AMTRAK

AIR BRAKE HANDOUT

26-C HEP AIR BRAKE SYSTEM

PREFACE

This booklet on the 26-C HEP Passenger Car Air Brake System has been designed to serve both as a basic reference source for air brakes found on Amtrak's Head End Power (HEP) conversion and conventional cars and to supplement the lectures and demonstrations of the Amtrak Air Brake course, MCB-102 "26-C Air Brake System HEP Conversion Cars". The materials selected for inclusion in this booklet are those considered to be most relevant among the documents provided by various regulating agencies, by the different vendors, and from materials developed by the Amtrak Technical Training Center.

Additional copies of this booklet may be obtained from the address below:

Amtrak Technical Training Center
Beech Grove Maintenance Facility
202 Garstang Street
Beech Grove, IN 46107

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26-C HEP AIR BRAKE SYSTEM

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I. Introduction

The 26-C HEP air brake system was developed as a basic air brake system from which has evolved several other systems, such as the 26-C Amfleet and the 26-C Superliner air brake system, which share many of the basic features of the original 26-C air brake system.

A. Definition of an Air Brake System

An accepted definition of an air brake system is, "A combination of devices operated by compressed air and controlled manually, pneumatically or electrically by means of which the movement of a vehicle on wheels is retarded or stopped".

B. Basic Operations of the 26-C Air Brake System

There are five basic operations performed by the 26-C air brake system: 1) charging; 2) service brake application; 3) emergency application 4) lapping, and 5) brake release.

1. Charging the 26-C Air Brake System

The charging of the 26-C air brake system requires that brake pipe air flows to the following components and charges them to 110 psi:

a. B-3-B emergency brake valve
b. E-3 brake application valve
c. A-2 quick service valve
d. 26-C pipe block
e. 26-C service portion
f. 26-C emergency valve
g. Out of port 7 to the control volume reservoir
h. Out of port 9 to the selector volume reservoir
i. Out of port 5 to the supply reservoir and the J-1 relay valve

2. Brake Application

During a brake application, the engineer moves the handle of the automatic brake valve which initiates a reduction of brake pipe pressure. Depending on the rate of reduction desired by the engineer, the handle is moved into either the service application or the emergency application position. On a full service application, the reduction of brake pipe pressure activates the service portion of the control valve, which permits supply reservoir air (110 psi) to pass through the service limiting valve in the service portion. This reduces the air pressure from 110 psi to 60 psi. The reduced pressure leaves the service portion and passes through pipe 16 to activate the J-1 relay valve. The J-1 relay (a 100% relay valve) the passes 60 psi of

supply reservoir air through pipe 30 to the decelostat valve and into the brake cylinders. The movement of the pressurized air from the supply reservoir to the brake cylinder results in the application of the brakes to the wheel.

3. Emergency Brake Application

An emergency brake application occurs when the brake pipe pressure is reduced at an emergency rate. This activates the emergency portion, which very rapidly exhausts the pressurized air in the brake pipe out the bottom of the emergency valve. The service portion then permits brake pipe pressure (110 psi) to pass through the emergency limiting valve in the service portion which reduces the 110 psi to 86 psi. The reduced pressure leaves the service portion and passes through 16 pipe to activate the relay valve. The J-1 relay valve (a 100% relay valve) then passes 86 psi of supply reservoir air through pipe 30 to the decelostat valves and into the brake cylinders. The brake should now be applied with a force greater than the service application.

4. Lap

When lapping, the reduction of air pressure in the brake pipe is stopped. The supply reservoir air will flow into the brake cylinder until the service portion of the control valve and relay valve moves to the lap position. The brakes will continue to lap as long as the pressure in the brake pipe and in the brake cylinders do not change.

5. Brake Release

To release the brake, the engineer adjusts the brake valve so that the brake pipe is recharged. The recharge of the brake pipe allow the service portion to return to the release position. This cuts off the flow of air from the supply reservoir through pipe 16, which has been activating the J-1 relay valve. The service portion, which is in the release position, will exhaust 16 pipe air pressure out the front of the pipe bracket (port 10) to atmosphere. The J-1 relay valve moves to the release position, which allows the pressurized air in the brake cylinder to be exhausted to the atmosphere at the relay valve exhaust. The brakes are thereby released.

In addition to the 26-C air brake system found on the conventional and the HEP conversion cars, the D-22 HEP, the 26-C Amfleet and the 26-C Superliner are other air brake systems currently deployed on Amtrak passenger cars. The four different air brake systems were designed to be compatible with one another, although the service portions are not interchangeable because the brake cylinder pressures are set at different levels.

II. Components and Operation of the 26-C HEP Air Brake System

A list of the major components and their portions which make up the 26-C HEP air brake system is presented below, followed by their descriptions and functions:

A. 26-C control valve
   1. Parts of the 26-C control valve:
      a. Pipe bracket
      b. Service portion
      c. Emergency portion
      d. Brake pipe cut-out cock and strainer portion
      e. Control reservoir release valve portion
   2. Parts complementary to the functioning of the 26-C control valve:
      a. Supply reservoir
      b. Control reservoir
      c. Selector volume reservoir

B. A-2 quick service valve
   a. Parts of the A-2 quick service valve:
      a. Pipe bracket
      b. A-2 quick service portion
      c. Some cars have a B-1 quick service valve

C. E-3 brake application valve

D. B-3-B emergency valve (conductor's valve). Some cars are equipped only with the B-3-A emergency brake valve, without the E-3 brake application valve.

