

## **How to Give Your Machine a Physical** by Jim Fitch

Doctors have perfected the skills of conducting physical exams. They know what questions to ask and how to examine the body for clues that signify health, injury or disease. The same is true of pilots. They are taught how to perform critical preflight checks or inspections that reveal mechanical condition and safety. By walking around the plane with checklist in hand, pilots survey the aircraft for signs of tire damage, maintenance errors, material defects, and even sabotage.

Mechanics, lubrication technicians and even equipment operators must be skilled at giving physicals as well. Like the doctor or pilot, they need to be alert to subtle changes or symptoms that might be an early sign of machine malfunction or accelerated wear. One of the obvious problems with conducting such inspections is that for most machines, the critical operating components are shielded from view by panels, casings, guards and housings, including the lubricant in most cases. It's like asking your doctor to give you a physical while wearing body armor.

Still, the machine and the lubricant can telegraph hints and signals to us in a variety of ways, but only if we are both tuned in and literate to their message. Tuned in means being vigilant and ubiquitous, like a detective, always looking for clues even when camouflaged from view. Literate means not only recognizing the presence of the clue but also being wise to the meaning of its message and the corrective response.

As in nearly all cases, the selection of machine inspections should be tailored to the machine design, criticality and operating environment. This means optimize the inspection process, not maximize. This is done by using good judgment in selecting which inspections are needed and how frequently they should be carried out. Following is a list of problem-revealing tests and inspections relating to oil lubrication. They require limited technical proficiency and most involve no special tools or instrumentation.

- 1. Oil Color Change.** Monitor changes in lubricant color through sight glasses and oil samples. Lubricants experiencing thermal and oxidative distress will exhibit marked changes (darkening) in color and opacity. Many types of contaminants will alter color as well. Additionally, a wrong lubricant can often be recognized by a shift in darkness or color.
- 2. Impaired Air-handling Ability.** Most healthy lubricants will rapidly release entrained air. However, distressed and contaminated lubricants may fail to release air from the body of the oil and may also form sustained surface foam. Aeration and foam problems are not always a problem with the condition of the oil but may point to entrained air sources and mechanical conditions. Sight glasses and inspection hatches may provide the first sign of a problem.
- 3. Impaired Water-handling Ability.** Water and oil don't usually mix. However, if they become conjoined in an emulsion, the problem is usually associated with a change in the oil properties (many causes) or contamination. Observing oil/water separation after violently mixing quantities of each in a sample bottle or laboratory glassware is an easy check for this property.
- 4. Blotter Spot Structure.** This inspection has been discussed before in Noria publications. It involves placing a couple drops of oil on blotter paper or card stock, then observe for radial

structure to form (rings, starburst, etc.). Healthy, uncontaminated oils don't produce structure. Instead, the oil will wick up into the paper leaving only a uniform gradient of oil color behind.

5. **Patch Test Inspection of Debris Field.** This test has also been discussed extensively in Noria publications. Sometimes called the poor boy's particle counter, it provides information not only about particle size and count but, to the trained eye, can also provide information about particle composition and shape. Even a \$20,000 particle counter can't do that!
6. **Bottom Sediment and Water (BS&W).** It is often said that what is bad for the oil, or has degraded from the oil, or has been liberated from the surfaces of your machine is also heavier than the oil. We know that substances heavier than the oil will settle when mixed with the oil. There is great wisdom to routinely inspecting for BS&W using special sight glasses or drain port sampling. After all, if nothing has settled, much could be said for what aberrant conditions are not happening to your machine.
7. **The Voice in Noise.** Few machines are quiet during operation. Even completely healthy machines have something to say. You've heard the adage, "a singing gear is a happy gear". This is often true, but not always. Machine sounds change for specific reasons. Try to locate the point of generation. Some maintenance technicians play doctor by using crude stethoscopes in the form of a garden hose or a steel rod held to their ear, with the other end touching potential noise-generation sources.
8. **Checking Your Machine's Temperature.** Doctors use thermometers, but maintenance technicians employ a variety of tools including online temperature probes (thermocouples or resistance temperature detectors (RTDs)), thermal imaging cameras or handheld heat guns. A few common causes of temperature excursions include wrong lubricants, degraded lubricants, contaminated lubricants, abnormal friction/wear, and the list goes on.
9. **Pressure Drop.** In the same way oil temperature can change in response to an assortment of problems, oil pressure can increase or decrease as well. Anything that can change viscosity (don't make me compile another list...) or form surface deposits can change system pressure. For similar reasons, it is no surprise that doctors pay special attention to blood pressure during an exam.
10. **Filter Life.** When filters plug prematurely, there is usually good reason. What's plugging the filters and why they're plugged are considerations worthy of our attention. Areas of concern are soft contaminants (such as sludge, organic material, dead additive residue, biomass, etc.), terrain dust and wear debris. The filter is the final resting place for a variety of machine and lubricant operational waste products. I'm sure you've already noted the interesting human health analogies here as well.

The above list of ten inspections is just a start. There are far too many field tests and inspections to describe in one column. For those who make a living caring for the health of lubricants and machinery, the value of being proficient in performing machinery physicals is immense. Flanked by laboratory analysis and other predictive maintenance technologies, the modern-day lubrication and condition-monitoring professional is indeed fortunate to have such an increasingly vivid view of the internal state and operational health of his machinery.

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