a vital role in reversing or simply reducing the impact in each of the above six cost groups. It also shows the important connection to the Optimum Reference State and a sustained state of cost control and reliability.

To see how, let's follow the trail backward from the six cost groups. Listed across the top of the ORS Benefits Grid are six tactics that describe how ORS lubrication enables reliability and delivers benefits to an organization. These six tactics are:



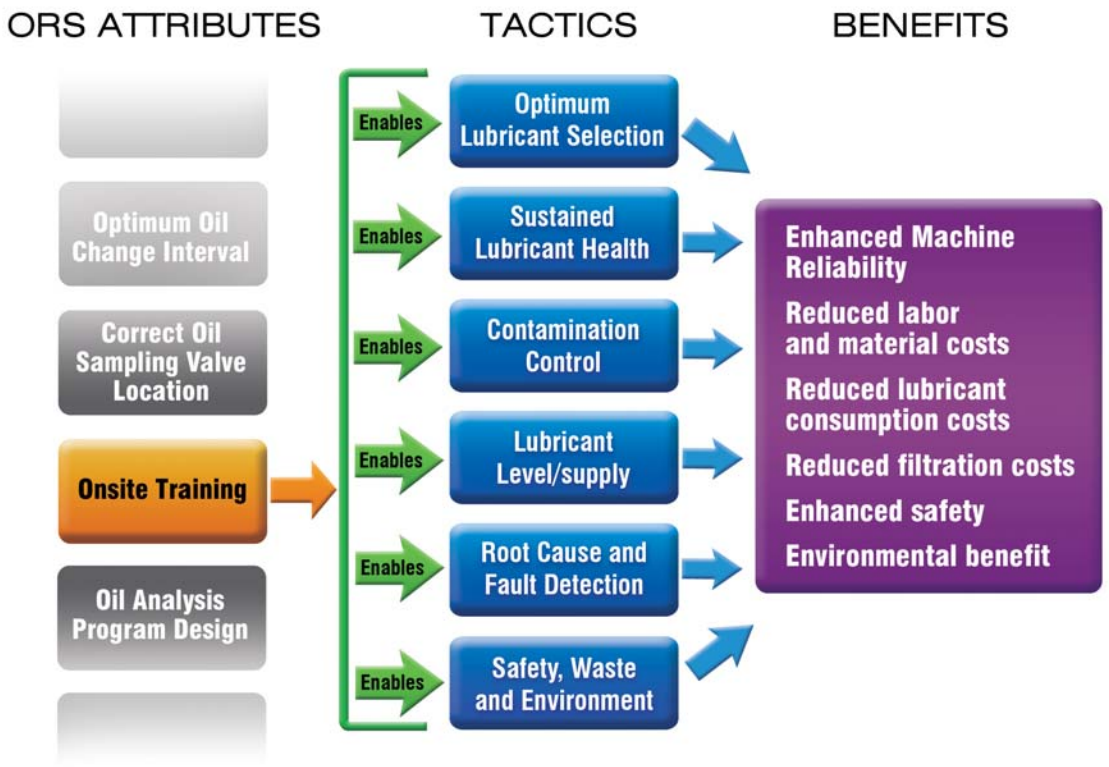
- **Lubricant Selection** — There is a complex array of lubricants on the market today. Suppliers of these lubricants make wide-ranging claims on performance relating to energy consumption, reduced wear, longer oil drain intervals, etc. Precision selection and proper delivery of these lubricants to the machine plays a critical role in machine reliability and lubricant consumption cost.
- **Lubricant Health** — Sustaining the health of a well-selected lubricant is no trivial matter. This includes mitigating harmful exposure to the lubricant to enable its performance to last longer. It also involves knowing when to change the lubricant by carefully monitoring the remaining useful life (RUL) using oil analysis. Managing the health of the lubricant translates to an enhanced state of machine reliability.
- **Contamination Control** — Contamination is the No. 1 cause of lubricant-related machine failure. It is also the No. 1 cause of lubricant degradation. There are many different types of contaminants that can harm the machine and the health of the lubricant.
- **Lubricant Level/Supply** — Machines often fail due to too little or too much lubricant. Maintaining the correct level and supply of lubricant is vital to achieving an optimum state of machine reliability.

Essential ORS Attributes

The critical Optimum Reference State (ORS) tactics aren't built into the DNA of most machines and maintenance organizations. They also don't come about on their own. Instead, companies must reinvent and modernize lubrication to create a state of preparedness and condition readiness that enables lubrication excellence. This is a prescription for the ORS.

Let's take a look at some of these reliability-enabling attributes relating to lubrication:

- **People Preparedness** — People are trained to modern lubrication skill standards and have certified competencies.
- **Machine Preparedness** — Machines have the necessary design and accouterments for quality inspection, lubrication, contamination control, oil sampling, etc.
- **Precision Lubricants** — Lubricants are correctly selected across key physical, chemical and performance properties, including base oil, viscosity, additives, film strength, oxidation stability, etc.
- **Precision Lubrication** — Lubrication procedures, frequencies, amounts, locations, etc., are precisely designed to achieve the reliability objectives.
- **Oil Analysis** — This includes optimal selection of the oil analysis lab, test slate, sampling frequency, alarm limits, troubleshooting rationale, etc.



By developing a lubrication program with ORS attributes and using a few critical tactics, you can realize the benefits of improved machine reliability and reduced costs.

- **Root Cause and Fault Detection** – There is an endless number of root causes and faults that are precursors to machine failure. Many of these are caused by the lubricant (e.g., contamination or degraded lubricant), while others are mechanical. Either way, the lubricant is a carrier of information related to the presence of most root causes and faults. Inspection practices and lubricant analysis can provide alerts to enable problems to be corrected early.
- **Safety, Waste and the Environment** – Reliability issues often present safety risks. Faulty lubrication has been indicted as the root cause of countless fatalities from machine failure. Lubrication impacts the environment in many ways, from waste disposal of old lubricants to energy consumption, to waste streams from power plants and internal combustion engines.

When to Expect the Benefits

So now let's put the process in the correct order:

1. First, you develop a well-engineered lubrication program consisting of ORS attributes based on decades of learning about machine reliability.
2. These attributes are critical building blocks necessary to support the tactics that fundamentally change the state of machine reliability and enable deep cost reductions. For instance, the tactics slow down the rate of machine wear and reduce lubricant consumption.
3. Once the tactics are fully sustained, a transformation or metamorphosis begins to emerge. The maintenance organization is no longer a firehouse operation under constant pressure to make emergent repairs. Instead, work is managed by plans through monitoring and control. Reactive maintenance is replaced by proactive and predictive maintenance. Failure is replaced by machine reliability.

Want to get the ORS started in your plant? Begin by getting your organization trained on the fundamentals of machinery lubrication.

About the Author

Jim Fitch has a wealth of "in the trenches" experience in lubrication, oil analysis, tribology and machinery failure investigations. Over the past two decades, he has presented hundreds of courses on these subjects. Jim has published more than 200 technical articles, papers and publications. He serves as a U.S. delegate to the ISO tribology and oil analysis working group. Since 2002, he has been director and board member of the International Council for Machinery Lubrication. He is the CEO and a co-founder of Noria Corporation. Contact Jim at jfitch@noria.com.