



North Georgia Live Steamers

Club Locomotive 1328

Procedures for Fire-Up, Running and Shutdown

Check list

Narrative

Boiler Backhead Schematic

N G L S Locomotive 1328 Log

Operating Rules

December 2016

Bob Cummings

Narrative

Introduction

In the glory days of steam the locomotives performance was determined by two things, the engineering department that designed the locomotive and the engine crew that ran the locomotive. No matter how well designed the locomotive if the engine crew was not a good team the engine would not perform up to standard. And no matter how excellent the engine crew if the engine was poorly designed it would never be efficient. Railroads kept track of the amount of fuel and water used to move the tons of freight over their railroad. Interestingly, the same amount of freight could be moved over the same rout by a ten wheeler as by a Mikado using approximately the same amount of fuel and water. Clearly the Mikado could move a longer, heavier train, but up to the capacity of the ten wheeler the efficiency was nearly the same with experienced crews in each engine. The point is that the experience of the engine crew is critical to the efficiency of the engine. It is my goal to help the new engineer in our hobby become both comfortable running the club locomotive as well as doing it well and efficiently. In doing so the engineers can enjoy their day at the throttle.

Pre-Start

Check log book in the Utility Car for previous problems or comments by the last crew to run the engine. Log into the book, include date and time.

Move the engine from the storage container to an open steaming bay. Locomotive, tender and utility car should be coupled together and safety chains attached. Check to see that they are secure. Check the socket head bolt that secures the locomotive/tender draw bar. Also check the air hoses between tender and utility car. Normally the engine, tender and utility car will remain complete as a unit.

Lubricate the engine drive wheel journals (Use the long spout oil can and oil from the opposite side across the frame to the top of the main journals). Lubricate the valve motion and rods. Give a shot of oil to the main rod where it connects to the cross head. Regular (not detergent or oil with additives) 30 weight motor oil is best. The oil can is in the utility car. Use the time while you are lubricating the engine to inspect it. Wiggle the rods of the valve gear and the drive rods. There should be some movement but not excessive or sloppy feeling movement.

The wheel bearings for the pilot truck on the engine and the bearings on the tender trucks and utility car trucks are sealed and need not be lubricated. The engine trailing truck is oiled on either side at the hole just above the axle.

Check the cylinder lubricator, left side forward, on the engine by removing brass cap (on top) fill to top of tank with steam oil. When running, check from time to time to make sure the oil level is going down. If the oil level can't be seen, fill as before. This is special steam oil which does not emulsify with heat and water. There is a bottle of steam oil and a "funnel" in the utility car. The steam oil is thick and dark when compared to the regular 30 weight lube oil.

Lubricate the brake cylinder by removing the screwed brass plug from the steam line, (located at the cab end of the left running board) and put a few drops of steam oil into the brake line. Replace the plug. Note this line is pressurized when the brakes are applied so the plug must be secure.

Attach the foot rest to the tender. One on the front beam attaches with two bolts to the front frame of the tender. The foot rest must be removed to allow the engine to be rolled into the storage container.

Check the propane bottles and battery in the utility car. The three propane bottles should have been turned off after the last run. Check the firing valve upper right side of the tender, make sure it is off, turned fully in the clockwise direction to its stop (off). Turn all three propane bottles on beginning at the rear most bottle (valve on top of each bottle) see the arrow on the handle for the direction to turn. Check for leaks by sniffing and listening for escaping propane. The rear most bottle has a gauge on it when the system is fully turned on this gauge should read in the green. If not, you'll need more propane. The bottles should be refilled not exchanged. Bleed the propane line to the burners in the firebox by opening the firing valve on the tender, listen and smell for the propane in the firebox. When you smell the propane turn off the firing valve. Note, propane is heavier than air and will fall away from the engine.

The boiler has been left open to help it dry and reduce rust. Reinstall the safety valves on top of boiler at the rear. Use thread compound to the male threads. Close the blow-down valves by pushing in the reach rods on each side of the cab at the lower back outside forward. The reach rods have a safety stop to prevent them from opening, make sure the reach rod is pushed forward until the safety stop drops into the preventer slot.

