LUBRICATION PROGRAMS: *Best-in-class* doesn't mean *your best guess*

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How many lube pros do you need?
Here's how to figure out – and justify your ask

Nothing grinds the gears of the maintenance manager and/or maintenance planner quite like the request for more labor to complete annual machine lubrication work. This seems especially true in facilities where this work role is awarded on a seniority and bid basis. There is reasonable justification for the angst of both parties. This is a prime topic for the application of a data-based management response, but what data does one need to objectively answer the siren call for "more"?

Organizing and executing a high-quality machine lubrication program is a challenge for most industrial facilities. One of the most common points of debate is how much time should be allocated to complete the machine lubrication routines on time and with a high degree of quality. This is a vexing topic given that the work is not like other work done by maintenance.

Routine planned maintenance includes a defined task, defined materials, allocated time, and often an individual assigned to that task. With machine lubrication, we need to assign a list of tasks and materials and allocate many tasks to an individual. The single list could encompass several hundred tasks and occupy a full week of time, or maybe only a few tasks and a few hours.

The challenge snowballs when we consider that the work of machine lubrication for a large facility may encompass hundreds of thousands of tasks on hundreds to thousands of scheduled routes during a given year. How should one go about objectively allocating labor to address that type of work requirement?

In this article I will address a granular, machine-specific, task-specific approach that the work planner can follow to come to a full understanding of how precisely how to allocate sufficient time to complete the annual work of machine lubrication.

DEFINING THE FUNDAMENTAL UNIT OF MACHINE LUBRICATION

Consider the task of lubricating a large vertical agitator at a chemical plant: The technician does not lubricate the agitator. Our lubrication technician also does not lubricate the motors or gearboxes. The subcomponent level of the asset is too high to assign the lubrication task, allocate a frequency, and allocate time to fulfill the task. We need to be more granular.

With regard to the agitator, the technician *does* lubricate the gear sump and the top and bottom bearings (if they exist); and regarding the electric motor, the technician *does* lubricate the inboard and the outboard bearings on each side of the motor. Notably, the motor bearings are often different, requiring differing volumes and sometimes even different feed intervals.

Once a coupling is figured into the equation, the "lubricate the agitator" task now comprises service requirements for six distinct asset reservoirs (oil and grease), and each may justify its own interval. Of course, all agitators are not created equal. Some have more and some have fewer distinct locations that require lubrication attention, but we'll go with this for our example.

When we set out to define the agitator lubrication job, we must account for each visit to address each lubricated item that is to be fed; this often delves into the sub-sub-subcomponent levels of the asset. Further, if we wish to have an accurate annual labor value, then we must assign a time-requirement value for each task type and assign a frequency for which we think each of the various task visits must be made for each asset. Let's look at some examples of the lowest common denominators for calculating our annual lubrication requirement.

The AMRRI team, which comprises several career maintenance and lubrication management professionals, set out to establish a baseline for the many tasks that we encounter when providing a detailed lubrication plan to our customer base. Table 1 represents our conclusions for the time needed to fulfill each distinct task in the variety of industrial complexes we routinely visit. These numbers have been used as the basis for lubrication essential-care plans at multiple plant sites where we've created work plans. When we break a machine down to its individual sub and sub-sub components and identify related lubrication points, we assign these value(s) to the required task(s).

Following this logic, let's consider a production department operating with a machine complement comprising five very common assets by type: air compressors (1), agitators (16), conveyors (9), fans (24), and pumps (50), totaling 100 assets. The task requirements (task type and time needed) for these five common machine types are represented in Table 1.

We'll start with a simple asset: a critical process pump. As shown in Figure 1, assuming our process pump is A- or B-level criticality, has a lubricated coupling using high-performance coupling grease (which requires disassembly each three years and purging only once per year), and assuming that we wish to have a reliability-centered lubrication approach, we might schedule as many as 58.3 distinct actions/tasks to be fulfilled for the one pump over a one-year period. Each task accounts for little time, but they add up to a sizable annual tally.

Following similar logic, consider another simple drive train: a process fan. As shown in Figure 2, the fan has fewer task types, but based on size and speed it may have an even more time-intensive visit plan. (Following an operation-context-specific approach - the higher the NDm value, the shorter the lubrication interval for grease-fed machines. Further, the more difficult the operating environment, the shorter the lubrication interval for grease-fed machines. Medium- to high-speed bearings operating in a lousy environment warrant more-frequent visits.)

