TRAIN BRAKES AT SVRY

Changes by Eric are in Blue
Changes By Jeff are in Red
Changes by Jerry and Larry are in Green

Introduction

It is essential that all SVRy train crew members understand the basics of train air brakes and how they function. This is a description of train air brakes used at SVRy. The Brake Stand in No. 19 is included in the description. Although the Brake Stand is different in No. 3, train operations are the same (pressure maintaining loco brake on 19). In writing this treatise I have referenced the 6-BL Brake Equipment Instructions Pamphlet No. 62, 1950 edition by the New York Air Brake Co.; The 1925 Modern American Locomotive, Construction and Operation, by Frederick J. Prior, MA. and combined this with inputs from SVRy members (list names), plus my own limited experience and knowledge. This description does not include information on mainline standard gauge railroads, nor does it necessarily describe the system and components used on other tourist lines be they standard or narrow gauge.

Brake System Components

Air Pump and Main Reservoirs. Located forward of the Fireman’s side of the cab of No. 19, the steam driven Air Pump supplies compressed air to the Main Reservoirs. The maximum pressure in the Main Reservoirs is set by an adjustable governor valve in the steam supply pipe to approximately 110 PSI. One Main reservoir is located on the Fireman’s side of the locomotive on No. 19. An additional Main Reservoir is located just forward of the cab on the Engineer’s side. The Main Reservoirs supply air to the Brake Stand in the locomotive and to the locomotive Reverser. The Main Reservoirs supply the air needed to charge and maintain the Brake Pipe at 70 PSI.

Brake Stand. The 6-BL Brake Stand is located in locomotive No. 19 cab on the Engineer’s side. It includes the H-6-L Automatic Brake Valve, LA-6-P Independent Brake Valve, Forward and Reverse Sanding Valves and a Bell Control Valve (not used). The Brake Stand includes provisions for adjusting and regulating the Brake Pipe pressure. An additional valve for the "Dead Engine" feature is included for cutting out the Brake Stand to allow brake control from another locomotive.
**Air Gauges.** Two duplex air gauges on the Engineer’s side indicate pressures in the Main Reservoir, Brake Pipe, Equalizing Reservoir and Independent (locomotive and tender) brakes. Air gauges located on the train indicate the Brake Pipe pressure.

**Automatic Brake Valve.** The H-6-L Automatic Brake Valve sets and releases brakes on all cars in the train by setting the Brake Pipe pressure. Located on the locomotive Brake Stand only, there are no other brake stands or Automatic Brake Valves on the train. The Automatic Brake has positions for service, lap, release, holding, running and emergency. Applying brakes with the Automatic Brake Valve also applies the locomotive brakes, which can be released with the Independent Brake Valve. In normal operation the Engineer moves the valve to the Service position until the desired amount of brakes have been applied, then moves the valve to the Lap position to hold the brake setting. To release the train brakes, the valve is moved to the Running position. The Release and Holding positions are rarely used.

**Independent Brake Valve.** The Independent Brake Valve provides a means for setting and releasing the locomotive and tender brakes without affecting the train brakes.

**Brake Pipe.** The locomotive and each car in the train have an iron pipe that run the length of the car with an Angle Valve (or Angle Cock) and Air Hose on each end. The Brake Pipe supplies air from the Brake Stand for all car brakes in the train.

**Angle Valve (Angle Cock).** Located on each end of the cars and locomotive, this valve is used to block or allow air to pass between cars and the locomotive. When closed, cars beyond the valve will NOT have controllable air brakes. In normal operation all Angle Valves are open. The last car in a train must have the Angle Cock closed, unless the Air Hose is connected to a pressure sensor or a portable Conductor’s Valve. If the last car has the Angle Cock closed, the Glad Hand must be attached to the Air Hose end to prevent dirt and debris from getting into the brake system. The Angle Valve on the uncoupled end of the locomotive must also remain closed with a glad hand on the end of the Air Hose.

**Conductor’s Valve.** Located on selected cars in the train, these valves are used by the train crew to make emergency applications of the train brakes. The Conductor’s Valve CANNOT be used to bring the train to a controlled stop. They are intended for quick release of Brake Pipe pressure only (emergency application).
**Auxiliary Reservoirs.** Located on each car and connected to the Brake Pipe via the Triple Valve. These reservoirs supply the air needed to apply car brakes when the Brake Pipe pressure is decreased.