To prevent the injector lines from bursting during a freeze in winter they have been drained by disconnecting them from the injector and opening the boiler check valve. Reconnect the injector lines at the injectors (right and left side under the cab) and tighten the caps on top of the check valves right and left side of the boiler forward. The threads on the line couplings and check valve tops are very fine and can cross thread easily. Take care that this does not happen when reconnecting and tightening them.

Some Notes on Boiler Operation

Boiler water is the most important safety item on the engine. Boiler water actually cools the metal of the boiler and prevents it from rupturing. When you are sitting behind the boiler you don't want the crown sheet of the boiler to rupture and the contents of the boiler (scalding hot water and steam) to come rushing out of the firebox door at you! There needs to be at least ½ inch of water over the crown sheet. The bottom of the water sight glass is at least ½ inches above the crown sheet. If you can't see water in the bottom of the sight glass turn off the fire. Do not attempt to put water in a hot low water boiler. Cold, or relatively cold water, will weaken the now unstable and overheated crown sheet and cause it to blow. The boiler must cool down completely and allowed to stabilize before it can be refilled.

The fire's energy is transferred to the water through the fire box of the boiler (60%) and the boiler tubes (20%) and 20% of the fire's energy goes up the stack. (These percentages vary from boiler to boiler but are generally accepted.) The fire's infrared energy heats the firebox steel and the water on the other side cools the steel by absorbing the heat energy. Water at atmospheric pressure boils at 212 degrees. When captured in a boiler and brought up to 330 degrees it is 125 PSI (Pounds per Square Inch), each square inch of interior boiler space is being pushed outward by 125 pounds of pressure. There is a table that shows the relationship of water temperature to steam pressure in a pressure vessel. The important thing is that temperature and pressure are locked together. A boiler that is continually popping off through the safeties is both under too much pressure and getting too hot. Boiler management is done by adjusting the fire or using the steam. When a boiler is popping off it is losing water through the steam that escapes, so a good way to bring the boiler under control is to use the injector to fill water into the boiler. The new water coming into the boiler is relatively cooler than that in the boiler and has a cooling effect, the injector uses steam to work. Our engine has a fairly short range of water safety so keep an eye on it. Ask yourself

constantly, “How’s the water doing?” Both Ohlenkamp style injector (right and left side of the engine) works well.

Filling the boiler and tender with water.

With the safeties installed and the injectors reconnected you are ready to fill the boiler with water. Open both injector valves (left and right, push pull valve) and open the blower valve (left side about half way up, twist valve). Doing so will allow the boiler to breath and the water to come in. Flush the hose out before attach it to the locomotive. Attach the hose to the hose coupling under the cab on the left side and open its valve. And open the water valve under the steaming bay. Hoses are kept in the storage container. When the water gets to 2/3 up in the sight glass turn the water off and disconnect the hose. Don’t forget to turn the valve off under the cab.

Check the injector water valves near the floor, right and left side of the tender. When the handles are straight up the valves are closed. Check the tender drain valve under the tender tank left side. The drain valve should be closed. Fill the tender to the top with water.

Lighting Off

Open the firing valve on the right side of the tender and make sure, by smelling and listening, that propane is getting to the burners in the fire box. Close the firing valve. Install the exhaust fan on the stack but don’t plug in yet, it will make it harder to light the burners. You will need an extension cord from the storage container for the exhaust fan. Use the Bar B Que lighter in the utility car to light the fire in the fire box. Light the starter first then insert it into the fire box through the fire box door and slowly open the firing valve on the tender. You will need to hold the flame above one of the burners. If it doesn’t light immediately turn off the firing valve. Don’t allow too much propane gas to accumulate in the fire box. It could flash and burn you. You may want to try lighting from below. Whichever works best for you in either case make sure the starter is lit before turning on the gas. When the fire is lit and before turning up the flame up, plug in the exhaust fan. If the exhaust fan pulls the fire off the burner turn the firing valve off and start over. Leave a little higher fire before plugging in the fan this time. Open the firing valve so that you have a full firebox of fire. Close the fire box door. Close the injector and blower valves. Bring the fire up as far as you can without blowing the fire out the bottom of the fire box.

As the boiler gets hot and the steam pressure builds keep an eye on the water glass. The water level in the glass should remain constant. If it seems to be falling check for leaks (most likely at the blow downs or other boiler fittings) If you think you are getting a false reading in the glass try quickly opening and closing the drain valve on the bottom of the glass body, this should result in a sudden drop of water level and then rebound of the water to an accurate level in the glass.