E. J-1 relay valve

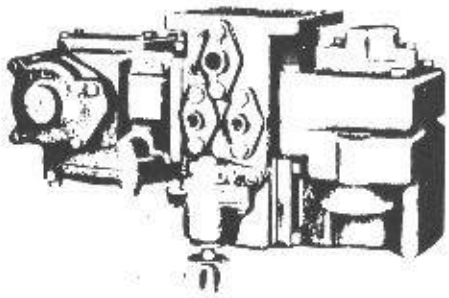
F. Displacement reservoir

   NOTE: Some cars do not have a relay valve or displacement reservoir

G. C-3 decelostat valve
   1. Parts of the C-3 decelostat valve
      a. Pipe bracket
      b. Release valve portion
      c. FA-4 magnet valve portion

H. 3-AP decelostat valves
   1. Parts of the 3-AP decelostat valve
      a. Pipe bracket
      b. Release valve portion
      c. Protection valve portion
      d. P-3 valve portion

I. Various cut-out cocks, hose connections, dummy couplings, etc.



26-C Control Valve

The 26-C control valve is an automatic device which controls the application and release of the brakes. The valve directs a flow of the air to and from the brake cylinder relay valve on the car in response to the amount of increase or decrease in brake pipe pressure.

The 26-C control valve is composed of the following major portions:

A. The pipe bracket, on which are mounted the service portion, the emergency vent valve portion, the brake pipe cut-out cock and strainer portion, and the control reservoir release valve portion.
B. The service portion, which provides for
    1. The charging of the auxiliary (supply) reservoir from the brake pipe
    2. Operates in response to changes in brake pipe pressure
    3. Supplies and exhausts air to the J-1 relay valve.
    4. Sets the maximum limits of brake cylinder relay valve control pipe (#16 pipe) pressure for service and emergency brake application
    5. Charges the control and selector volume reservoir from brake pipe

The service portion of the 26-C control valve consists of the following parts:

1. The service spool valve, which includes two diaphragms to provide the development of brake cylinder pressure in accordance with brake pipe reduction. When the air pressure in the brake pipe is reduced, the service spool valve assembly moves upward opening the application valve which supplies air to the

brake cylinder relay valve control pipe. (#16 pipe) The service spool valve exhausts the pressurized air from the brake cylinder relay valve control pipe when brake pipe pressure increases.

2. The application valve, which controls the movement of air from the supply reservoir to the brake cylinder relay valve.
3. The charging valve, which cuts off the flow of air from the quick service volume to the atmosphere. It also stops the flow of control reservoir air to the brake pipe during graduated release.
4. The graduated release cap, which is used to manually position the valve for the graduated or direct release. The settings for the cap are:
   a. The letters "REL" are cast on the body below the graduated release cap
   b. When the letters "DIR" are over "REL", the valve is set for direct release, and
   c. When the letters "GRA" are over "REL", the valve is set for graduate release. The graduated release cap is set by removing the two cap screws and turning the cap so that either "DIR" or "GRA" is aligned with the "REL" on the body.

5. The selector valve, which controls the quick service function. It also provides the direct release function when it is required and which enables the control valve to be compatible with the D-22 brake equipment.
6. The brake cylinder limiting valves, which limit the maximum pressure directed to the brake cylinder relay valve control pipe (#16 pipe) in the service and emergency applications. The service limiting valve limits #16 pipe pressure to 60 psi while the emergency limiting valve limits #16 pipe pressure to 86 psi.

C. The emergency portion, which is designed to provide a large local opening for exhaust of brake pipe air during an emergency application. During an emergency rate of brake pipe reduction at the control valve, one end of the diaphragm piston unseats the vent valve to locally exhaust the brake pipe air. The other end of the diaphragm piston is a spool valve that provides a stability of exhaust of the quick action chamber air.

D. The brake pipe cut-out cock and strainer portion, which assists in preventing the entrance of dirt and/or moisture which may be carried by air from the brake pipe into the 26-C control valve pipe bracket. The cut-out cock opens or

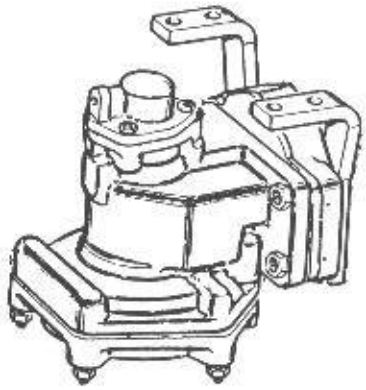
closes the flow of air between the piping and the 26-C control valve. The strainer portion contains an air filter which is easily replaced. This insures that the air is cleaned before it enters the pipe bracket. The dirt chamber and body contains an umbrella shaped check valve which holds the collected dirt and moisture in the dirt chamber.

E. Control reservoir release valve portion, which provides a means of manually draining the control volume reservoir.

F. The control reservoir, which provides a reference force to move the service valve in the service portion of the 26-C control valve when a reduction occurs in the opposing brake pipe pressure. The control reservoir also functions as a reference volume for the proper development of brake cylinder pressure.

G. The selector volume acts as a stablizing volume when the selector valve is operated during quick service and graduated release operations.

H. The supply reservoir, which serves as an air supply for the brake cylinders, water system and pneumatic doors.



J-1 Relay Valve

During the operation of the air brake system, the J-1 relay valve transmits or "relays" the application and release operation of the control valve by directing or exhausting supply reservoir air in the brake cylinder pipe. The J-1 relay valve is a self-lapping valve, and 100% relay.

The J-1 relay valve will pass supply reservoir air to the brake cylinders in proportion to 100% of 16 pipe pressure.

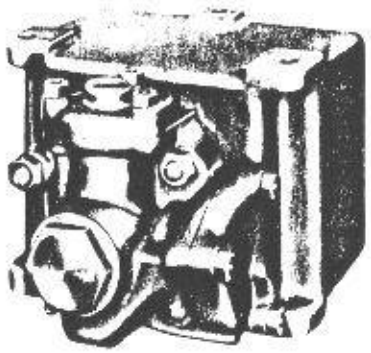
NOTE: 16 pipe pressure only tells the relay how much pressure to send to the brake cylinders.

Because some of the HEP conversion cars are significantly lighter in weight than the cars as originally designed, the following table shows the adjustments which are necessary in the disc brake equipment to avoid excessively high retardation rates:

26-C HEP (disc) Brake Cylinder Pressure with J-1, F-1 or B-3 Relay or with no Relay

Feed Valve	Full Service	Emergency
Set at:		
90 p.s.i.	60 p.s.i.	77 p.s.i.
100 p.s.i.	60 p.s.i.	85 p.s.i.
110 p.s.i.	60 p.s.i.	86 p.s.i.