**Triple Valve.** Located on each car, the Triple Valve has three functions. It *charges* the Auxiliary Reservoir, *applies* the brakes and *releases* them. Operation of this valve is precipitated by changes in Brake Pipe pressure. The Triple Valve is mounted on the Auxiliary Reservoir and connected to the Cutout Valve, which in turn is tee connected to the Brake Pipe. Coach 100 has a separate Auxiliary Reservoir connect by pipe to the Triple Valve.

**Cutout Valve.** Located between the Triple Valve and the Brake Pipe, this valve must be open during normal operation. This valve is closed when it is necessary to disable an individual car’s brake system, possibly due to faulty operation. The open position of this valve is with the handle 90 degrees to the pipe.

**Brake Cylinder, Brake Piston and Piston Rod.** Air pressure in the Brake Cylinder allows movement of the Piston and Piston Rod and a system of rods, levers, brakebeams and brake shoes on each car.

**Bleed Valve.** This valve releases air from the Auxiliary Reservoir to release brakes set by a decrease in Brake Pipe pressure. When uncoupling, the Brake Pipe pressure is allowed to decrease to zero PSI, fully applying the train brakes. The Bleed Valve releases air in the Auxiliary Reservoir, thus releasing the brakes.

**Emergency Valve.** This valve is located in the cab on the fireman’s side. It is used in an emergency to apply the brakes when the fireman cannot get to the Automatic Brake Valve.

**Air Brake Operations**

In the diagram below the steam driven Air Pump compresses air. Air gains heat when compressed and is cooled in Condenser Coils and then stored in the Main Reservoirs. As the air is cooled in the radiator condenser coils and air reservoirs, water condenses out of the air and is trapped there instead of being propagated throughout the rest of the train braking system. This water must be drained periodically, the frequency depending on atmospheric conditions but never less than daily. A Governor on the steam supply line is adjusted to allow steam to drive the Air Pump until the air in the Main Reservoirs is approximately 110 PSI at which time the Governor shuts off the steam supply. *Air to the Brake Pipe running throughout the length*
of the train is supplied from the Main Reservoirs by the 6-BL Brake Stand at a pressure of 70 PSI (sentence reworded).

With the Automatic Brake Valve in the **Running** position, the Brake Pipe pressure is kept at 70 PSI. The Triple Valve charges the Auxiliary Reservoir on each car in the train to the Brake Pipe pressure. With equal pressure on both faces of the triple valve, the piston in the Triple Valve is in an equalized position, and the brakes are released (sentences reworded).

When the Automatic Brake Valve is moved to the **Service** position, the pressure is released in the Equalizing Reservoir on the locomotive to the desired level (sentence reworded). Once the desired reduction is obtained, the valve is moved to the **Lap** position retaining the reduced pressure in the Equalizing Reservoir. The Equalizing Reservoir then reduces the Brake Pipe pressure until it is the same as in the Equalizing Reservoir. The Triple Valve senses the difference between the decreased pressure in the Brake Pipe and the pressure in the Auxiliary Reservoir on each car. It moves in proportion to the difference in pressure and introduces approximately 2 ½ times that difference into the Brake Cylinder. The Brake Piston moves against the spring that is inside the cylinder and applies pressure to the braking rigging and the
brake shoes. The greater the reduction in Brake Pipe pressure, the greater the pressure against the piston and the greater the brake shoes push against the wheels.

To release the train brakes, the Automatic Brake Valve is moved to the Running position, (the Holding position is seldom used since it leaves the locomotive brakes set) and the Equalizing Reservoir and thus the Brake Pipe are once again charged to the operating pressure of 70 PSI. The Triple Valve senses the difference between the increased pressure in the Brake Pipe and the pressure in the Auxiliary Reservoir on each car. It moves back to its original position and releases the air pressure from the Brake Cylinder. The spring inside the Brake Piston moves it into the released position and releases the pressure to the braking rigging and the brake shoes. Meanwhile the triple Valve also is recharging the pressure in the to equal that of the brake line again (70 lb.).

