ACCUCRAFT TRAINS
MUSEUM QUALITY BRASS MODELS

D&RGW K-28 COAL FIRED
INSTRUCTION MANUAL

Instructions Provided by Pikes Peak Locomotive Works

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K-28 COAL FIRING- MATERIALS NEEDED

Following are recommended supplies you will need to successfully fire and run your coal fired K-28 from Accu-craft.

COAL High quality, low clinker coal. The size of the pieces should not exceed that of a lima bean.

"Dr. Clinkers Welsh Steam Coal"

Welsh steam coal in "Bean Size" from Coles' Power Models has been used extensively in the prototype locomotive. This coal has soft lumps, the larger of which are easy to break up into a proper size; we use a garden hand clipper. Coles' coal bums very clean, with little smoke, almost no clinker and very little ash and cinders. The only downsize of this coal is that it burns at a fairly high rate, and the firebox needs to be stoked more often. This comes in a large bucket weighing about 50 pounds, shipped UPS.

Available from: Coles' Power Models, Inc
PO BOX 623
WARREN, TX 77664
TEL: 409-544-3400
www.colespowermodels.com

OTHER BRANDS OF COAL
We have personally tried several other kinds of coal, Pennsylvania Pocahontas Coal among them. None of these coals were as suitable for firing the K-28 as "Dr. Klinkers." Several of them formed large masses, or clinker, that continuously needed to be broken up with the pick to maintain adequate combustion. Without exception, they all produced more ash, cinder and clinker than the Coles' product. Therefore, at this time, we recommend the Coles' product only.

CHARCOAL
Real wood, **NOT BRIQUET**, charcoal. Available from gourmet cooking stores, barbeque supply stores and some home improvement centers.

"Cowboy Brand" barbeque charcoal

"Cowboy" brand barbeque charcoal available from LOWES' HOME CENTERS in 20 pound bags has been used exclusively with the prototype locomotive. This charcoal is a mix of pieces of hard and soft woods that have been run through a charcoal kiln. They range in size from 2 to 4 inches in length, and are easily chopped into "lima bean" sized chunks with a pocket knife. The cut pieces are placed into a metal coffee can with a plastic snap on lid and lamp oil poured over them. You do not need to excessively saturate the charcoal. Keep about a quarter to one half inch of liquid lamp oil in the bottom of the can which will soak up through the charcoal, keeping it moist with oil.

LAMP OIL
Non-aromatic lamp oil or patio torch oil is best for soaking your charcoal. Try NOT to use kerosene or stove oil. We use "TIKI" brand torch fuel available from LOWES' HOME CENTERS. "TIKI" torch fuel is produced by TIKI in Menomonee Falls, WI, 53051, and comes in a 1 gal. container.

DISTILLED WATER
Every effort should be made to use only "STEAM DISTILLED" water. **NEVER USE WATER DEIONIZED WATER**. Deionized water will remove ions from the copper and solders used in constructing your boiler, eventually causing It to fail. Water that has been OZONATED will not harm your boiler, but straight STEAM DISTILLED water is best. Occasionally you will find water that has been purified using REVERSE OSMOSIS. This purifies water as well as steam distillation, and is equal in every respect.

STEAM OIL
Your coal fired conversion contains an adjustable feed lubricator with the feed line separate from the main steam line. This allows you to adjust the feed rate to provide adequate oil to the cylinders without creating an excess of oil soaked residue of cinder and ash in the smoke box. A heavy grade of steam oil will work best in this capacity. The best oil to use for your K-28 conversion is an ISO 460 AGAMA 7 compounded steam cylinder oil. We have been using oil that meets this criteria that was purchased from an Accucraft dealer, but Sulphur Springs Steam Models has a comparable oil. ISO 460 AGAMA 7 compounded cylinder oils are also available from your local petroleum bulk dealer. This is a darn, thick oil that allows easy adjustment of the lubricator. Flow rate of this oil should be adjusted to provide about 1 to 1.5 cc per hour of running time . On our locomotive this flow rate results from opening the needle valve between 1/8 and 1/4 of a turn from closed.

LUBRICATOR SYRINGE
The best way to adjust your lubricator is by measuring the condensed water remaining after a run. Your lubricator is fitted with a drain to use for removing the condensate at the end of a run, but this makes measuring it difficult. The best way to accomplish this is by using a syringe with an 1/8 inch tube to draw out the water from the bottom of the lubricator. This allows you to adjust the feed rate to provide adequate oil to the cylinders. The amount of water should approximate 1 to 1.5 cc per hour of running. A very nice brass syringe is available from Accucraft. Sku# AP-29201.

LUBRICATING OIL
Because of the additional loads imposed on the running gear by the axle pump, we recommend OIL the use of STRAIGHT 40 WEIGHT, automotive lubricating oil for your locomotive. Lubrication of all moving parts prior to each run is highly recommended , with special attention to the eccentric, ram and driving yoke of the axle pump.

AFTER RUN BRUSHING
To clean off the light dusting of ash and cinders following a run we use a 1 1/2 to 2 inch wide, soft bristle paint brush. Since a proper adjustment of the lubricator results in little to no oil splatter on the locomotive, the brush down will almost completely remove all dust, cinders and ash.

CLEANING SOLVENT
The running gear of your locomotive needs regular cleaning, We use and recommend the use of “STODDARD” solvent for this purpose. This is a product that is designed for parts washing in the aviation and automotive industry. It is an excellent grease and oil remover, has a low flammability and leaves only films or residue. It is available from your local Petroleum Bulk Supplier, either under the name of “Stoddard” solvent or as parts washing fiJid. Most automotive machine shops can point you in the right direction to buy it.

SOLVENT SPRAYER
We apply the Stoddard solvent using a pressure type garden sprayer. Ours is a HUDSON brand “Bugwiser Sprayer,” model number 67220. This has a 2 gallon, stainless steel, canister, which is solvent resistant. We purchased ours from LOWES’ HOME CENTER. One note about this sprayer and Stoddard Solvent. You will have to occasionally put some oil down the top of the sprayers pump barrel to lubricate the piston, as the solvent tends to wash away the pumps lubricant.

VACUUM CLEANER
One of the components of all coal is sulphur. Sulphur burns producing sulphur dioxide, which combines with moisture to form sulfuric acid. To reduce the corrosive effects of sulfuric acid you should clean all of the accumulated ash and cinders out of the smoke box following every run . This can be accomplished using a computer vacuum . The specific brand we use is a Metropolitan Metro DataVac w/Micro-Tools. Ours was bought from a Fry Electronics store, but they are available from various computer and electronic supply stores, and on line from Office Quarters. Their website is : www.officequarters.com

FIRING

Firing and running a coal fired locomotive is an entirely different experience from that of a butane fired engine. Coal firing is a dynamic process that is continuously changing from moment to moment. The variables presented by temperature, humidity, track conditions, train load, firing technique, distractions and your attention to the firing process will make every run a new and challenging event. Although many of the elements of running your locomotive will be familiar to you from running a butane fired locomotive, coal firing introduces many new elements that require you to be continuously thoughtful and attentive .