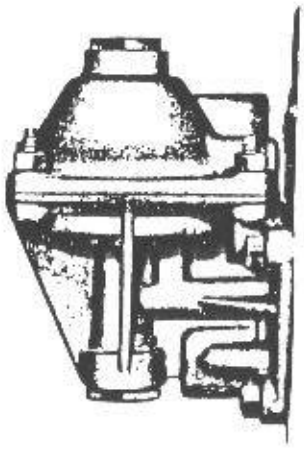
NOTE: The J-1.8 relay can be set for 100% or 80% brake cylinder pressure



A-2 Quick Service Valve

The A-2 quick service valve passes local quick service activity from car to car to provide fast transmission of the brake pipe reduction. This provides for additional local venting of brake pipe air during service brake application. The parts to be found on the valve are:

A. A-2 quick service valve
B. Pipe bracket with two strainers. The exhaust opening is protected from dirt and insects by a hair strainer held in place by a plug and is accessible on the bottom of the body. The valve is protected by a strainer located in the pipe bracket and is accessible upon removal of the body.
C. Choke #51, which is located in the face of the pipe bracket. this choke provides a controlled rate of brake pipe reduction when the valve is in the application position. The choke is accessible upon removal of the body.



B-1 Quick Service Valve

On cars 75 feet or longer, the A-2 quick service valve is replaced with a B-1 quick service valve. The B-1 quick service valve portion passes local quick service activity from car to car to provide fast transmission of the

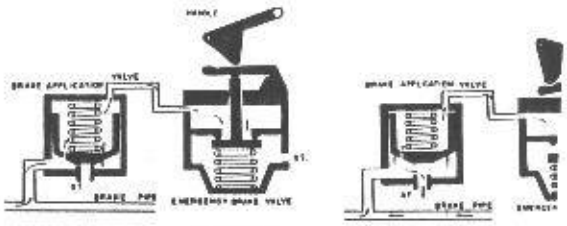
brake pipe reduction on long cars similiar to that obtained on shorter cars without interfering with light brake applications.

E-3 Brake Application Valve

The two E-3 brake application valves, which are located in the brake pipe branch tee's leading to each of the B-3-B emergency brake valves, allow the brake pipe air to be vented to atmosphere at an emergency rate when activated by a B-3-B emergency brake valve.

B-3-B Emergency Valve (Conductor's Valve)

The two B-3-B emergency valves, or conductor's valves as they were formerly known, permit the conductor to initiate the emergency brake application in cases of emergency or accident. One B-3-B emergency valve is located at each end of the car.

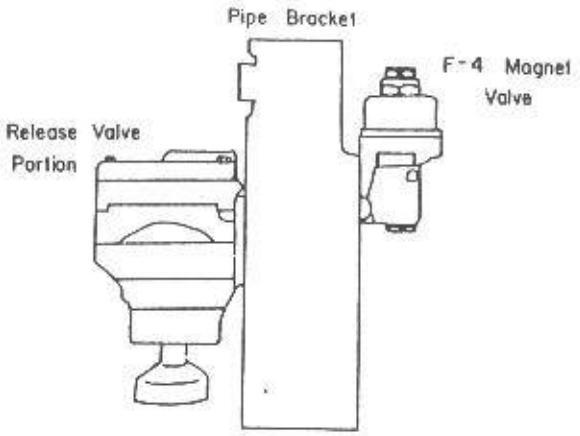


NORMAL EMERGENCY

During an emergency application, when the piston is unseated by the lever attached to the B-3-B emergency brake valve, air excapes from the 3/8 inch pipe and the E-3 application valves faster than it is supplied through the port in the piston valve of the E-3 application valve. Pressure above the piston valve in the E-3 brake application valve is quickly reduced. The greater pressure on the outer face unseats the piston, making a large direct opening from the brake pipe to the atmosphere. Brake pipe air that is exhausted at an emergency rate activates the emergency portion of the control valve to also produce an emergency brake pipe reduction.

Displacement Reservoir

The displacement reservoir provides the proper operating volume for the J-1 relay valve.



C-3 Decelostat Valve

The C-3 decelostat valve, found in the E-5 electro-pneumatic system, vents and restores brake cylinder air pressure by responding to electrical signals from an external wheel slide sensing device when sliding is about to occur.

The following parts of the C-3 decelostat valve deserve attention:

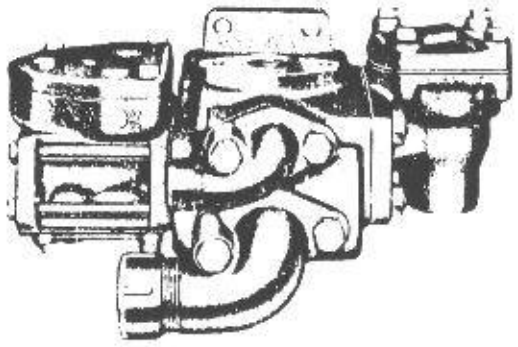
A. The pipe bracket portion, which is bolted to the truck or car body and holds the release valve portion and the FA-4 magnet valve portion. The pipe bracket portion allows for the removal and replacement of the valve portions without disturbing pipe connections. The pipe bracket

portion is usually installed in the brake cylinder air line so that port 1 is connected to the brake cylinder side and to port 2 from the air supply source (the J-1 relay valve)

B. The FA-4 magnet valve portion, which cuts off the air supply from the relay valve portion and vents the air from the top of the piston in the release valve. The FA-4 magnet valve portion is an electro-pneumatic device with a nominal voltage of 64 volts.

C. The release valve portion, which allows the brake cylinder air to be exhausted to the atmosphere. The body for this pneumatic type valve houses a piston assembly.