When the Automatic Brake Valve is moved to the Emergency position a large and direct reduction is made in the Brake Pipe pressure causing the Triple Valve to rapidly apply the Auxiliary Reservoir pressure into the Brake Cylinders, yielding a rapid and maximum Brake Piston and Piston Rod travel and thus maximum braking. In addition, pressure from the Brake Pipe is also introduced into the Brake Cylinder which increases the rate of Brake Pipe air pressure reduction to the back of the train. Similarly, when a Conductor’s Valve is opened on the train, a large and direct reduction is made in the Brake Pipe pressure and the train brakes are set to emergency. The inherent safety feature of train air brakes is that when the Brake Pipe pressure is released rapidly for any reason including broken pipes or air hoses, or an unexpected uncoupling, the train brakes are set into emergency.

In normal operation, when train brakes are set on #19, the Independent Brake is released, or bailed off. This reduces the amount of heating to the driver tires (if overheated they can slip or come off of the cast wheel centers), reduces wear on the locomotive brake shoes, and most importantly, reduces slack action within the train.

Comments on Use of Air Brakes
The rule book requires the use of the hand brakes to hold the train, not the air brakes. This is because any leakage in the braking system can cause the brakes in the train to gradually release. Never “park” the train with the air brakes applied. Once the hand brakes are applied, release the air brakes so that you know the hand brakes are sufficient to hold the train.
Maximum brake application is reached with a 20 lb. Brake Pipe reduction (20lb. x 2 ½ = 50lb. pressure in the Brake Cylinders). Reducing Brake Pipe pressure further does not apply the brakes any harder on the cars, as all the air in the Auxiliary Reservoir has been used (per Martin Depew, former RFE).

Frequent Brake Pipe reductions with little time between them to recharge the Auxiliary Reservoirs throughout the train can deplete the air pressure in the Auxiliary Reservoirs to the point that there is little pressure available to apply the brakes. The recharging rate is a function of the difference between the Main Reservoirs and the Brake Pipe pressure and the number of cars in the train. Generally speaking a “recharge” time of 30 seconds to a minute seems to be sufficient to maintain Auxiliary Reservoir pressure at an adequate level with our usual 5 car consists.

The K type Triple Valves used on most SVRy equipment have internal parts that move in response to differences in air pressure in the Brake Pipe and the Auxiliary Reservoir. There is a certain amount of friction between the moving surfaces and they do not respond well to slight differences in air pressure. If a 2 lb. reduction is made nothing may happen, then when another reduction is made it may all of sudden move and cause a sudden application to the brakes to that car. It may even cause an emergency application of the brakes throughout the train. Therefore, the minimum reduction should be no less than 4 or 5 lb (per Martin Depew).

Once the initial brake pipe reduction is made, additional reductions can be made if more braking force is desired. Brake releases with SVRy equipment cannot be done in steps, however. They must be fully released and then reapplied if the application was too much.

If the brake application is small, say 5 to 10 PSI, the locomotive can continue to move the train but with some difficulty. If however, a large application is made of 20 PSI or more, the locomotive may find it too difficult to move the train, and it will stop or spin the driver wheels.

**Independent Brake differences between locomotives #19 and #3**
While the Automatic (train) Brake operations are very similar for both of the steam locomotives, the Independent (locomotive) Brakes are quite different.

On the #3 the locomotive brake is totally independent of the train brake. Applying the train brakes does not apply the locomotive brake. In addition, once the locomotive brake is applied, any leakage in the system is lost to the atmosphere and the brakes will gradually release. Never leave the cab without putting down the chains to block the wheels.
On the #19 the locomotive brake can be applied and released independently of the train brakes, but it also is applied when the train brakes are applied. Therefore, it must be “bailed off” as described earlier if it is not desired to be applied (normal operations). It is also pressure maintained by the brake system, meaning that if 50 lb. is applied to the brakes and there is a leak, the difference is made up to keep the brakes at 50lb. As long as there is adequate pressure in the Main Reservoirs, it will be kept applied regardless of any leakage. Chains do not need to be put down any time the engineer leaves the cab, but are still recommended if not in the immediate vicinity of the locomotive.

FAQs.

If the Independent Brake is applied won’t this stop the train?
Yes, In most cases it will stop the train.

If the answer to the questions above is yes, why not use the Independent Brake instead of the Automatic Brake?
Because, with no brakes applied to the train, there will be slack action. If the train is being pulled, the cars will bunch toward the locomotive, and stop with considerable force. The cars furtherest from the locomotive will receive a severe jolt which could injure passengers or crew, or damage wooden frame cars. Similarly, if the train is being pushed, the cars will tend to continue to move, eventually stopping, but causing terrific force on the cars, passengers and crews.