Component Type	Task Type	Frequency	Duration, Minutes
Air Compressor, Screw	Oil, Level Check - Top Up	W1	15
Air Compressor, Screw	Oil, Drain and Fill	Y1	90
Air Compressor, Screw	Oil, System Flush and Refill	Condition	180
Bearing Sump	Oil, Level Check - Top Up	W1	5
Bearing Sump	Oil, Drain and Fill	Y1	60
Bearing Sump	Oil, Drain, Flush, and Fill	Condition	120
Bearing, Grease	Grease, Lever Gun	Calculated Value	5
Bearing, Grease	UE Grease, Initial Startup	Calculated Value	30
Bearing, Grease	UE Grease, After Startup	Condition	5
Bottle Oiler / Drip Feeder	Top Up	W1	3
Coupling	Annual Purge	Y1	30
Coupling	3 Yr. Breakdown and RePak	Y3	90
Filter Element	Filter Element Check	W1	5
Filter Element	Filter Element Replacement	Condition	60
Kidney Loop	Sump Filtration Routine	M1	15
Machine Condition Check	Sample Fixed LP	M3	15
Sump, Drive >5, < 45 gal	Oil, Level check - Top Up	M1	5
Sump, Drive >5, < 45 gal	Oil, Drain and Fill	Y1	90
Sump, Drive >5, < 45 gal	Oil, Flush and Fill	Condition	60

Table 1. Lubrication Task Time Allotment and Standardized Frequency Values

Single Critical Pump, lubrication tasks and hours / year (HPY)

❑ **Motor** (2 bearings × 2 events / year, 5 min. ea.)	=	4.00 Tasks	@ 0.33 HPY
❑ **Coupling** (1 ea. × 4 events / 3 years, 60 min. ea.)	=	1.30 Tasks	@ 1.20 HPY
❑ **Pump Oil Level Check** (1 × 52 checks / year)	=	52.00 Tasks	@ 2.60 HPY
❑ Pump Sample (none / year)	=	0.00 Tasks	@ 0.0 HPY
❑ **Pump Oil Change** (1 × 1 change / year)	=	1 Task	@ 0.50 HPY
Net Lubrication Events and Hours Per Year	=	58.3 Tasks	@ 4.63 HPY

Figure 1. Process Pumps – Annual Task and Net Labor Detail

Single Direct-Coupled FD Fan, lubrication tasks and hours / year (HPY)

❑ **Motor** (2 bearings × 2 tasks / year, 5 min. ea.)	= 4.0 Tasks	@ 0.33 HPY
❑ **HS Coupling** (1 ea. × 1.3 tasks / year, 60 min. ea.)	= 1.3 Tasks	@ 1.20 HPY
❑ **Shaft Bearings** (2 bearings × 24 tasks / year, 5 min. ea.)	= 48.0 Tasks	@ 4.00 HPY
Net Lubrication Events and Hours Per Year	= 53.3 Tasks	@ 5.53 HPY

Figure 2. Critical Agitator – Annual Tasks and Net Labor Detail

Filling out the remainder of our imaginary production cell, we have air compressor, agitator, and belt-type conveyor labor requirements (see Figures 3, 4, and 5, respectively). As you can see, the belt conveyor has even more locations where a lubricant is in use, and accordingly more task types and more discrete visits to fulfill each task.

As we begin to aggregate the net number of task types, with each task having a time stamp and each task having a repeating interval, we can see that even a small production cell can accumulate a multitude of events each year that require scheduled attention. Table 2 shows a summary of annual hours for each asset multiplied by the instances of that asset type in the production cell.

Once task-visit requirements roll together, we can see the hours pile up. Eventually, we can articulate to management precisely what is needed to cover the lubrication task requirements for our mechanical footprint.

A rule-of-thumb estimate of seven to eight hours net requirement per asset is good enough to put one in the right ballpark, but there is no substitute for evaluating the actual operating assets, their respective complexity and operating environment, and the difficulty of accessing each asset as time goes by.