D. There is one external sensor located on each of the four axles which "reads" the 100 tooth gears. The sensors convey the information to an E-5 control box. If a wheel slide is about to occur, the FA-4 magnet valve is energized by the E-5 control box. The FA-4 magnet valve then cuts off the air supply from the relay valve and exhausts the air from the top of the piston in the release valve. The piston in the release valve then opens and exhausts brake cylinder air to the atmosphere. When the FA-4 magnet valve is de-energized, the braking force is automatically restored.



3-AP Decelostat Equipment

The 3-AP decelostat equipment is a pneumatic system that automatically reduces brake cylinder pressure if a wheel slide is about to occur. It functions automatically when a wheel slide is about to occur to rapidly decrease brake cylinder pressure permitting the wheel speed to return to train speed. After an interval sufficient to enable the wheel speed to have regained train speed, brake cylinder pressure is quickly restored.

The parts of the 3-AP decelostat that deserve attention are the following:

1) The P-3 decelostat controller is mounted on one end of each axle and its function is to direct the B-3 decelostat valves to vent brake cylinder air to atmosphere in the event a wheel slide is about to occur. The P-3 decelostat controllers will quickly restore brake cylinder pressure when the wheel slide condition is corrected.

2) The B-3 decelostat valve, removes and restores brake cylinder pressure when wheel sliding is about to occur during brake applications. The B-3 decelostat valves, which are located on each end of the car, are controlled by the P-3 decelostat controllers. The B-3 decelostat valve is made up of three parts:
   (a) The decelostat pipe bracket, which is bolted to the truck or car body and to which the other portions of the 3-AP decelostat equipment are attached.
   (b) The release valve portion, which will exhaust or restore brake cylinder pressure as controlled by the P-3 decelostat controllers when a wheel slide is about to occur.
   (c) The protection valve portion, which insures that the release valve portion adjusts brake cylinder pressure to a predetermined low point in the event a wheel slide occurs. It also incorporates the decelostat protection feature which ensures normal brake application and release in case the P-3 decelostat control pipe is broken.
3) The flexible rubber hoses, which connect the P-3 decelostat to the B-3 release valve control pipe.

4) Operation - in the event a wheel slide is about to occur the following takes place:

a) The P-3 decelostat controller vents the decelostat control pipe air to atmosphere.

b) Venting of the decelostat control pipe directs the protection valve to vent air from the top of the release valve piston to atmosphere.

c) The release valve then opens and vents brake cylinder pressuré to atmosphere.

d) When the wheel slide condition is corrected the protection valve will direct air back to the top of the release valve piston forcing it to close, which allows the brake cylinder to reapply.

B. Piping Diagram of the 26-C Air Brake System

For display purposes, three piping diagrams of the 26-C air brake system have been provided on the following pages. These diagrams indicate the shape and connections of the components of the 26-C air brake system. However, these diagrams are not drawn to scale.

III. Truck Mounted Brakes

The truck mounted brake components include the brake cylinders, brake rigging, brake heads and pads, the brake disc, and the handbrake arrangement. Those portions of the brake system mounted on the trucks include the following:

1) Brake cylinder, which produces the force that is applied to the brake disc. There is one cylinder per disc, with a total of four cylinders per truck, and are attached to the brake tongs with pins. The brake cylinder has a bellow type boot to protect the piston rod from the dirt and water when the cylinder is in the applied position. It also prevents the entrance of moisture and dirt into the cylinder on the release stroke. The boot is attached with steel clamps.

When operating, the brake cylinder produces the force which is applied through the brake pads against the brake disc by supplying the pressure that pushes the ends of the brake tongs apart, forcing the brake pads against the discs. The operation of the brake cylinder is as follows:

- Release position - the piston is in its bottom position, back in the cylinder, the spring is extended, holding the piston back in place, and the brake pads are applying no pressure on the brake disc.

- Application - the air enters the cylinder, air pressure forces the piston outward into the cylinder, and the brake pads are forced against the brake discs.
- Release - the air pressure in the cylinder decreases, the spring pushes the piston back in the cylinder, the brake tong ends are pushed back together, and the brake pads are pulled away from the brake discs.

2) Brake rigging, which connects the brake components to each other and transfers the force from the brake cylinder to the brake pads. The parts of the brake rigging are:
   - Tongs, which connect the brake cylinder to the brake heads. The tongs operate as levers when the brakes are applied.
   - Bridge assembly, which is bolted to the bottom of the fulcrum pivot assembly. The bridge assembly supports the two brake tongs, keeping them in proper alignment.
   - Fulcrum pivot assembly, which is attached to the fulcrum support of the brake frame with the pivot pin. This allows for the movement of the brake parts to maintain the proper alignment in case of tilting, curves, car roll, etc.
3) Brake heads and pads, which are supported by the tong and shoe pin. The brake heads and pads are constructed for right-handed and left-handed application. The brake pad assembly is held in place by a

stop pin at the bottom of the brake head and by a self-locking spring loaded wedge type key at the top. The brake pad spring, spring retainer and key hold the brake pad secure to the brake head.

This assembly is placed down over the tong pin on top of the pad assembly and is applied in the following order:

- Spring
- Spring retainer
- Retainer key (driven through the tong pin)

4) Brake disc, which is a one-piece casting of cast iron bolted to the inside wheel hub. The brake pads push against the surface of the brake disc to slow the train. The brake disc has cooling fins to aid in cooling the disc as the pressure of the pads creates heat.

The inspection and maintenance of the truck brake components is as follows:

1) Cylinder - check the bellow type boot and replace it if torn or missing. The procedure for the changeout of the bellow type boot as follows:
   - For safety, release the brakes and cut-out the brake cylinder cut-out cocks
   - Remove the inside pin holding the cylinder
   - Remove the screw clamps and pull off and replace damaged boot

- Replace the inside pin holding the cylinder

Apply the brakes and listen for the air blowing out of the piston end of the cylinder.