Unlike a butane fired locomotive, you can not set your coal fired K•28 running down the track while you casually stand by watching it perform or visit with onlookers; it needs your constant attention. Many butane locomotives will run out of fuel before water, and slowly come to a stop with no harm done. The functioning water level of a butane locomotive, with its usual single flue, located along the bottom of the boiler, is less critical than that of a coal fired boiler with a crown sheet. The crown sheet needs to be in constant contact with water to keep from being permanently damaged. This means you must devote yourself to being ever watchful of the water gauge. The combustion of coal is also a more intricate process than the burning of butane. Coal firing needs to be managed in a thoughtful manner; the regular stoking and proper management of the firebox is an absolute necessity to a successful run. Stoking the firebox, like maintaining water level , can not be done in a haphazard manner.
The various elements of owning and firing your coal fired conversion are thoroughly covered in the five sections of this manual.

Section 1 - Materials Needed

Section 2 - Instructions

Section 3 - Owner Maintenance

Section 4 - Attachments

Section 5 - Firing Checklist and Quick Reference

One laminated for trackside use.

All of these materials are provided to assist you in getting the most out of your Coal Fired K-28, and we hope every run will be an enjoyable one.

Included with these instructions, as an addendum, are several published articles that have appeared in various magazines and elsewhere. They are included with permission from their respective authors, and we thoroughly suggest that you read them as well as these instructions.

Introduction To Coal Firing

Coal firing a locomotive is a dynamic, interactive, process; quite unlike firing with butane. The best way to approach it is to envision yourself as both fireman and engineer in the cab of a steam locomotive at the turn of the century. The engineer's duty can be likened to that of an orchestra conductor, coordinating the many elements necessary to create harmony from what would otherwise be chaos. The fireman, on the other hand, is like the first chair violin position, or concertmaster, setting the tone, style and rhythmic reliability of the production. While the engineer was in charge of the throttle, Johnston bar, brakes and progress of the locomotive, the fireman held it all together; tending to the needs of the locomotive's heart and soul, the boiler. The fireman was always alert to the processes taking place and the need to address continuously changing situations.

The following statement is taken from the "Handbook For Railway Steam Locomotive Enginemen."

"The duty of the locomotive fireman is to provide an adequate supply of steam at all times, and to match these requirements to the needs of the road and the engineer, so as to maintain the required timetable . This must be done in such a way that the safety of the locomotive, its crew and passengers is maintained at all times."

Failing to anticipate the needs for changes in power, as the train sped up, climbed hills, slowed down, or stopped at stations, could result in delays and boiler damage, wrecks and explosions.

To this end, maintaining a proper level of combustion in the fire box and adequate water over the crown sheet were paramount on the fireman's mind.

About Your Boiler

A good place to begin the firing process is to have a thorough understanding of your locomotives boiler and how it behaves. The boiler in your locomotive duplicates a full size boiler in all aspects, including significant areas of flat surface. Construction includes 8 fire tubes and 1 flue, a water legged firebox, a flanged steam dome, 5 bushings for mounting various fittings and a pass through for the blower pipe.

The major flat surfaces are the firebox front, sides and top, the boiler front sheet and the fiat outside portions of the boiler wrapper surrounding the firebox. The firebox is surrounded by water legs on 3 sides, the back being dry. These fiat surface water legs are supported against the internal pressures by copper rods or stays tying them to each other. The top of the firebox, or crown sheet, also basically fiat, is supported from collapsing by vertical plates that connect it to the outer shell, or wrapper. The front of the firebox, or rear flue sheet, and the front of the boiler, or front flue sheet, are supported against boiler pressure by being connected to each other with the tubes and flue. The barrel of the boiler, being spherical, is self supporting within the limits of its design strength.

Several of these boiler plates are flanged and all are assembled using a high strength, high temperature, silver bearing brazing compound. To maintain joint strength, those boiler plates exposed to the combustion process, and more particularly the crown sheet, must be in direct contact with and covered at all times by the water in the boiler. This means WATER LEVEL IS CRITICAL. To this end , the locomotive is equipped with an axle pump , hand pump and Goodall valve, and can also be optionally fitted with an injector. It should be noted that injectors in smaller sizes are notoriously finicky devices, not generally reliable, and should NEVER BE RELIED ON for critical boiler feed .

The K-28 conversion boiler is designed to function at a working pressure between 60 and 75 pounds per square inch. This pressure is continuously trying to collapse the crown sheet and inner firebox sides. The water level must be maintained above a point equivalent to the bottom edge of the blower pass through pipe at all times. The lower working limit for water level is the TOP OF THE RED LINE scribed on the water gauge. The installed axle

pump is sized to pump water in excess to the needs of the engine, and given time, will fill the boiler to its maximum capacity. During those times the locomotive is stopped and the blower is on, makeup water needs to come via the tender pump.

Maximum water level is not critical, but should not exceed the bottom edge of the top nut of the water gauge. Over filling the boiler results in the engine priming, or passing water to the cylinders, and can be noticed by a spray or mist of water coming from the cylinder exhaust or blower stream exiting the smokestack. A more detailed discussion of maintaining water level will be presented later in these instructions.

Coal Burning Processes

The combustion of coal in a firebox, and using the derived energy for steam production, is not a simple process. Coal is a complex material and its combustion is intricate. Coal, a mineral compound, contains, depending upon its specific type and source, various quantities of moisture, hydrocarbon volatile, ash, sulphur and fixed carbon . Coal needs a significant amount of heat to initiate and maintain combustion as well as a continuous supply of oxygen. Coal combustion takes two avenues. The first avenue takes place at a relatively low temperature and results in the combustion of the volatile hydrocarbon components. As fresh coal is added to the top of the burning bed of coal on the grates, the volatile hydrocarbons are gasified and driven off, burning in the space above the coal bed and producing hot flue gases that transfer their heat to the firebox, tubes and flues by convection, with minimal radiant energy. The second stage involves the fixed carbon portions of the coal bed situated on the grates.

The fixed carbon in the presence of a significant supply of oxygen, burns at a high temperature, becoming incandescent in the process. This second process produces considerable amounts of radiant energy as well as additional hot flue gases. The sulphur component, which is relatively small, also bums producing a corrosive in the form of sulphur dioxide which, in the presence of moisture, becomes sulphuric acid. The ash, or non-combustible portion, composed mostly of clay, remains behind to form clinker, clog grates, drop into the ash pan and be deposited in the smoke box.