Steam-Up

When the boiler pressure gets to 40 PSI, gauge upper right side of cab, open the blower valve a little and remove the exhaust fan. The fan will be hot! Use gloves to handle the exhaust fan. Set the fan on something that won’t be affected by its heat.

Open the blower valve enough to draw all the flame through the boiler tubes and ensuring that the flame does not come out from under the engine’s firebox. There is a blower sweet spot where there is enough

draft to excite the fire and not so much that the fire is cooled by the incoming air or is sucked off the burner. As the boiler pressure increases the blower flow will increase as well. Adjust the blower down to compensate for this change. The blower is one of those things that you will develop a touch for. The need for blower will change depending on the need for steam. Drifting down grade you will need to use more blower. Going up grade the engines exhaust will create the draft needed. Standing in the station or at a stop you will want to reduce the fire and correspondingly the blower.

Ideally, you should keep about 120 to 125 PSI boiler pressure. The safety will pop at about 125 PSI. During Steam Up allow the boiler to pop off then turn on the right Ohlenkamp injector to check that it works and to bring down the boiler pressure. When the safety pops again test the left injector. If the safety pops and you have high water let it run for a minute and then try the injector. When the safety valve runs it allows more water to convert to steam and the boiler water level drops.

Injector Operation

The injector works by accelerating the water particles to a speed where they can pierce the pressure vane of the boiler. To do this the steam must “hit” the water in the injector with some force. For this reason the best valves for a steam injector is the push/pull type where, when activated, allows a sudden rush of steam to enter the injector.

Starting the injector. Both injectors work the same. First turn the water on, the water valves are on the tender floor on either side. The valve is open when the lever is parallel to the floor. Watch for water to flow out of the injector overflow. When the water is flowing open the push/pull steam valve in the cab. The injector should pick-up. If water continues to flow out of the overflow throttle back the water until the injector does pick up. If it fails to pick up the boiler pressure is too low. Turn off the water, build up the pressure and try again. The right side water valve in the tender and the right side steam valve operate the right side injector. Correspondingly the left side valves operate the left injector.

To turn off the injector first turn off the steam and then the water.

Be aware that when running upgrade the water level in the sight glass will appear to be high and when running downgrade the water will appear to be low. In the case of running down grade and the appearance of low water it is better to be safe and turn on the injector.

Running the Locomotive

Before leaving the steaming bay check to see that all hoses and wires are removed from the locomotive that connected it to the steaming bay.

Check the locomotive brakes. The Locomotive brake valve is a rotary lever valve located on the right side of the cab below the sight glass. Rotate the lever up to apply move the lever clockwise, down to release the brakes. There is a spot about half way between where the pressure in the brake line will hold, some call this the “Lap” position. Check to see that the brake shoes clasp the drive wheels and that they relax when the brakes are turned off.

Check the train brakes by operating the train brake valve on the tender, left side forward.

Put the engine in full forward or reverse by moving the “Johnson Bar” or “cutoff-lever” full forward or back. This is the lever in the right side of the cab that controls the valve gear and timing of the engine.

Once the engine and train are rolling adjust the cutoff lever back, about half way to center. The engine will be more efficient using less water and steam in this position.

When operating the engine “cold” make sure the cylinder cocks are open. The cylinder cocks are operated by the lever in the cab on the left side floor. The cylinder cocks are open when the lever is forward. When the cylinders are cold the steam will condense into water when it enters the cylinder. Water does not compress and will cause damage to the cylinder heads and or cylinder rod packing at the cross head. When the cylinders have warmed to the point where the steam no longer condenses the cylinder cocks can be closed by moving the cab lever to the rear position. Water coming out of the stack is a sign that the cylinders are not yet warm enough to run with the cylinder cocks closed. If you are forced to stop for a while out on the railroad the cylinders will cool and you’ll need to open the cylinder cocks. Standing in the station will also allow the cylinders to cool. It is OK to run a little with the cylinder cocks open, this is how you warm the cylinders. Don’t forget to close the cylinder cocks though as running with them open for any extended time will wash the lubricant out of the cylinders and cause damage. Running with the cylinder cocks open also makes the engine less efficient.