Also inspect the fulcrum pivot assembly section of the rigging for the following:

- Loose rubber retainer - the retainer keeps the pivot assembly from bouncing on the pivot pin and the pivot pin from bouncing on its bushing. It also restricts lateral free movement, holds the unit vertically centered when the brakes are release, and prevents the toes of the pads from dragging on the discs.
- Replaceable wear plates - tongs wear laterally against these plates when the brakes are released, preventing the shoe linings from dragging and wearing. Replace if the wear plates are worn.
- Tong bushings - tong bushings when worn excessively in the bore or in the thickness of the flange. Replace the bushing when worn beyond 1 9/16 inches at its largest diameter or if the thickness of the flange is worn 1/8 inch or thinner. Replace if the distance from the bottom of the bushing flange to the bottom of the surface of the fulcrum pivot casting reaches 5 7/16 inches or more.

- Pivot pin pushing - the pivot pin bushing should be checked for wear when the nominal inside diameter is 2 5/16 inches or more at its largest diameter. Replace the bushing when it is worn to 2 5/16 inches or more at its largest diameter.

2) Brake pad - replace the brake pad when the lining is 1/4 inches or less. Damage to the brake disc and pad assembly can result if the linings are used beyond the wear limit. The procedure for brake pad and assembly removal procedure is as follows:
   - Release and cut out the air supply to the trucks by placing the truck cut-out cocks in the off position
   - Using a hammer, remove the brake pad key
   - Remove the spring retainer and spring from the pin
   - Remove the brake shoe assembly by lifting the assembly off the pin
   - Install the brake assembly by (a) driving the pad key in the slot and then check that the key has a tight fit, (b) removing the loose key and check that the brake shoe spring height is 1 1/32 inches, (c) replacing the brake shoe spring if under 29/32 inches, (d) checking that the spring retainer wear on the top surface of the retainer,

replacing when worn to 3/32 inches or less, (e) checking the brake shoe key wear, replacing when worn to 5/8 inches or less

3) Brake heads - the brake heads should be inspected for cracks, breaks, bent heads, or loose bushings. These heads should be replaced if worn or damaged. The procedure for the changeout of the brake heads is as follows:
   - Remove the brake pad assembly
   - Lift the pair of heads from the pins. The brake heads must be removed in pairs because they are interlocked by the guide pin
   - Lubricate the following with a "dry" lubricant: (a) pad pin shank and bushing, (b) pad pin head contact surface for the wear plate, (c) wear plate, (d) guide pins and bushings, (e) exposed surface of the tong thrust washers
   - Assemble the outside and the inside of the brake heads in pairs
   - Lower the heads on the pins

4) Inspect all discs on a regular basis for thermo cracks. Any disc where a crack has extended to the inside or outer edge of the outer ring should be replaced. Also, any crack 3 inches or longer and within a 1/2 inch of the outer or inner edge of the ring is cause to remove the disc.

The only repair procedure for the brake disc requires that the disc be removed and replaced by removing and replacing the wheel and the axle assembly.

B. Handbrake Equipment

The handbrake equipment is generally located at the "B" end of the car, though some cars have handbrakes on both the "A" and "B" ends. There are two types of handbrake equipment, the wheel type (850W series) and the Ratchet-Peacock type (800R - right hand and 800L - left hand series). This equipment provides a pulling force routed through a series of chains, sheave wheels, rods and levers. The pulling force pulls the brake shoes or pads against the wheel or disc. The application of the handbrake causes the brake shoes to contact the wheel or disc. The force is enough to hold a fully loaded car on a 5% grade.

The inspection and maintenance of the handbrake arrangement requires that the chains be examined on all trucks. The use of repair links to repair chains is prohibited. Check all chains for approximately 3 inches - 5 inches slack when fully released. If there is too little slack, the chain will tighten and pull the brake shoes against the discs when the car goes around a curve. Apply the handbrake and check to see that the shoe or pad is pulling against the wheel or disc.

If the shoe or pad does not apply, the chain is too short or the lever is frozen.

On TFM trucks, inspect the following: (a) levers for cracks or wear (b) all pins, bushings and chains for wear, and (c) sheave wheel for proper operation (rotation). Also inspect and lubricate the handbrake during every COT&S.

On clasp trucks, inspect the following: (a) connecting rods and levers for wear or cracks (b) pins and bushings for wear, and (c) check for welded rods. The rods are not to be welded.

IV. Conventional and HEP Conversion Cars Auxiliary Pneumatic Systems

Within this section of the booklet will be included those pneumatic and electro-pneumatic systems which are connected to the air brake system and which use it as a source for air pressure. The auxiliary devices on the conventional cars and the conversion cars to be considered here include the water system, doors, and the train signal systems. The components of these systems, as well as the air flow and system operation, are discussed below.

NOTE: Some cars are equipped with fresh air dampers.

A. Water Systems

The water systems for the conventional and the HEP conversion cars are air pressurized from the supply reservoirs. Pipe #6 leads from the control valve pipe bracket to the supply reservoirs. Each car has two 200 gallon tanks mounted in the line or parallel beneath the cap. The HEP diner has two extra 50 gallon hot water tanks located in the ceiling.

The location of the A-1 governor and reducer, which controls the air from the supply reservoir, varies among the cars and may be found in the water tank casing or along side of the casing. The governor, which is designed to protect the brake system, does not open until there is an 50 to 65 psi build up of pressure. The reducer valve decreases the air pressure from 110 psi to 28 to 30 psi for the water system.

The E-1 safety valve is a device used to protect the water tanks and pipes from excessive air pressure. If pressure reaches 40 psi, the device is set to vent off excessive pressure.

There are two fill heads located on each car, with one found on each side in the center of the car. The fill heads are used to fill the water tanks under the car.

There are two air portions on each car, located directly under the fill head body and mounted to the body carriage. The handle has two positions, a horizontal position which is de-pressurized and a vertical position which is pressurized.

The check valve prevents the possibility of water backflowing into the air system. It is located in line between the E-1 Safety valve and the fill head.