In small scale locomotive boilers the heating surface apportionment between the fire tubes and the firebox, coupled with the small diameter of the tubes and their relative short length, generally favors the firebox for absorbing the energy of combustion . Most of the heat value in coal is contained in the fixed carbon portion , and since the fixed carbon portion combust with a high level of incandescence, this energy is readily transferred to the boiler radiantly. This results in the firebox being the major contributor to the steaming capacity of the boiler.

The combustion of both the volatile and the fixed carbon portion takes considerable amounts of oxygen. This necessitates that the bed of burning coal have a sizeable amount of air passing through it to maintain combustion. This air is provided by the exhaust nozzle and a separate blower, both located in the smoke box. The nozzle, as the engine runs , and the blower when it is stationary, reduce the pressure in the smoke box which induces air to be drawn up through the grates and burning bed of coal, through the tubes and flue, and out the stack.

The main requirement for this to take place, is for the air to have a free and unobstructed passage through the bed of coal, and that the coal be evenly spread across the grates. Any obstruction to the flow of air or lack of forced draft will cause the fire to go out . As well as obstructions, if there are large holes in the coal bed that allow air to circumvent passage through the burning portions of coal, combustion will be reduced . This is true also with leaving the firebox door open.

How you fire and run your locomotive needs to take into account how coal burns. The frequency of stoking , the quantity of coal stoked , how it is spread on the grates, as well as the quality of the coal , will all have considerable impact on how your locomotive performs . The specifics of coal firing will be covered in detail further on in these instructions.

Selecting Coal, Water And Oil

Your selection of coal , water and oil will contribute as much to the success of your coal firing experience as your firing technique.

Coal

A discussed above, coal is a complex compound and comes in many “flavors.” Coal falls into 4 basic classifications, anthracite is a hard, shiny coal with a high heat content; in excess of 15,000 BTU per pound, and a carbon content of 85 to 95%. Next down the scale is bituminous. It is softer, has less carbon, 45 to 85%, has a heat content of 10,500 to 15, 000 BTUs, and has less sulphur. Following this is sub-bituminous coal which contains upwards of 50% carbon, has a heat con lent between 8,000 and 13,000 BTU per pound, is softer and dull colored. On the bottom is lignite which is totally unsuitable for our purposes. All of these have other characteristics, depending upon their impurities and how they were formed millions of years ago, which impact their ability to be used in the small fireboxes of gauge one locomotives. These characteristics are less dependent upon their basic classification and more dependent upon the specific mine the coal comes from. Just because it is being used by some power company in a generating plant, does not mean it is suitable for our small firebox boiler.

Anthracite, bituminous and sub~bituminous coals can all be suitable for our uses. The single most important characteristic for our consideration is their ash content and their ash fusion temperature. Coals with high ash content and low ash fusion temperatures are prone to clinkering, clogging grates and forming masses that can blanket the bed of coal. In our small fireboxes this is especially problematic. As mentioned above, our boilers depend upon a significant transfer of heat radiantly . Anything which reduces radiant transfer, limits steam production greatly. Our small boilers also have a limited grate size, and anything that inhibits air flow will also inhibit steam production.

Whether you use anthracite, bituminous or sub-bituminous coal , you need to look for a clean burning coal that has low ash and is not prone to clinkering. The Welsh steam coal available from Coles’ Power Models falls into this category. Although it bums relatively fast and needs more continuous stoking than other coals, it burns without much ash, no smoke, and more importantly it does not form clinker. It is also easy to break up into the smaller size pieces needed to stoke through the firebox door.

Of the 3 or 4 different coals we have tried. Coles’ has been the most successful and easy to use, as well as the easiest to clean up afterwards.

Water

“Water, water everywhere, but not a drop to drink.” We have all heard of the plight of the shipwrecked sailor, surrounded by unlimited water, but none of it potable. The same is true with your locomotive. We are all aware of the need to use “purified water,” but all water on the store shelf is not the same. Your locomotive’s boiler is an assembly of many components that have been joined using a silver brazing compound . These brazing compounds are atomically different enough from the copper in the boiler plates to be subject to electrolytic decomposition in the presence of an electrically active fluid. The water used in your boiler needs to be as pure as possible, and within a relatively narrow range of pH. pH is the measure of the ionic properties of a liquid material which classify it as an acid or a base. This is measured on a scale from 0 to 14 where 7 is neutral: below 7 is an acid, above 7 is basic. Acidic solutions have an abundance of H+ (hydrogen) ions while basic solutions are strong in OH (hydroxide ions.) It is the presence of these ions that makes the fluid electrically conductive. Freshly “STEAM DISTILLED” water will measure approximately 7. and is ionicly neutral, but with long term exposure to carbon dioxide in the air slowly will become slightly acidic with pH of around 6; therefore. “the fresher the better.”

We often think of some natural waters as being very pure; for instance rain water, or “Pure Spring Water.” It is true they may not have significant dissolved solids in them, but their pH can vary from acceptable to miserable, we’ve all heard of acid rain. Just as we use acids and bases as electrolytes in batteries to pull electrons out of the metal battery plates, the pH of your water can cause electrolytic effects to take place in your boiler, which can cause the brazed joints to break down over time.

Distilled water that has been 'DEIONIZED" is extremely active electrically and should NEVER be used in your boiler. Often water Will be OZONATED to kill bacteria. Water that has been ozonated is acceptable as long as it has also been steam distilled.

*** We recommend only the use of STEAM DISTILLEO water in your boiler ***

Oil

Since the beginning of the steam age there has been a heated discussion of which oils are best for cylinder lubrication. The development in recent years of a plethora of synthetic oils has only exacerbated this discussion. All the major oil companies now produce innumerable synthetics; yet they all still recommend similar, non-synthetic, oil and tallow blends for the use in saturated steam cylinders. Although these may carry individualized brand names, they are all a compounded ISO 460 heavy oil for use in steam cylinder environments. They have all been developed to resist being washed off the metallic surfaces by the action of water and hot steam, and all are designed to be carried to the necessary lubrication points by being entrained in the stream of steam. The oil companies also occasionally reference these oils as " AGAMA 7 Compounded" oils, and they also come in weights other than ISO ratings of 460.

Oil that meets this specific criteria is available from your Accucraft Dealer and from Sulphur Springs Steam Models, as well as from the bulk distributors of the various oil companies. What you need to ask for is "ISO 460 Steam Cylinder Oil, AGAMA NO.7 Compounded." Esso names their brand of oil" CYLESSTIC ," Conoco calls theirs" Inca ," Chevron references theirs as" Cylinder Oils W ," Mobil uses the name" 600 W Super Cylinder Oil," and Phillips calls their oil" Hector." Also available is "Green Velvet Steam Cylinder Oil." We have not tried this oil, and have no opinion as to its suitability, but it is being used by various "ride on", 7.5 inch gauge builders. It can be purchased from William L. Petitjean, P.E., Inc. doing business as Steam Engine Lubrication Specialties. Their address is P.O. Box 1118, Fall City, Washington 98024, telephone 425 222-6781.

