"Notes from the Unit Shop"

Kevin O'Connor's advice for the beginning small scale live steamer

LUBRICATING OIL FOR SMALL SCALE LIVE STEAM LOCOMOTIVES

DISCUSSION

Small scale live steam locomotives, their tenders, and the rolling stock that they pull require proper lubrication of their moving parts. This is especially true of locomotives that have prototypical valve gear whether it is externally or internally hung. Most high-end locomotives have crossheads and crosshead guides as well as axle pumps that must be kept oiled at all times. All locomotives, irrespective of price, have connecting rod bearings, coupling rod bearings, and axle bearings that must be lubricated. Eccentrics that drive valve gear and axle pumps, as well as bell cranks and reversing gear, must also be kept properly lubricated. The locomotive's tender and rolling stock, with the exception of rolling stock that has sealed ball bearing fitted to the axles, must also have proper lubrication provided to axles and bearings.

All of this lubrication must be applied and then run in a hostile environment. The small scale live steam locomotive operates at 250 to 300 degrees Fahrenheit, and even though the running gear is exposed to the air circulating around it, it is still very hot to the touch. Too light an oil will rapidly disappear at these temperatures. Too heavy an oil will build up on the surface. Dirt contamination of the lubrication film becomes a real problem if the viscosity of the lubricating oil is increased This is especially true if the live steam locomotive is run on the ground as in a garden railroad setting. Those of us who run consistently on elevated tracks have less problem in this regard, but none of us want to worry about oil film failure that would lead to metal to metal contact, or attracting unnecessary amounts of grit and dirt.

I once worked on two Roundhouse "Pooters" that had many a mile on them. Both were poster children for the heavy viscosity oil lobby. Both were caked with a grease-like substance, which turned out to be cooked heavy weight oil and dirt. What could wear was worn to its limits. This was especially so in the valve motion components. The Hackworth gear's reverser, a kind of slot that a ball affixed to the valve gear runs in, was worn as well as the ball itself. This wear was caused by the use of too high a viscosity lubricating oil that attracted and

held dirt, and then served as a lapping compound as the ball traversed the slot with every stroke of the piston; it was ugly.

LUBRICATING OILS; WHAT IS NOT

For the purposes of this discussion I am limiting it to the products best described as petroleum (mineral) based lubricating oils. I am aware that there are other products on the market that lubricate, but I, with one exception, intend to ignore them for now. Let's start off with the exception.

WD-40 and LPS, and other similar products, **are not** lubricating oils. They **are** penetrants and protective products that are designed to work their way into the smallest of crevasses (bound up threads), displace water (spray WD-40 on your wet automobile ignition wires), and surface protectants to bar oxygen in the air from coming in contact with ferrous surfaces (precision tools) to prevent rust. They have very little film strength and they will not produce an oil wedge in rotating machinery at any useful load. In future I will be writing about the storage of small scale live steamers, and I will be singing the praises of these products, but for now, let's avoid their use as lubricants.

LUBRICATING OILS; WHAT IS

All mineral oils, which are derived from crude oil, starting with gasoline (a poor lubricant) through kerosene, heating and diesel oils and on up into the families of light to heavy viscosity oils that include bunker and asphalt are considered lubricating oils. Bunker oils and asphaltic tars internally lubricate the screw pumps that move them from place to place. Diesel and heating oils lubricate the transfer pumps and injectors that are part of a fuel supply system. Diesel oil also is used as a cooling fluid in mechanical diesel engine injectors. Excess fuel circulates through the injector and then carries heat back to the fuel tank (heat sink) to be cooled by the air surrounding the tank. That clear, odorless, tasteless (yuck!) over-the-counter nostrum known as "mineral oil" is in fact derived from crude oil. One of the reasons that it is used in the human body is because it lubricates impacted matter trapped at the end of the line, and thus allows that matter to be evacuated with only minor discomfort.