B. Door Systems

Some door systems used on the conventional cars and the HEP conversion cars usually are the sliding type and are pneumatically operated. Air is taken from the supply or water rising air reservoir through a line which contains a 1/2 inch cut-out cock and a strainer choke. The strainer choke has a 1/16 inch orifice to prevent air from being drawn in so quickly that it might interfere with the operation of the air brakes. The pipe from the supply tank tee's into a pipe which runs the length of the car to serve the door engines at both ends of the car. The strainer is installed in the air line near the operator while the shut-off valve is installed in the air line about five feet above the floor line. The door supply will function best at pressures between 100-120 psi, but will operate at pressures as low as 80 psi.

NOTE: Some doors are not pneumatic but are manually operated.

C. Fresh Air Dampers

Some cars are equipped with fresh air dampers. Its air source is 110 psi. supplied by the water rising air reservoir.

D. Train Signal System

The train signal systems found on the conventional cars and on the HEP conversion cars are used by train personnel to send messages from the cars to the engineer in the locomotive. While the train signal systems on the conventional cars are pneumatic, the HEP conversion cars have an electro-pneumatic train signal system.

The parts of the pneumatic signal system found on the conventional cars include the following:

- 3/4 inch I.D. pipe running the length of the car
- 3/4 inch cut-out cocks
- 1 1/8 inch x 22 inch hose with H coupling
- Car discharge valve, which is located at the end of the car and has a rope attached to the discharge valve.

The signal pipe is charged to 45 psi of pressure. The signal system on the conventional cars is operated by pulling a cord attached to the signal valve, which discharges air from the signal pipe. This activates a valve in the locomotive that blows a whistle audible to the engineer. The signals are interpreted by either long or short blasts from the whistle.

To inspect the pneumatic signal system found on the conventional car, charge the signal line to 45 psi and

then lap the gauge. If pressure is lost at a rate of over three pounds per minute, locate and repair the problem. Check the piping, the hoses, the cut-out cocks, and the discharge valves. Test the system by pulling the cord and listen for a discharge of air from the car discharge valve. If no blast of air is detected, the problem may be one of the following:

- Cut-out cock is closed
- Line is plugged
- Discharge line is plugged

The parts of the electro-pneumatic train signal system found on the HEP conversion cars include the following:

- Electric train line to the engine
- Electric push button conductor's signal located on the wall at the ends of the HEP conversion cars

To operate the electro-pneumatic train signal system found on the HEP conversion cars, a button is pushed which sends electrical current to the locomotive. This current activates a magnet valve which sends air to a whistle audible to the engineer. The signals for the electro-pneumatic system are the same as for the pneumatic system. While conductors, engineers, and workmen are now using two-way radios for communication, it is wise to remember the old system in the event of a radio malfunction.

V. Regulations

This section of the booklet is concerned with the regulations and tests required by the Federal Railroad Administration (FRA) and the American Association of Railroads (AAR) that apply to the 26-C air brake system found on conventional cars and HEP conversion cars. The FRA, which reports to the secretary of Transportation, is responsible for carrying out "the functions, powers and duties of the Secretary pertaining to railroad safety". The AAR is an association "composed of most of the railroads of North America and one of its purposes is the standardization of equipments so as to make practical the interchange of cars among its members".

Included in this section on regulations will be a desplay of lamp, hand, and flag signals, communicating signals using conductor's signals, procedures for conducting the air brake clean, oil, test, and stencil (COT&S), single car tests, and tests for running maintenance. The running maintenance discussion will provide a review of train air brake tests and tests for troubleshooting the train air brake systems.

A. Lamp, Hand, and Flag Signals

All maintenance personnel should be aware of and know the six basic hand, flag, and lamp signals. While many of the terminal points responsible for conducting inspections rely on two-way radios for communication, the basic visual signals are still commonly used. In the event of the absence or malfunction of a radio, the hand signals are very useful.

1. Stop - swung at right angle to the track. The stop signal when using the lamp is below shoulder height while hand or flag movement may be above the shoulder.

2. Reduce speed - held horizontally at arm's length

3. Proceed - raised and lowered vertically

4. Back - swung vertically in a circle at half arm's length at right angle to track

5. Apply air brakes - swung horizontally above the head, when standing

6. Release air brakes - held vertically at arm's length, when standing

7. Stop - any object waved violently by anyone on or near the track is a signal to stop

B. Communicating Signals Using the Conductor's Signal

Each car must be connected to the locomotive by a communicating signal appliance. When the signal appliance is inoperative, and cannot be put into operation without detaining the train, the train may proceed after the conductor and engineman have an understanding as to how the train is to be operated. The train signal system

uses an electro-pneumatic signal system to send a whistle that is audible to the engineer.

In the following display, the "o" will represent a longer whistle while the "-" stands for a shorter whistle. The signals sent to the engineer are as follows:

	SOUND	INDICATION
a.	oo	When standing - start
b.	oo	When running - stop at once
c.	ooo	When standing - back
d.	ooo	When running - stop at next passenger station
e.	----	When standing - apply or release brakes
f.	oooo	When running - reduce speed
g.	ooooo	When standing - recall member of crew protecting train
h.	ooooo	When running - increase speed
i.	-ooo	Shut off train heat
j.	oooooo	When running - increase train heat

k. ----- When running - brakes sticking; look back for hand signals

l. -----o M.U. - motor wheels are spinning

C. Cleaning, Oiling, Testing, and STenciling (COT&S)

The performance of a COT&S requires that all air brake components be removed and replaced and that a single car test be conducted. The COT&S are to be performed every three years (36 months), while the single car test must be conducted whenever any valve is replaced on the car.