Why is it necessary to bail, or release the Independent Brake after applying the Automatic Brake?
The Automatic Brake is applied to slow or stop the train and/or control slack action. If the locomotive brake is left applied the engine may not continue to move the train. If the locomotive continues to move there will be excessive wear and heat on the engine brake shoes. Excessive heat on the engine brake shoes can cause the tires to heat up and slip on the rim. The locomotive can move the train with small Automatic applications. The locomotive may lose traction and spin out with large Automatic applications.

What is the function of the Automatic Brake Valve positions and how are they used?
**Release** position directly connects the Main Reservoirs to the Brake Pipe. This position is rarely used. The train brakes are designed to operate at a pressure of 70 PSI. Improper use of the release position can allow the full 110 PSI Main Reservoir pressure to be applied to the Brake
Pipe and can cause damage to gaskets, hoses or Brake Piston rings. It can also cause erratic brake applications since the Auxiliary Reservoirs are overcharged in relation to the Brake Pipe. Over charging the Brake Pipe and Auxiliary Reservoirs will cause a brake application (possibly an emergency application) when the Automatic Brake is returned to the Run position. This occurs because when the Automatic Brake is returned to the Run position, the Brake Pipe pressure will be lowered to 70 lbs and the triple value has 70 lbs on one side and a higher pressure on the Auxiliary Reservoir side thus applying the brakes by sending this higher pressure to the brake cylinder.

Running position is the normal operating position of the Automatic Brake with no application. In this position all train brakes are released and the Brake Pipe and Auxiliary Reservoirs are recharged to 70lb.

Holding position releases the train brakes, but keeps the locomotive brakes applied. This position is very seldom used, and should NOT be used in normal train operations because there will be excessive wear on the locomotive brake shoes.

Lap position is used to hold brake applications. After an Automatic Brake application has been made in the Service position, the valve is moved to the Lap position to maintain the application. If an emergency application has been made, the valve should be moved to this position to enable the Main Reservoir to recharge and maintain full pressure.

Service position is used to make a train brake application. Brake Pipe pressure will gradually decrease in this position. The longer the Automatic Brake Valve is left in this position, the lower the Brake Pipe pressure will drop, and the harder the brake application. Once a desired brake application has been made, the valve should be moved to the Lap position to hold the application.

Emergency position give a direct and rapid reduction in Brake Pipe pressure. Once initiated, Triple Valves on the train will cause a rapid reduction in the Brake Cylinder pressure on each car yielding a maximum brake application on the entire train. Following an emergency application, the Automatic Brake Valve must be moved to the Lap position to hold the application and prevent depletion of the Main Reservoir pressure.

If the train becomes uncoupled while running, what should the train crew do? Send the Rear Brakeman out to flag the Fire Train or any other trains on the main line. Set all hand brakes immediately. Determine if there are any passenger injuries. The Head Brakeman and Engineer should inspect the train and determine the problem and how to alleviate the problem. The Conductor should inform McEwen of the situation.

Describe a typical operation of the train brakes.
After coupling to the train at McEwen Depot, ½ of the hand brakes are set, the Automatic Brake Valve is moved to the **Running** position, to allow the train brake Auxiliary Reservoirs and Brake Pipe to fully charge, and the Independent Brake is set to full application. Experience has shown that allowing one minute per car will yield the best results during the Terminal Brake test. Following a crew meeting and a Terminal Brake Test, the Automatic Brake Valve is again released (moved to the **Running** position). The Independent Brake remains applied in the locomotive.

Prior to departure, the Conductor and Rear Brakeman release all hand brakes. After a proper hand signal is received by the Engineer, he moves the throttle to begin departure and releases the Independent Brake. After the train has left the McEwen Yard and reached sufficient speed, the Engineer does a Running Brake Test by moving the Automatic Brake Valve to the Service position and decreases the Brake Pipe by 5 PSI (65 PSI on the Brake Pipe gauge), then moves the valve to the Lap position to retain the setting and immediately bails off the Independent Brake. Once the Engineer is satisfied the train brakes are operating properly by slowing the train, he moves the valve to the Running position and adjusts the throttle for required speed, continuing to Sumpter. If for any reason the Engineer determines the brakes do not appear to be functioning properly, he will inform the Conductor the train is stopping and a determination must be made as to the problem with the train brakes.