MEASURING AVAILABLE LABOR HOURS

The next step in ensuring adequate labor coverage is a measurement of the available service hours. This is largely paint-by-numbers, as follows: Each laborer has 52 weeks × 40 base-load hours per week to deliver 2,080 net possible hours. If the production site labor rules determine that the machine lubrication task is one that warrants seniority privileges, then labor coverage after holidays, vacation, and sick leave becomes more difficult.

For a typical process plant running a 24/7 production schedule, there are:

- 10 standard holidays for most companies, which equals 80 hours
- X weeks standard vacation per Y

Critical Screw-Type Compressor, lubrication tasks and hours / year (HPY)

❑ **Motor** (2 bearings × 2 events / year, 5 min. ea.)	=	4.00 Tasks	@ 0.33 HPY
❑ **Coupling** (1 ea. × 4 events / 3 years, 60 min. ea.)	=	1.30 Tasks	@ 1.20 HPY
❑ **Reservoir Oil Level Check** (1 × 52 checks / year)	=	52.00 Tasks	@ 13.0 HPY
❑ **Reservoir Oil Sample** (1 × 4 samples / year)	=	4.00 Tasks	@ 1.00 HPY
❑ **Reservoir Oil Change** (1 × 1 change / year)	=	1.00 Task	@ 1.50 HPY
Net Lubrication Events and Hours Per Year	=	62.3 Tasks	@ 17.03 HPY

Figure 3. Critical Screw-Type Compressor – Annual Tasks and Net Labor Detail

Critical Agitator, lubrication tasks and hours / year (HPY)

❑ **Motor** (2 bearings × 2 events / year, 5 min. ea.)	=	4.00 Tasks	@ 0.33 HPY
❑ **Coupling** (1 ea. × 4 events / 3 years, 60 min. ea.)	=	1.30 Tasks	@ 1.20 HPY
❑ **Reservoir Oil Level Check** (1 × 52 checks / year)	=	52.00 Tasks	@ 2.60 HPY
❑ **Reservoir Oil Sample** (1 × 4 samples / year)	=	4.00 Tasks	@ 1.00 HPY
❑ **Reservoir Oil Change** (1 × 1 change / year)	=	1.00 Task	@ 1.50 HPY
❑ **Upper Drive Bearing** (1 ea., 12 events / year, 5 min. ea.)	=	12.00 Tasks	@ 1.00 HPY
❑ **Lower Centering Bearing** (1 ea., 12 events / year, 5 min. ea.)	=	12.00 Tasks	@ 1.00 HPY
Net Lubrication Events and Hours Per Year	=	86.3 Tasks	@ 8.63 HPY

Figure 4. Critical Agitator – Annual Tasks and Net Labor Detail

Critical Conveyor, lubrication tasks and hours / year (HPY)

❑ **Motor** (2 bearings × 2 tasks / year, 5 min. ea.)	=	4.0 Tasks	@ 0.33 HPY
❑ **HS Coupling** (1 ea. × 1.3 tasks / year, 60 min. ea.)	=	1.3 Tasks	@ 1.20 HPY
❑ **Reservoir Oil Level Check** (1 × 52 checks / year)	=	52.0 Tasks	@ 2.60 HPY
❑ **Reservoir Oil Sample** (1 × 4 samples / year)	=	4.0 Tasks	@ 1.00 HPY
❑ **Side-Stream Sump Filtration** (12 times / year)	=	12.0 Tasks	@ 3.00 HPY
❑ **Oil Change - based on condition** (none / year)	=	0.0 Tasks	@ 0.0 HPY
❑ **LS Coupling** (1 ea. × 1.3 tasks / year, 60 min. ea.)	=	1.3 Tasks	@ 1.20 HPY
❑ **Head Pulley Bearings** (2 ea. × 12 tasks / year)	=	24.0 Tasks	@ 2.00 HPY
❑ **Tail Pulley Bearings** (2 ea. × 12 tasks / year)	=	24.0 Tasks	@ 2.00 HPY
❑ **Take Up Roll Bearings** (6 ea. × 12 tasks / year)	=	72.0 Tasks	@ 6.00 HPY
❑ **Assume all other bearings are sealed**	=	0.0 Tasks	@ 0.0 HPY
Net Lubrication Events and Hours Per Year	=	200.6 Tasks	@19.33 HPY