During a COT&S, the following components must be removed and replaced:

1. 26-C control valve service portion
2. 26-C control valve emergency portion
3. Reservoir release valve
4. J-1 relay valve if car has one
5. A-2 quick service valve or B-1 quick service valve
6. Decelostat valve - the car may be without a decelostat valve or may have one of the following:
   a. C-3 decelostat valve
      (1) Release valve portion
      (2) FA-4 magnet valve portion
   b. 3-AP decelostat valves
      (1) Release valve portion
      (2) Protection valve portion

7. If the car has a 3-AP decelostat system, a hose connects the wheel sensor to the truck
8. E-3 brake application valve
9. B-3-B emergency brake valve (conductor's valve)
10. Brake cylinders
    a. Regular (6)
    b. Handbrake type (2)
11. Hose and coupling - main reservoir: 1 1/4 inch X 22 inches and 1 1/4 inch nipple
12. Hose and coupling - brake pipe 1 3/8 inch X 22 inch hose and 1 1/4 inch nipple
13. Brake cylinder pressure switches
14. Hose from cut-out cock to main reservoir line
15. Hose from angle cock to brake pipe
16. 1 1/4 inch angle cock - brake pipe
17. 1 inch cut-out cock - main reservoir line
18. 3/4 inch cut-out cocks - truck line
19. 3/4 inch hose - car to truck
20. 1/2 inch reservoir drain cocks
21. Branch pipe cut-out cock and strainer - 26-C only

NOTE: Do not change the angle cocks and cut-out cocks unless they leak when charged with air

When removing the parts listed above during the COT&S, place each of them in a special shipping cover, which is provided, to keep it clean and safe from damage. When replacing the parts, keep each in its special shipping cover until it is ready to be applied. It is necessary to be especially cautious

with the new parts so that they are protected from damage and dirt before they are applied.

Before beginning the removal and replacement of air brake components, take note of and follow all the safety precautions as prescribed in the Amtrak Mechanical Department Safety Rules. Rules 1107 D,E,F,G,H, and I are of special importance. Be absolutely sure that no one is under the car or near a device where tests are being conducted because the exhaust of air could damage hearing or frighten the worker. Set the handbrakes and block wheels at both ends of the car.

Close the branch pipe cock on the control valve and drain the air out of the control reservoir by pulling toward you the handle of the reservoir release valve on the front of the 26-C control valve. Hold the handle in this position until all air has been exhausted. Open the drain valve on the bottom of the supply reservoir and drain the air. Then close the truck line cut-out cocks.

To clear the air lines and pipes, two types of supply line connections are needed because of the size differences between the brake pipe and the main reservoir pipe. Hook the supply line glad hand marked L to the main reservoir pipe, then check that the 1 inch ball cocks are open. Charge the line with 110 psi and blow out the

line. Shut off and disconnect the air supply from the main reservoir line. Connect the other supply line glad hand marked F to the brake pipe line, then check that the 1 1/4 inch ball cocks on each end of the car are open. Turn on the air supply and blow out the brake pipe. Turn off the air supply. Close the 1 1/4 inch ball cock on the opposite end of the car. Turn on the air supply and open the control valve cut-out cock, thus blowing out the branch line. Finally, shut off the air supply. When working on an old conventional car, the main reservoir line (1 inch) will be a signal line (3/4 inch).

Thoroughly clean the exterior of the brake parts, scraping off all dirt collected around any brake part and on the car underframe. Make special efforts to clean around the gaskets between the pipe bracket and the valve portions. Wipe all of the parts off with a cloth.

After removal of the valves, clean all of the pipe brackets, loosen any dirt in the pipe passages and on the face of the pipe bracket with scrapers, wire brushes, and/or a suitable solvent. The dirt must also be blown from the face of the pipe bracket on the 26-C control valve and into the branch pipe passage toward the open dirt collector. All stud threads and hex head bolts used to remount the valves are to be cleaned with a wire brush.

When remounting the 26-C brake valves replace the old gaskets with new ones. Apply the gaskets, then apply a thin coat of graphite to the stud threads and bolts. Remount the brake valve portions onto the pipe bracket, tightening all nuts evenly and firmly. The nuts and bolts must be tight enough to prevent gasket leakage but not so tight that it causes the gaskets to be distorted.

NOTE: Be sure to attach the F-dummy coupling to the brake pipe hose glad hand and L-dummy coupling to the main reservoir hose glad hand. This will prevent dirt or rocks from entering the pipe.

D. Single Car Test

The single car test is administered following the complete changout of the components of the 26-C brake valve system and after the replacement of any valve in the system. Make certain that all safety procedures stated in the Amtrak Mechanical Department Safety Rules booklet are followed.

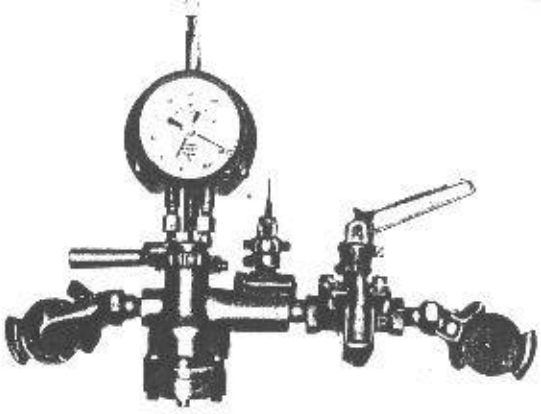


Figure 1 Standard Passenger Single Car Testing Device with FLOWRATOR

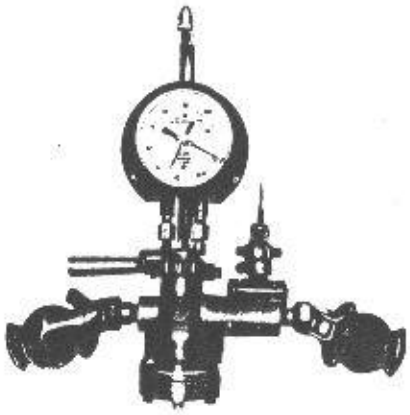


Figure 1A Alternate Standard Passenger Single Car Testing Device

The device used to conduct the single car test includes a suitable feed valve or reducing valve in the supply line ahead of the feed valve. The 3/8 inch test device cock provides for emergency brake pipe reduction. The positions on the gauge include the following:

- Position 1 - Quick charge
- Position 2 - Slow charge
- Position 3 - Lap
- Position 4 - Slow application
- Position 5 - Service stability application
- Position 6 - Emergency application

The gauge must be tested at least once a day. Before coupling the device to the car, move the handle to position 2. Close and open the flowrator bypass cock, checking that the float does not stay at the top of the tube. Move the handle to position 3. Couple the test coupling to the brake pipe or the coupling end of the device. Move the handle to position 1. Close the flowrater bypass cock, checking that the ball float rises to the zone between the condemning line and the top of the glass. Move the handle to position 3. Open the flowrator bypass cock and remove the dummy test coupling. Leakage from the brake pipe connection or exhaust port of the device, when detected with soap suds, must not exceed a 1 inch bubble in five seconds. The gauge must be tested every month at an approved AAR repair shop.