****** We recommend only the use of the ISO 460 oils listed above ******

Excess oil beyond that necessary to lubricate the valves and cylinders is detrimental to the locomotive.

Unlike a butane fired boiler, your K-28 does not have any holes or drain in the bottom of the smoke box. This means that excess oil delivery to the cylinders will become mixed with cinder and ash to form a sludge in the smoke box, besides forming this sludge, oil soaked cinder and ash can be carried out the stack to be deposited as an abrasive on the running gear.

To ensure proper lubrication your K-28 conversion is fitted with an adjustable lubricator and oil piping that is separate from the main steam line. This allows the oil flow to be regulated to optimize lubrication while reducing excess oil residue in the smoke box and oil splatter on the exterior of the locomotive. The use of a proper steam cylinder oil as listed above, one that has high adhesion and resists being washed away, means a proper adjustment of the lubricator can be made. Adequate lubrication of your valves and cylinders results from an oil flow rate of between 1 and 1 1/2 cc of oil per hour. Oil flows in excess of this are unnecessary, wasteful and can contribute to cleanup problems and excess wear and tear on the running gear. Proper adjustment of your lubricator will be covered in detail further on in these instructions.

Accessories You Will Need

What You Need To Obtain

1. Shovel Pick (sku#AP-28200), Flue Brush (sku#AP-28201), & Draft Fan (sku#AP-28202)
   They can be purchased from Accucraft dealers.

2. Charcoal

As discussed earlier, coal needs exposure to heat to initiate combustion. The easiest way to do this is to build your coal fire upon a strong bed of charcoal embers. Charcoal is easy to ignite, especially when soaked in lamp oil, burns hot and reduces completely to ash. This makes it an ideal initiator for beginning the firing process. The charcoal you use needs to be " real wood" charcoal, not briquettes. This can be obtained at most barbeque supply stores as well as some gourmet cooking stores. It is also available from Lowe's Home Centers, under the brand name of" Cowboy Charcoal" in 20 pound bags. This charcoal is made from scrap lumber that includes both soft and hard woods. The charcoal pieces are fairly brittle, and can be easily broken up into the proper sized pieces using a good pocket knife.

3. Lamp Oil

To ensure that the charcoal will ignite readily, we soak it in a flammable fluid like kerosene or lamp oil. The better of the two is lamp oil, and preferably a clear unscented variety. The best product we have found is from Lamplight Farms, Inc in Menomonee Falls, WI. At the moment we are using their "Tiki Torch Oil" because it is readily available from LOWE'S HOME CENTERS. Although it contains a slight amount of citronella, it burns very cleanly. is not significantly oily, is locally available and inexpensive. Lamplight Farms also produces a product that is called "Outdoor/Indoor Ultra-Pure # 60600". This does not have the citronella, and is available through their website for $6.99 a half gallon, which will last a long time. It may also be available through your local home center.

4. Lubricator Syringe

The best way to learn where to set your lubricator adjustment is by measuring the condensed water remaining after a run . Your lubricator is fitted with a drain to use for removing the condensate at the end of a run, but this makes measuring it difficult. The best way to accomplish this is by using a syringe with an 1/8 inch tube to draw out the water from the bottom of the lubricator. This allows you to adjust the feed rate to provide adequate oil to the cylinders. The amount water should approximate to 1.5 cc per hour of running. It can be purchased from Accucraft dealers. The sku# is AP-29201.

5. Gondola

To ease the chores of firing and maintaining your locomotive we HIGHLY RECOMMEND you purchase a Accucraft D&RG Gondola to connect behind the tender. The use of a gondola to carry your coal and fire from will save the paint on your tender, provide you a larger supply of coal, give you a place to put the shovel and pick and GREATLY REDUCE THE CHANCE OF COAL DUST CONTAMINATING YOUR WATER SUPPLY.

6. Paint Brush

Ash and the small cinder particles that accumulate on the exterior of your locomotive from running can be easily brushed off using a 1 1/2 to 2 inch wide bristle paint brush . Provided you have properly adjusted the lubricator, there should be almost no oil spotting of the locomotive exterior, and a simple brushing will provide adequate cleanup after a run of an hour or two .

7. Vacuum

One of the components of all coal is sulphur. Sulphur burns producing sulphur dioxide, which combines with moisture in the smoke box to form sulfuric acid. To reduce the corrosive effects of sulfuric acid you should clean all of the accumulated ash and cinders out of the smoke box following every run. This can most easily be accomplished using a computer vacuum . The specific brand we use is a Metropolitan Metro DataVac with Micro-Tools. Ours was bought from a Fry Electronics store, but they are available from various computer and electronic supply stores, office supply stores and on line from Micro Center.

8. Solvent Cleaner

Following every 4 to 5 hours running time you will want to more thoroughly clean your locomotive, including the smoke box. We recommend you accomplish this by washing with" Stoddard" solvent. This product is designed for parts washing in the aviation and automotive industry. It is an excellent grease and oil remover, has a low flammability and leaves no oily films or residue, and absolutely will not damage the paint It is available from your local Petroleum Bulk Supplier, either under the name of "Stoddard" solvent or as parts washing fluid. Most automotive machine shops can paint you in the right direction to buy it.

9. Solvent Sprayer

The most convenient way to apply the Stoddard solvent is by using a pressure type garden sprayer. We recommend a HUDSON brand" Bugwiser Sprayer," model number 67220. This has a 2 gallon, stainless steel, canister, which is solvent resistant. These can be purchased from LOWES' HOME CENTER. One note about this sprayer and Stoddard Solvent. You will have to occasionally put some oil down the top of the sprayers pump barrel to lubricate the piston, as the solvent tends to wash away the pump's lubricant.

Advanced Preparation

Before you begin firing your locomotive, you need to tend to some preparatory items. The first is to insure you have an adequate supply of properly sized coal. Your firebox door is 3/4 of and inch tall and 1 1/4 inches wide. The shovel is 7/8 of an inch wide, 112 inch deep and 2 1/4 inches long. Coal needs to be sized accordingly. Your lumps of coal should have an upper limit in size of 1/2 X 1/2 X 314 of an inch; 3/8 X 318 X 3/8 being ideal. Coal that is smaller, ie. lima bean sized is better. Any pieces smaller than a 1/8 inch cube can also be used, but only after a good bed of coals is established. If you are using the Cole's

Power Models product, it will come in a bucket with pieces ranging from pea sized on up to the a lump twice the size of the first joint of your thumb, This is a relatively soft coal and large lumps can usually be broken down with your fingers. If you prefer, you can use a garden style hand pruner or clipper. You will soon notice that coal has a grain to it and cutting it across the grain will sometimes cause it to crumble.