There are standards that automotive lubricating oils must meet to be considered for use in the transportation industry. Some standards are: viscosity, viscosity index, flash point, pour point, additives, and Sulphur content. Lubricating oils that meet the standards for viscosity are expressed as SAE W30 for 30 weight oil and so on for the other viscosities. Most automotive lubricating oils contain additives that may include detergents to prevent the buildup of carbon deposits within an internal combustion engine, and emulsifiers that trap free water (vapor or liquid) so as to prevent the production of sulfuric acid in the crankcase. Neither of these additives are needed for the lubrication of small scale live steamers. Plain old, non-additive, machine oil is what we're after.

Actually, after all is said and done, the selection of the proper lubricating oil is not a hard task. Intuitively one knows that 40 weight oil is a non-starter; it is too honey-like at room temperature; and it "strings out" of the applicator or oil can; it just looks like a dirt magnet! At the other end of the spectrum we have watchmaker oil (used to be sperm oil) which is obviously too light for our uses. Next is sewing machine oil, which is about 10 weight. The regular old red can of 3-in-1oil is in this league. The next step up encompasses two similar 20 weight products; something called turbine oil and the "harder to find than its well known cousin," 3-in-1 electric motor oil in the **blue** can. Last is 30 weight machine oil, and it has just too much resemblance to the aforementioned 40 weight product that was previously discarded as a candidate. At this point the field is pretty narrow, and personal choice

or product availability will probably be the deciding factor in choosing the best lubricant.

TESTING

For the past five years I have run my personal live steam locomotives with lubricating oils that ranged from W10 up to and including the sticky W40. I have found that with regard to live steam locomotives **the operating temperature of the locomotive**, not the ambient temperature of the environment dictates the choice of a lubricating oil. Over the last five years I have run live steam locomotives in local temperatures from a low of 40 F (and raining) to a high of 105 F using these various weight lubricating oils with dead-on similar results. The one that works the best does so at all local outdoor temperatures.

I expected that there might be a difference in the way that rolling stock might be affected by the choice of differing weight lubricating oils applied to their wheel bearings as ambient temperatures dropped in winter. At first I though I saw a trend in this direction. I was wrong. What I was seeing was a reduction in tractive effort caused by the live steam locomotive giving up heat to the colder air (black body law). That required much higher fuel settings to maintain the required boiler pressure to pull the same load at the same speed. Since all the gas fired live steam locomotives that were used in my testing either had footplate mounted gas tanks or steam heated tender bunkers, it is safe to assume that there was no drop of butane pressure as the outside air temperature cooled.

CLEAN-UP

All live steam locomotives need to be cleaned up on occasion, and certainly before storage. I will cover this clean-up process in some detail in another piece, but for now let's just concentrate on good engine keeping. I clean my locomotives by first spraying them with "water white" kerosene. I concentrate the spray on the wheels, chassis, running gear, and all the machinery between the frames. I am lucky enough to have an outdoor utility sink, and once the kerosene has done its work, I spray it off with cold water using the sinks handpiece. I then sit the locomotive on the track and let it drip-dry. Using the proper viscosity machine oil for locomotive lubrication make this job easy. If too high a viscosity oil is used, multiple turns with the kerosene spray will have to be employed to dislodge all the crud and gunk that collect on the bottom of a locomotive.

BOTTOM LINE

After five plus years of small scale live steam operation (two or three afternoons a week for the last three years), and some semi-scientific (but not junk-scientific) testing, and considering some practical matters like availability (hardware store) and portability (will the container leak in the toolbox?) I decided that the best mechanical lubricating oil for use with small scale live steamers is ..... **3-in-1, 20w, electric motor oil** followed by the third place winner, turbine oil. 20 weight oil forms a proper oil film on all moving parts. It will not evaporate at normal live steam operating temperatures, adding additional 20W lubrication flushes away dirt. 20W provides a protective lubricating film without becoming a dirt magnet. Electric motor oil contains no additives to allow it to emulsify with water. I easily flushes away with an application of kerosene. One can easily obtain it from Sulphur Spring Steam Models. And once it's properly caped it won't leak in your tool box. Turbine oil is OK. My biggest objection to it is the container in which it is purchased. The container has a sort of "pokey spout" with an impossibly long pull-out proboscis. The supplied friction cap resides on the end of the proboscis, and thus leaks at the spout/proboscis

interface are encouraged if the container is stored on its side. After all it is light oil and its purpose is to flow into (and out of) small clearances.

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