E. Running Maintenance

1. Air Brake Stencil
   a. Old stenciling must be removed and the area painted over with quick drying paint.
   b. Show place, month, day, and year of COT&S.
   c. Stencil shall include railroad or private owner reporting marks, initial of shop or station performing maintenance.
   d. Stencil must be applied in a suitable location for visual inspection.

e. Stencil must not be changed until all work has been performed.

f. Any deviation from these standards must be corrected when found.

2. Passenger cars may not be placed in service beyond COT&S date stencilled on car. In addition, COT&S must be performed for the following reasons.
   a. Stenciling missing
   b. Stenciling incorrect
   c. Stenciling indistinct
3. Any railroad passenger car which is overdue for COT&S may be moved to another location for rebuilding, reconditioning repairs, or scrapping provided the car has passed a single car test.
4. COT&S must be performed upon evidence of brake valvular equipment having been submerged whether found operative or inoperative after submerging.
5. In the repair of brakes on passenger type equipment, components must only be replaced in kind.
6. At time of COT&S maintenance, handbrakes must be inspected, lubricated and tested. Including all connections to insure safe and effective operation.
7. No welding is permitted on body portion of cast iron reservoirs, however, holes in mounting lugs when worn may be built up by welding. Mounting lugs fractured

or broken off (separated) within 1/2 inch or more distance from the body portion of the cast iron reservoir maybe welded by using bronze welding procedures to replace lug.

F. Running Maintenance - FRA Rules (Federal Railroad Administration)

1. Public Law 89-670, approved October 15, 1966 (49 U.S.C. 1651-9), established the United States department of Transportation. Pursuant to that law, certain functions, powers, and duties of the Interstate Commerce Commission were transferred to and vested in the Secretary of Transportation, including the following laws relating generally to safety appliances and equipment on railroad engines and cars, and protection of employees and travelers:

   a. The Act of March 2, 1893, as amended, (27 Stat. 531; 45 U.S.C. 1 et seq.)
   b. The Act of March 2, 1903, as amended, (32 Stat. 943; 45 U.S.C. 8 et seq.)
   c. The Act of April 14, 1910, as amended, (36 Stat. 298; 45 U.S.C. 11 et seq.)

2. Public Law 89-670 (49 U.S.C. 1655 (f) (3) (a)) further provided that the Federal Railroad Administrator

shall carry out the functions, powers, and duties of the Secretary pertaining to railroad safety as set forth in the statutes transferred to the Secretary. Also included in this publication are Part 231, Railroad Safety Appliance Standards, and Part 232, Railroad Power Brakes and Drawbars. These Parts are codified under Title 49 of Code of Federal Regulations.

Plates C through V are provided to show safety appliance arrangements. For specific details, see appropriate text.

The U.S. Safety Appliance Standards are administered by the Federal Railroad Administration, U.S. Department of Transportation, Washington, DC .20590.

The FRA rules cover initial terminal train test, but Amtrak has developed and issued Air Brake and Train Handling Instructions (AMT-3). These instructions adhere to FRA's rules and must be followed by Amtrak employees. You may obtain a copy of AMT-3 from your local Air Brake personnel.

G. Troubleshooting Train Air Brake System Tests

The following section of this booklet considers the more commonly appearing problems found in the 26-C

air brake system. A description of these difficulties is followed by a means for pinpointing the source and for correcting the problem.

Problem:	Brake pipe pressure is leaking in excess of five pounds per minute.
Location:	Close the angle cock directly behind the engine and determine if the leak is on the engine or on the car portion of the consist.
Solution:	a) If the leak is on the locomotive, 1) check the angle cocks and notify appropriate personnel. 2) change locomotives if the problem is not remedied. b) If on the car portion of the consist, 1) close the angle cocks one at a time starting in the middle of the consist on each car repeating the test to narrow down the lead to a particular car of cars. 2) Once the defective car is identified, check the hoses, angle cocks, valves, reservoirs, etc. 3) If you cannot hear the leak, apply liquid soap to the components. 4) If you have time, repair the leak. If

	there is not enough time, pull the car from the consist and repeat the initial terminal train test.
Problem:	Brakes do not apply on the train consist after a 20 pound service brake pipe reduction.
Location:	Check to see if the angle cock is closed directly behind the engine.
Solution:	Open the angle cock.
Problem:	Brakes do not apply on a particular car in a consist after a 20 pound reduction.
Location:	1) Check to see if the angle cock is closed directly in front of the defective car. 2) Check to see if the brake cylinder cut-out cocks are closed (if they are closed, find out why). 3) Check to see if the combined dirt collector and cut-out cock is closed (this usually indicates control valve problems). 4) Check to see if the brake rigging is fouled.
Solution:	Take corrective action. If all of the above check

out, then one of the following valves is defective:

1. The service portion is not sending air through the 16 line to activate the relay valve.
2. 16 line is missing or blanked out.
3. The relay valve is not sending air to the brake cylinders.
4. Check valve in the decelostat pipe bracket is stuck.
5. There is a hole in the supply reservoir or piping or the piping has been blanked off.
6. There is a hole in the control and selector volume reservoir or piping, or the piping has been blanked off.
7. The pipe bracket or pipe bracket chokes are clogged.

Problem: Brakes do not apply on the last car (or the last two cars) in a train consist after a 20 pound service brake application.

Location:	1) Check to see if the angle cock is closed directly in front of the defective car (or cars). 2) Check to see if the brake pipe on the consist was fully charged.
Problem:	Brake pipe is overcharged.
Solution:	Feed valve in the locomotive is defective.