We sort our coal out in the garage, taking a large handful from the bucket; the usable size pieces go directly into a large plastic container, built like a large pitcher, but designed for pet food and purchased at Wal-Mart. The overly large pieces get broken up over an old rag which is used to catch the broken pieces and crumbles. Coal dust, which is slightly oily, is much like the lead in a pencil, it will work its way into the pores of almost any material and can be hard to remove , so, act accordingly .

Your charcoal needs to go through this process also. We use a scrap plywood board, about 12 to 14 inches on a side, on which to cut and fracture off properly sized pieces from the chunks of charcoal lumber. Again try for pieces about 3/8 X 318 X 3/8 of an inch. As with the coal we keep the bulk of the cut and broken up charcoal in a pet food container. The charcoal is kept dry in this container, not oil soaked. About a quart of this charcoal is then put into a large coffee can with a tight fitting plastic lid and soaked in lamp oil. After putting the charcoal into the can, put in about a cup of lamp oil, place the lid on the can and tumble to expose all of the charcoal to the oil. This coffee can then becomes the container we fire the locomotive from on startup. We leave the oil in the can, and as we replace charcoal we have used with fresh charcoal, add oil as needed so that there is always a slight amount of liquid in the bottom of the can .

Firing Your Locomotive

Since it is absolute human nature "**not to read instructions**," there is included with this set of instructions a "K-28 COAL FIRING CHECK LIST". This checklist covers the entire firing process, in abbreviated form, from setting the locomotive out on the track to putting the locomotive in long term storage.

After assembling all the necessary items, coal, charcoal, water, oils and tools, you need to find a spot to lubricate the locomotive and tender. I usually use a convenient table or other flat surface where I can place a folded towel to protect the locomotive when I lay it on its side. You need to oil the running gear on both sides, oil the axle boxes, the lead and trailing truck and the axle pump yoke and eccentric. I also put a drop of oil on the axle pump ram. The locomotive is then placed on the steam up bay track and the tender axles oiled in a similar fashion.

After placing the tender behind the locomotive on the track, connect the drawbar in its long position. Although you can run the loco with the drawbar in the short position, it is less convenient to stoke the firebox, there is less access room to reach the controls and it puts a more acute bend in the tender water lines.

Next connect the tender water lines. The return line slips onto the locomotive stub pipe about 3/16 to a 1/4 of an inch. The pump feed line screws onto the locomotive fitting; it contains an "O" ring to sea! it, and finger tight is tight enough. **Check that the "O" ring has not become misplaced.** Following the tender hook up you should check the lubricator for proper oil level. **The correct level is even with the bottom of the cross tube.** Before adding oil, check that you drained the condensate after the prior run by using your syringe or opening the drain. An easy tip for adding oil is to again use your syringe; fill the syringe with oil, insert the tube down below the cross tube and add oil to the proper level. This keeps oil from spanning across the gap between the lubricator sides and the cross tube and not draining down. After filling the lubricator, open the lubricator adjustment valve approximately 1/8 to 1/4 turn, or to the setting that experience has shown will feed 1 to 1 1/2 cc of oil per hour of running time.

Water can now be added to the tender. It will hold approximately 2 quarts, and should be filled to the bottom of the hatch. Once the tender is full of water, you can clear the pump feed lines of air. Begin by ensuring that the boiler and gauge glass blow downs. the throttle and the blower valve are all closed. Open the axle pump bypass valve a half turn or so, and pump the tender pump 10 to 15 strokes. Close the bypass and pump the tender pump an additional 8 to 10 pumps; or until the water level is 1/8 inch above the red line on the water glass. Leave the bypass closed.

NOTE: If the boiler needs more water than a few strokes of the tender pump, it is easiest to add water using the Goodall Valve and Pump Bottle.

Do not overfill the boiler. The water level will rise as the boiler is heated and comes up to steam pressure. This can cause the water level in the boiler to be so high that the boiler will" prime" or pass raw water to the cylinders when you first start the locomotive moving. If the water level is more than 3/16 inch above the red line, water can be released from the boiler as steam pressure builds by using the gauge glass blow down or the boiler blow down.

The most convenient way to fire your locomotive is from a gondola full of coal coupled up behind the tender. The gondola also provides a handy place to keep the fire pick and shovel. Fill the gondola about 2/3 full of coal and couple it up to the tender . After placing your suction / smokestack fan in a convenient place next to the front of the loco, fill the firebox with oil soaked charcoal level with the bottom of the door . This takes about 8 to 10 shovel fulls, and should be spread out evenly in the firebox, side to side and front to back. Check that the blower, throttle and axle pump bypass valves are all closed. Place the fan into the stack, light the charcoal, and immediately turn on the fan and shut the firebox door.

You will now have about 2 to 2 1/2 minutes to relax as steam pressure builds to about 10 pounds on the gauge. As soon as the gauge shows 10 pounds, add 2 shovels of coal, remove the fan and turn on the blower. The blower is much more effective at providing draft than the fan , and pressure will build very quickly; you should be able to actually see the gauge climbing . As pressure builds, you will need to turn the blower down slightly. At between 40 and 50 pounds pressure, add 2 or 3 more shovels of coal and open the cylinder drain cocks.

The pressure should, by now, be approaching 70 pounds, and you can place the locomotive in forward gear, turn the blower down to a light level , but not totally off, open the throttle and proceed to pull out.

Let the locomotive run about 100 to 150 feet, then stop it to check the firebox. If needed, add enough coal to bring the level up even with the bottom of the door.
Also, now is the time to shut off the cylinder drain cocks, but leave the blower on at a very light level. Be sure to also check the water level on the gauge. If the water level is low, that is, at or below the red line, add water using the tender pump or Goodall valve. This can happen because the usage of the blower while building steam pressure was not made back up, and the short run did not give the axle pump time to fill much. Double check that the lubricator is open about 1/8 to 1/4 turn and the bypass is closed, shut off the blower and you are ready to open the throttle and begin running in earnest.

You will need to keep an eye on the water gauge as the axle pump will begin to bring the level up towards the top nut. Because the level of the fire in the firebox is constantly changing states, from blanketed with fresh coal to a roaring fire, it is not practical to try to set the pump bypass to exactly compensate for consumption. When the level approaches the top nut of the gauge, open the bypass, when it approaches the red line close the bypass. You do not need to stop the engine to open or close the bypass, it is easily manipulated on the fly.