The throttle is under the right side of the cab roof. The throttle is closed when the lever is fully forward. Ease the lever back to start the engine. Do this slowly, steam must begin flowing to the cylinders and then fill the cylinders before enough power is generated to move the engine and train. This is another area where you will develop a “touch for it.”

As you run on our railroad you will learn its profile, the up and down grades. As you become familiar with the profile you can anticipate the engines need for power/steam. Going down grade is a good time to add water. As you approach an upgrade build up your fire. Your train length and or weight will determine how much fire and water you will need. It will be different if you are running light or pulling a train. Passenger make up will also have an effect. Mostly children will be a “lighter” train than one with mostly adults. Before leaving the station look at your train, is it going to be really heavy or just heavy?

It is easier to start a train than to stop it. As you approach a down grade slow to a speed that will allow you to control the train on the down grade. Remember you may have to stop because of a derailment, something on the track or traffic ahead of you. Safely stopping is always preferable to an accident. To stop apply the train brakes, anticipate that the train brakes will take a moment to come on. You can also apply the locomotive brakes. Be cautious when using the locomotive brakes, the wheels can lock and skid creating a flat spot. You can also reverse the engine with the cutoff lever and open the throttle.

Passengers are unpredictable. Most people are well behaved and sit still but others can be really excited about the ride and unaware that bouncing up and down, wiggling and twisting in their seat can upset the train and cause a derailment. Sometimes people are unaware of what their reaction will be, this is especially true of children. Some people will reach out and point or grab at things the train passes. Some may even attempt to stand up. Some will giggle or laugh or yell. This can be especially disturbing as you run the engine. Check with your conductor and get your signals straight. As engineer you have responsibility for the safe operation of the train. Passengers are unpredictable. As engineer you are responsible for the safe operation of the train and the well being of your passengers. See section 302 in General Operating Rules.

Shutting Down

At the end of the day return the cars to the yard or put them away in the storage container. Back the engine and its utility car into the steaming area. Turn off the fire by shutting the propane tank valves in the utility car, then close the firing valve on the tender. While waiting for the boiler to cool and the pressure to come down to a safe pressure perform the shut down maintenance and inspection. Lubricate the rods, valve gear and wheel journals. Fill the cylinder lubricator. Inspect the engine to see that it is in the same condition it was when you brought it out that morning. Also disconnect the battery in the utility car. Drain the tender and the tender water lines clean the water filters and reinstall them. Remove the foot rests.

Blowing down Allow the boiler to cool and its pressure to fall to 40 PSI. to help speed this you can use the injector. As the boiler pressure falls you will have to throttle back the water. Eventually the injector will stop picking up and you'll have to wait until the boiler gets down to 40 PSI. This is important because one of the things that makes steam so desirable to be used as a power source is that it will continue to expand at pressure even though the space it is confined in gets bigger. If you blow down at operating pressure, 120 PSI, the steam pressure will stay at 120 PSI until the water has been blown out of the boiler. Then the pressure will drop dramatically. This sudden drop in pressure is hard on the boiler and can cause it to contract and misshapen even pulling the tubes away from the tube sheets. You can see this in action. When you open the blow downs watch the pressure gauge it will hold at 40 PSI until the all the water is blown out of the boiler, then the pressure will suddenly drop. By letting the boiler to cool to 40 PSI you reduce the sudden drop of high pressure and still get the advantage of opening a hot boiler and letting the remaining heat dry it out.

After blowing down remove the safety valves and wipe the engine jacket running gear and tender down. Open the injector valves and blower valve. Loosen the caps on top of the check valves and disconnect the lines from the injector to the boiler allowing the lines to drain. Doing this will reduce the chance of water in these lines from freezing and bursting the lines. Oil the cylinders by removing the plugs and putting a squirt of steam oil in each hole and replacing the plug securely. As you move the engine into storage the oil will work its way down through the valves and pistons and out the cylinder cocks. Remove the foot rests and put them on top of the propane tanks in the utility car. Fill out the engineer's log. Note any problem you had and alert the "Superintendent of Motive Power, Steam" about what happened. Replace the log book in its box in the utility car. Return the engine, tender and utility car (as a unit) to the storage container.