After the train is underway the Engineer may elect to apply train brakes to periodically slow the train or to keep the slack stretched in the train. The first occurrence is typically to slow the train before reaching Hawley Siding. As the train approaches Whitney Hwy crossing, the Engineer will make a minimum application again. This is done to prevent slack action in the train. After the train passes over Hwy 7 if an Automatic Brake application has not been made, considerable slack action will occur as the train passes into the dip on the west side of Hwy 7. After crossing Hwy 7 the Engineer may elect to make minimum brake applications periodically to control train speed instead of readjusting the throttle.

Approaching Austin St. the Engineer will once again make a minimum train brake application to control slack action and slow the train for spotting at the depot.

Operations downhill to McEwen require periodic brake applications to keep the train speed within safe speeds. Generally, the brakes are cycled on and off to keep recharging the Auxiliary Reservoirs and to keep the application from becoming excessive due to normal brake pipe leakage.
Pretrip Locomotive Air Brake Test
A. Prior to leaving the service facility at the beginning of the day, an application and release test of the locomotive brakes must be made in the following order:
   1. Ensure brake pipe pressure is set to prescribed pressure.
   2. Apply independent brake fully and observe that brakes apply on the locomotive. Release independent brake and observe that brakes release on the locomotive.
   3. With equipment fully charged, make a 10 psi brake pipe reduction and observe that brakes apply on the locomotive. Bail (release) independent brake and observe that the brakes release on the locomotive.
   4. Reduce brake pipe pressure an additional 10 psi and observe that brakes apply on the locomotive. Release automatic brake and observe that the brakes release on the locomotive.
   Note: Steps 3 and 4 do not apply to the Heisler.
B. Locomotive brake pipe leakage at the beginning of each day that the locomotive is used.
   1. Take a 20 psi reduction on the automatic brake valve.
   2. Wait 1 minute for the brake pipe pressure to equalize.
   3. Observe brake pipe pressure for one minute. Leakage should not exceed 5 psi per minute.

Initial Terminal Brake Test
Before operating the train, a Terminal Brake test must be performed. The Terminal Brake test steps are as follows. It is the job of the Head Brakeman to perform the Terminal Brake test.

1. After the Brake Pipe has begun charging, allow one minute per car for the brake system to release and stabilize. For example, in a 5 car train, allow 5 minutes before proceeding with the test.
2. While the system is equalizing, inspect both sides of the train for possible brake system damage and air leaks. Inspect to see that all brakes are released.
3. Give a clear hand signal to the Engineer requesting a brake application. Wait for the Engineer to give a service application. The Engineer will reduce the Brake Pipe pressure by 20 PSI, from 70 to 50 PSI, and indicate the application has been made with a short whistle signal.
4. Inspect each car to see that the brake piston rod has extended and thus applied brakes. The piston extension range should be between 6” to 8”. Inspect both sides again to make certain all brakes have been applied properly.
5. Allow brake pipe to equalize for one minute prior to timing for leakage.
6. Wait one minute for the Engineer to note any leakage. Leakage greater than 5 PSI in one minute must be corrected before the train can proceed.

7. Give a hand signal for release. Wait for the Engineer to indicate full release with two short whistle signals.

8. Inspect each car’s brake piston rod. The piston rod must fully retract for full brake release. After completion of the Terminal Brake test, the Head Brakeman reports the results to the Engineer.

**Standing Brake Test**

If no changes are made in the train consist it is NOT necessary to perform a Terminal Brake test again during the day’s operations. However, whenever the locomotive is uncoupled and re-coupled to the train, it is necessary to perform a Standing Brake test as described below, and once again this is done by the Head Brakeman.

1. After coupling the locomotive to the train, slowly open the Angle Cock on the first car in the train to charge the Brake Pipe.

2. While walking from the locomotive to the end car, inspect all cars to see that their brakes have released.

3. Once it is determined that all brakes are released, hand signal for a brake set.

4. The engineer does a 20 PSI reduction and give a short whistle signal.

5. Inspect the last car only to see that the brakes are applied. Also, check the air gauge on the last car to verify that a 20 lb. reduction has been made. (See Safety Rule 4608.)

6. If the brakes on the end car apply satisfactorily, hand signal the Engineer for a release.

7. After the release, inspect the end car to determine if the brakes release satisfactorily. Check the air gauge on the last car to verify that the train line is charged to 70 lbs. If brakes have released and the gauge the proper pressure, then the brake test is complete.

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