After another 300 or so feet of travel, stop the locomotive, crack the blower on, and check the firebox. How often you need to add coal will depend on several factors. How hard the engine is working, the quality of the coal you are using and how much coal you added the time before. I have found that firing on a more regular basis works best. When you let the fire drop too low, the heavier blanket of new coal does not have sufficient heat available to readily begin combustion, and pressure will fall. This can sometimes be avoided by running with the blower, but regular and even firing works best

By now your locomotive should be completely converted over from the startup charcoal and you can begin a regular rhythm of stoking, checking the water gauge, and occasionally adding water to the tender, Keep an eye on the pressure gauge also. Proper pressure is dependent upon two things, the amount of coal burning in the firebox, and how vigorous it is burning. The amount of coal is controlled by stoking, and the level of combustion by the amount of draft. **These need to be kept in balance for how hard the locomotive is working.** The harder it is working the better the draft. If the safety is continuously popping off you can cool things down a bit by opening the firebox door for a short period, say 150 feet or so. If you run your locomotive slow with a light load you might need to crack the blower slightly while it is running.

With the coal I use, the Dr. Klinkers from Cole's, mentioned elsewhere, I have found the best stoking rhythm is one or two shovels every 5 to 8 minutes or so. This is always a good time for checking the water level, if the water gauge is close to the red line, closing the bypass will usually pick it up in 300 to 400 feet. Water consumption is related to the level of combustion in the firebox and the rate of steam consumption. If the engine is working hard consumption goes up, but it also goes up with blower usage and when the safety is popping off. These can all effect how fast the level of water goes up and down in the gauge. Also keep in mind the speed of the locomotive on the track. The axle pump runs at axle speed, which means the faster you run the more you pump, but steam consumption is not linear with speed. For any given load, there is an optimal speed for best efficiency. Too slow, or too fast and you will use more water. By experimentation, you will find the optimal speed to run. The prototype locomotive seems to run best at the speed of a gentle walk.

As your experience increases, you will fall into a rhythm that is natural for you, your engine, the speed you run it and the load it pulls. You need to be always aware of what is taking place. The needs of the engine must come first. If you let yourself become distracted, combustion can drop off, water can get low, the tender can run dry and you can find yourself up the proverbial creek without a paddle. Enjoy your run, but stay on top of it too.

Ending Your Run

Unlike a butane locomotive, you can not just turn the burner off to finish a run . When it approaches time to quit, quit stoking, but keep the engine running as the combustion level drops. Adding water will also further cool the boiler down. Let the locomotive finish cooling down to a temperature that allows handling without discomfort. When the engine is cool enough to move around , hang the rear truck over the edge of a table and drop the grates with the unburned coal , ash and occasional clinker. There should not be any hot embers remaining, but on the off chance there are, it is best to hold an empty coffee can underneath the grate while you drop it. Shake the grates and ash pan out and use the grate retaining pin to clear any small bits that may be stuck in the spaces of the grates.

Before replacing the grates be sure to brush down the rear truck, and locomotive frame pieces that may be littered with ash. Replace the grate, and brush the accumulation of ash off the locomotive and running gear. This superficial brush down will suffice for an couple of hours between runs, but is not sufficient for overnight or longer storage,

After Run Cleaning

When you are finished running your locomotive for the day, and will be returning it to storage, it will need a thorough cleaning, and re-lubrication. The extent to which you clean it will depend upon how long you have run it and how long it will remain in storage.

AFTER EVERY RUN

- Remove grate I ash pan
- Place engine on table so that front truck and rear truck are on newspaper or paper towel.
- Open hinged Smoke box door and using the flue brush, thoroughly brush out the tubes and flue.
- Use computer vacuum to remove accumulated cinders from Smoke box. With rear truck overhanging table edge, use toothbrush to brush out the firebox sides, front and back.
- Brush off rear truck and its swivel linkage.
- Relubricate front and rear truck axles and swivel linkage. Use straight SAC - 40 weight oil.
- Lightly spray running gear with WO-40 and wipe excess off with a paper towel to remove cinder, ash and ballast dust
- Relubricate entire running gear. Use straight SAE - 40 weight oil.
- Replace grate/ash pan.

In situations where your running time has not exceeded 2 hours, and you will be running the locomotive again in less than 24 hours, the above cleaning will suffice .

AFTER 3 TO 4 HOURS OF ACCUMULATED RUNNING TIME

- Remove grate/ash pan
- Place engine on table so that front truck and rear truck are on newspaper or paper towel.
  Remove Smoke box front. One 1.6mm hex bolt at top of boiler.
- Use the flue brush to thoroughly brush out the tubes and flue.
- Use computer vacuum to remove accumulated cinders from Smoke box .
- Use toothbrush to thoroughly brush inside of smoke box and its pipe work; vacuum again.
  With rear truck overhanging table edge, use toothbrush to brush out the firebox sides, front and back.
  Brush off rear truck and its swivel linkage.
- Using “Stoddard” solvent in a sprayer, thoroughly wash out smoke box, smoke box front, engine, running gear, and firebox.
- Wipe off residue with paper towels and let engine air dry for a while .
- Lightly spray running gear only, with WD-40 and wipe excess off with a paper towel.

- Reassemble smoke box, replace grate/ash pan .
- Re-lubricate entire engine. Use straight SAE - 40 weight oil.
- After re-lubricating, wipe the engine and tender with a paper towel dampened with Lemon Pledge, or similar furniture polish.

The above level of cleaning should be performed, withQut fail, after all runs of more than 3 hours, or when accumulated running time exceeds 3 hours,

Placing Your Locomotive In Storage

Short Term Storage •••••• More Than 24 Hours, Less Than 60 Days

- Follow the steps for cleaning the engine listed above in “AFTER 3 TO 4 HOURS OF RUNNING.”
- If the engine will be fired again within 60 days, you may leave the boiler with water at or above the red line on the gauge glass.
- Store engine and tender in a dry environment. Do not wrap in plastic; condensation can form with tem perature changes and the moisture can not evaporate.

Long Term Storage •••••••• More Than 60 Days

- Follow the steps for cleaning the engine listed above in “AFTER 3 TO 4 HOURS OF RUNNING.”
- Drain boiler

  Place a length of large model airplane fuel line on both the gauge glass and boiler blow down pipes.
  Unscrew Goodall Valve from boiler.
  Open both boiler and gauge glass blow downs and let boiler drain out. When empty, close valves and replace Goodall Valve.

- Store engine and tender in a dry environment. 00 not wrap in plastic; condensation can form with tem perature changes and the moisture can not evaporate.

Maintaining your Coal Fired K-28

The amount of maintenance your locomotive needs will be directly related to how well you lubricate, clean and care for it. It should need relatively little maintenance, other than keeping the pipe work tight, and occasionally adjusting the axle pump gland. All of this maintenance can be done with a nominal selection of wrenches.

Tools You Will Need

The boiler and its fittings use standard inch sized wrenches. These can best be purchased from your local Sears store, or on line at www.sears.com . You will also need an alien wrench that accommodates the 2 mm stainless steel socket headed cap screws, although we provide one for your use, replacements can also be purchased at your Sears store.