Figure 5. Belt-Type Conveyor – Annual Tasks and Net Labor Detail

Asset Type	No. of Each	Total Tasks per Year	Hours, Annual Lubrication Requirement	Net Hours per Year
Air Compressor	1	62.3	17.63	17.63
Agitator	16	86.3	8.63	138.08
Belt Conveyor	9	200.6	19.33	173.97
Direct Coupled Fan	24	53.3	5.53	132.72
Process Pump	50	58.3	4.63	231.50
Summary	**100**	**460.8**	**55.75**	**693.90**

Table 2. Net hour requirement for a small production cell.

years of service per person, which equals between 40 and 200 more hours deducted from "hours possible"
- X weeks sick leave per Y years of service per person, which equals between 40 and 200 more hours deducted from "hours possible"

The entry-level technician may have only regular holidays, only one available week of sick leave and only one week of vacation time, but that alone deducts 160 hours (four weeks) of available labor to cover the bases. The long-term employee with 30 years of service time would have the same regular holidays and could then also have five weeks of vacation time and five weeks of sick leave (which the tenured employee might need and take), effectively reducing available hours by 480 hours (or about one-quarter of the work year). Assuming a new hire and a tenured employee are in the work crew, we would have 3,520 net available hours (see Table 3).

It's rare to find too much labor in a lube crew following a thorough review, but it's not uncommon to find too little. Given headcount limits and some difficulty in hiring qualified personnel, it is important to be confident in the need for more labor before approaching senior management with a request for additional personnel. The options to work around a deficit in available labor hours to fulfill the net lubrication work-plan requirement could include the following.

Option A: Just don't fulfill the prescribed task-visit schedule.

Practical consequence: Hire more mechanics to keep up with repairs.

Option B: Reduce the time allocated per task.

Practical consequence: At an extreme, plan for more rescheduled tasks; more turnover and training; and possibly more injuries.

Option C: Reduce the frequency of visits per task.

Practical consequence: Hire more mechanics to keep up with repairs.

Service Level	Net Available Hours	Regular Holiday Hours	Vacation Hours	Sick Leave	Net Available hours
New Hire	2,080	-80	-40	-40	1,920
Tenured Hire	2,080	-80	-200	-200	1,600
Summary	4,160	-160	-240	-240	3,520

Table 3. Estimating available labor hours.

Option D: Assign level-check tasks to operators.

Practical consequence: Good idea. You need have a periodic follow-up plan, and there *must be* a training routine for operators.

CONCLUDING EXAMPLE

In the early 2000s I was hired by a maintenance manager to conduct a systematic benchmark/gap analysis and make an improvement report for a large Southern paper producer. This was an old mill, built piecemeal over a 50-plus-year period. It had a lot of machinery to care for – certainly more than a mill built on a 2005 design for an equivalent tonnage would have had.

Upon my arrival, I learned that the scope of my assignment had changed and I now was to make an objective assessment of how many labor hours were required for the full complement of machine lubrication activities. Apparently, management had just recently been informed of another R.I.F., and the thought was that perhaps the hit for the maintenance department could be absorbed to a heightened degree by the lube crew, as it was perceived by some that the lubrication work schedule was consistently reported back as "fully completed," leaving the perception that there might not be enough work to go around. (This mill had a policy of "risk of termination" for falsifying company documentation such as work plans and felt pretty good about the veracity of the written reports.)

The mill had not previously measured the job size. Management was operating on feedback and instinct for staffing levels for the lubrication crew. Upon review of the standing work plan, it was evident that (as is often the case) that the plans were underdeveloped (not all machines were included, for example, and tasks were described vaguely). I discussed with management that it would be best to take a granular approach based upon the process described above. We agreed upon allowable times for the task types in their plan and discussed and agreed upon visit frequencies for many common tasks for common machine types. The team then provided the mill asset list for rotating equipment, and I went to work.

The site had 10 lubrication technicians, and a couple of them were on short-term leave. Based on my week-long number-crunching, I determined and reported back that the mill needed an additional two persons immediately to have any chance of fulfilling the expectations it had set.

The evidence from the study suggested that management had put technicians in a compromising position based upon a decision made with too little information about the components of the entire job, and harsh consequences for "pencil-whipping" work plans.

This particular work role is one that needs to be thoroughly measured and quantified and labor allocated based on what the machines require, not on opinions about the machine lubrication requirement for production plans that existed a generation ago.

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