The wrench set best suited for maintaining your locomotive boiler and piping is:

Craftsman 10 pc. Wrench Set, Standard Combination Ignition Sears item #00942319000 Mfr. model #42319

The allen wrench available al Sears is a 1.5 mm wrench.

You will also need a 1/8 inch open end wrench to use on the micro-couplings on the lubricator piping . This is included in a set of wrenches available from HMC Electronics, their website is: www•hmcelectronjcs,cornl.

The wrench set is their item:

41-560 Miniature Open-End Wrench Set, 6 Pieces

You should also acquire from Accucraft the necessary socket wrenches to fit the numerous 1.6 and 2 mm bolls used throughout the locomotive.

K-28 COAL FIRING CHECK LIST AND QUICK REFERENCE

1. Unpack Tender

    Lubricate Tender
        Use straight SAE - 40 weight oil.
        Journals and bolsters
    Place Tender on Track

2. Unpack Locomotive

    Lubricate Locomotive
        Use straight SAE - 40 weight oil.
        Axle Pump
        Truck Swivel Points
    Left Side
        Trucks and Driver Axles
        Side Rods and Connecting Rod Crank Pin
        Cross Head and Connecting Rod Pin
        Valve Gear and Valve Guide
    Right Side
        Trucks and Driver Axles
        Side Rods and Connecting Rod Crank Pin
        Cross Head and Connecting Rod Pin
        Valve Gear and Valve Guide
        Reverse Rod
    Check That Grates are Clean and Installed

3. Place Locomotive on Track and Prep

    Check That Smoke box is Clean
        Close Door

    Drain and fill Lubricator as needed.
        Couple to Tender
        Draw Bar
        Bypass Return
        Pump Feed

    Fill Tender Tank
        Approximately 2 Quarts of Water
*** USE ONLY DISTILLED WATER - DO NOT USE WATER THAT HAS BEEN DEIONIZED. u*
Water that has been OZONATED or distilled by reverse osmosis is acceptable, but it is best to use water that has been Steam Distilled without further processing.

    Fill Boiler• If Needed

    Water Level 1/8 in . above red line

Purge Air from Pumps
    Open Bypass Valve and Pump Tender Pump 15 Strokes.
    Close Bypass Valve and Pump Tender Pump 5 Strokes .

••• LEAVE BYPASS CLOSED'"
Adjust Lubricator
Consumption should be about 1 to 1 112 cc per hour of running time. Opening the adjusting valve 1/8 turn from dosed Is a good place to start.
Close Blower Valve

4. Prepare Coal Supply

Fill Firing Car with Coal
Maximum Size 112 X 1/2 X 1/2
Shovel
Rake / Pick

5. Begin Firing Process

Place Suction Fan in Smokestack
Leave Switch Off
Stoke Firebox with Charcoal Soaked in Lamp Oil.
Fill level with bottom of firebox door.
Light Charcoal
Simultaneously Turn On Fan.
Close firebox Door.
When Steam Pressure Reaches 10 lbs. Turn Off and Remove Fan.
Turn On Blower.
Add 2 to 3 Scoops of Coal.
When Pressure Reaches 30 Lbs . add coal• fill level with bottom of Door. Use Rake I Pick to spread the coal evenly through out firebox. Reduce Blower slightly to compensate for increased pressure.

When Pressure Reaches 70 Lbs. Start Engine
Check Coal Level• Add level with bottom of door if needed.
Open Cylinder Drains .
Check that Bypass Valve is Closed.
Place Johnson Bar in Forward.
Open Throttle 112 to 3/4 Turn.
Assist Locomotive if needed.
After traveling 15 to 20 feel close cylinder drains and adjust Throttle .
Throttle opening approximately 114 turn .

After traveling approximately 100 feet add coal level with bottom of firebox door.

6. Continuous Running Procedures

WATER
Closely Monitor Water Level.
If level is Above, At or Close to the Top of Glass, OPEN BYPASS VALVE.
If level is At or Approaching Red Line. CLOSE BYPASS VALVE.
IF WATER IS BELOW RED LINE
IMMEDIATELY STOP LOCOMOTIVE MAKE SURE BLOWER IS OFF
OPEN FIREBOX DOOR
USE TENDER PUMP TO ADD WATER TO BRING WATER IEVEL 1/8 IN . ABOVE RED LINE.
NOTE; Goodall Valve and pump bottle can also be used to add water.

When water level is restored turn on blower, close door and commence running locomotive.

COAL

Approximately every 4 to 5 minutes when using Welsh Coal from Coles', check condition of fire .
Coal from Coles' burns fairly fast. Other coat may burn slower.
A strong bed of embers needs to be maintained, and coal should be added as necessary .
The intensity of the fire can be watched through the 2 holes in the door.
Adjusting the Fire.
Pressure dropping below 55 lbs, turn on the blower valve.
Safety continuously blowing off, close blower valve, if open, and open firebox door.
When running very slowly with light load it may be necessary to crack blower valve.

I Left Fire Die Down too low.
Add 1 shovel of coal, turn on blower - wait for fire to build.
As fire builds, slowly add more shovels of coal to renew bed of embers.

The fire went out.
If the dead bed of coal Is not too deep, add several scoops of charcoal. Place fan in stack, relight char coal, turn fan on.
As fire builds, add Coal.
When pressure reaches 10 to 15 lbs, remove fan and turn on blower.

If heavy bed of coal, dump grates and start over from scratch with charcoal.
You should be able to reuse the unburned coal that was dumped.

7. Ending Your Run

Cease adding coal and let the fire burn out while the engine continues to run.

When pressure drops to about 45 lbs. Run engine onto cooling track.
Close throttle, close lubricator valve, close blower valve. Open firebox door.
Open gauge glass drain for a few moments to flush out glass, close drain.

Water level may be left at or slightly above the red line during short term storage

As soon as fire is totally out, no visible embers, open blower to release boiler pressure, disconnect lender pump feed and bypass return line.
When engine is cool close blower valve.
Brush cinders from engine and tender with soft 1 1/2 inch paint brush.
Drain all water from tender by turning upside down.
Place engine so that rear truck overhangs a table edge or track decking.
With wastebasket or open ground under overhanging portion of engine, pull grate / ash pan pin, remove and empty .
Brush off any unburned coal. ash and cinders from rear truck and its swivel linkage. (Old toothbrush works wen.)
Brush off grate / ash pan and replace on engine.
Drain water from lubricator and refill level with the bottom of cross the tube. Consumption should average about 1 to 1 112 cc per hour of running time.

8. After Run Servicing

AFTER EACH RUN
Remove grate / ash pan
Place engine on table so that front truck and rear truck are on newspaper or paper towel.
Open hinged Smoke box door and using the flue brush, thoroughly brush out the lubes and flue.

Use computer vacuum to remove accumulated cinders from Smoke box.
With rear truck overhanging table edge, use toothbrush to brush out firebox sides, front and back.
Brush off rear truck and its swivel linkage.
Re-lubricate front and rear truck axles and swivel linkage. Use straight SAE - 40 weight oil. Lightly spray running gear with WD-40 and wipe excess off with a paper towel. Re-lubricate entire running gear. Use straight SAE - 40 weight oil.
Replace grate/ash pan

AFTER 3 TO 4 HOURS OF RUNNING

Remove grate I ash pan
Place engine on table so that front truck and rear truck are on newspaper or paper towel.
Remove Smoke box front. one 1.6mm hex bolt at top of boiler.
Use the flue brush to thoroughly brush out the lubes and flue.
Use computer vacuum to remove accumulated cinders from Smoke box.
Use toothbrush to thoroughly brush inside of smoke box and its pipe work; vacuum again . With rear truck overhanging table edge, use toothbrush to brush out firebox sides, front and back.
Brush off rear truck and its swivel linkage.
Using “Stoddard” solvent in a sprayer, thoroughly wash out smoke box, smoke box front, engine and run ning gear, and firebox.
Wipe off residue with paper towels and let engine air dry for a while.
Lightly spray running gear with WD-40 and wipe excess off with a paper towel. Reassemble smoke box, replace grate / ash pan .
Re-lubricate entire engine. Use straight SAE - 40 weight oil.
After re-lubricating, wipe the engine and tender with a paper towel dampened with Lemon Pledge, or similar furniture polish.

9. Short Term Storage

Follow the steps for cleaning the engine listed above in “AFTER 3 TO 4 HOURS OF RUNNING.”
If the engine will be fired again within 60 days, you may leave the boiler with water at or above the red line on the gauge glass,

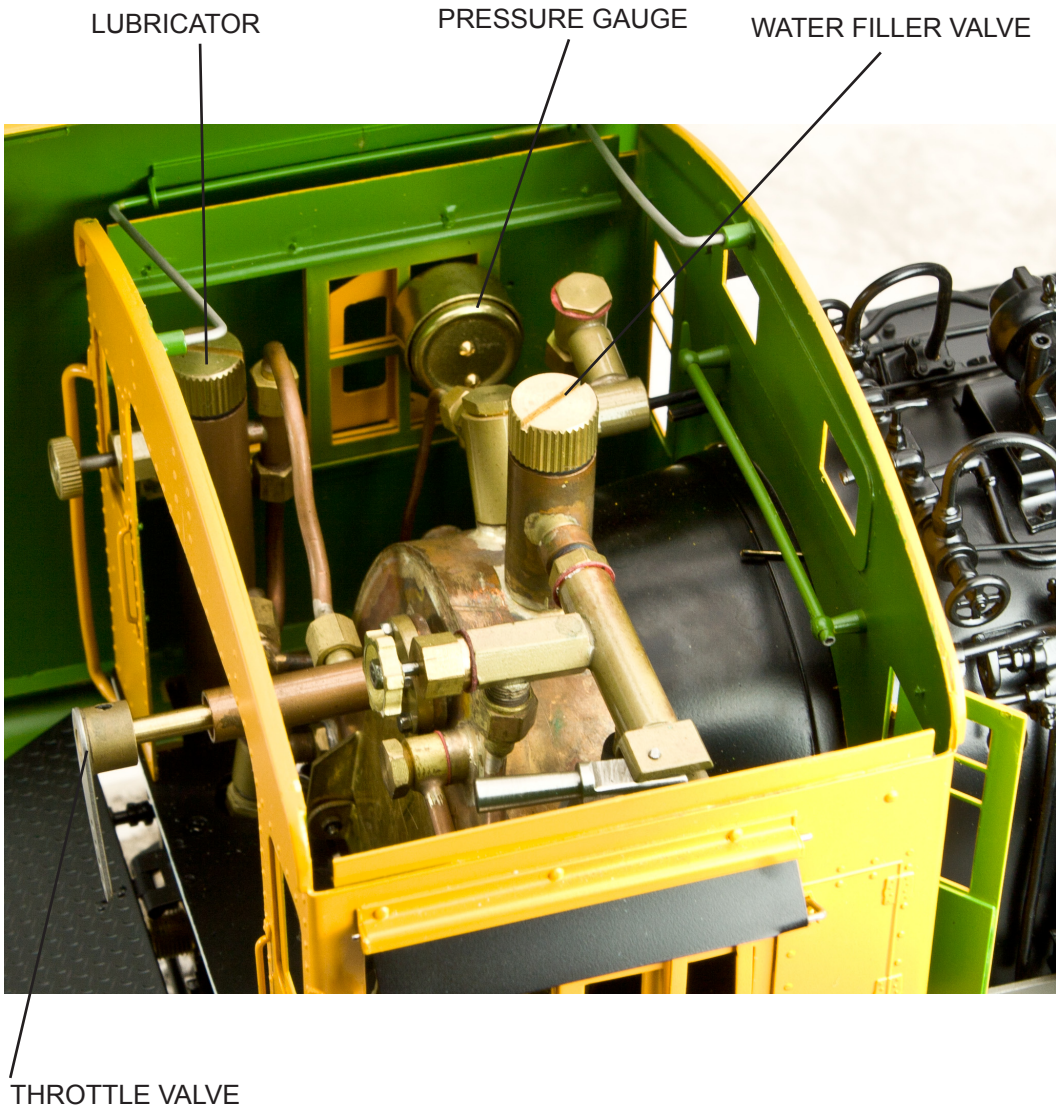
Store engine and tender in a dry environment. Do not wrap in plastic; condensation can form with temperature changes and the moisture can nol evaporate.

10. Long Term Storage

Follow the steps for cleaning the engine listed above in “AFTER 3 TO 4 HOURS OF RUNNING.”
Drain boiler

Place a length of large model airplane fuel line on both the gauge glass and boiler blow down pipes.
Unscrew Goodall Valve from boiler.
Open both boiler and gauge glass blow downs and lei baiter drain out. When empty. close valves and replace Goodall Valve.

Store engine and tender in a dry environment. Do not wrap in plastic; condensation can form with temperature changes and the moisture can not evaporate.



ACCUCRAFT K-28

Control Layout

Control layout is shown above with the cab removed to provide clarity. All controls are readily accessible from the rear of the cab with the tender connected, and the Throttle, Blower Valve and Axle Pump Bypass Valves all project outside of the cab within easy reach.

The Firebox Door is easily opened using the corner of the shovel or the hook end of the Fire Pick. Il also runs cool enough to be opened and closed by hand. The door has two small air holes in it that allow the operator to see the intensity of the fire.

The water gauge and pressure gauge are easily visible through the left side window, and the water gauge is clearly marked with a red line showing the CRITICAL LOW WATER LEVEL POINT. The LOW WATER LINE also lines up with an imaginary horizontal line passing across the top of the Blower Pipe where it enters the back of the boiler.