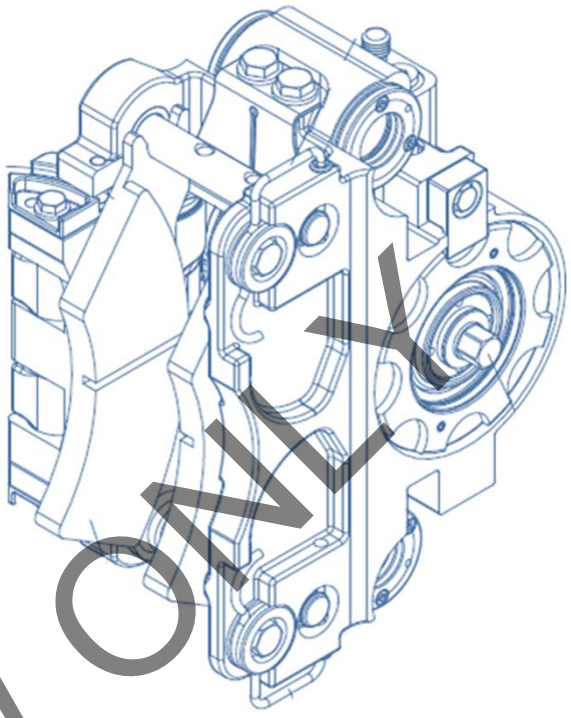
Inspection and Maintenance of Friction Brakes



Course 205






PARTICIPANT GUIDE

RAIL CAR TRAINING CONSORTIUM

Friction Brakes

Inspection and Maintenance

Course 205

Participant Guide

November 2017 DRAFT

Rail Car Training Consortium

Table of Contents

MODULE 1

GENERAL INSPECTION AND MAINTENANCE

Outline

Outcome and Objectives

Participants will be able to explain the principles of inspection and maintenance when working on a rail vehicle's friction brakes.

Upon completing this module, the participant should be able to complete the following objectives with an accuracy of 75% or greater:

- Explain agency's schedule of friction brake systems' inspection and maintenance.
- Examine requirements of PM sheets
- Recognize diagnostics-based maintenance

Key Terms

- Unscheduled maintenance
- Scheduled (preventive) maintenance

Abbreviations

- BCU: Brake Control Unit
- ECU: Electronic Control Unit
- HCU: Hydraulic Control Unit (sometimes HPCU for Hydraulic Pressure Control Unit
- LOTO: Lockout/Tagout
- NAS – National Aerospace Standards (for particle levels in hydraulic fluids)
- OEM: Original Equipment Manufacturer
- PPE: Personal Protective Equipment
- PSI: Pounds per Square Inch
- RTS – Rail Transportation System

1-2 INSPECTION AND MAINTENANCE SCHEDULES

Each transit agency schedules periodic inspection and maintenance of each of their rail vehicle's friction braking systems by following recommended cycles recommended by the rail car industry, the authority having jurisdiction (AHJ) over the public transportation agency, the OEM, or a combination of all. Generally these schedules are based on time, for example, the number of hours a rail car is in operation; or on distance, the number of miles the rail car is in operation. In addition, there are also maintenance schedules recommended by the manufacturers or OEMs that are considered by transit agencies.

Preventive Maintenance

Preventive maintenance (PM) involves the inspection and maintenance of the rail vehicle friction braking system that is performed on a regular schedule in order to lessen the likelihood of failure. Preventive maintenance has many advantages including:

- Better conservation of assets and increase life expectancy of assets, thereby eliminating premature replacement of machinery and equipment.
- Timely, routine repairs circumvent fewer large-scale repairs.
- Reduced cost of repairs by reducing secondary failures. When parts fail in service, they usually damage other parts.
- Improved safety and quality conditions.

For its 1000-series rail cars, PATCO performs preventative maintenance at specific distances the car has is in revenue service. For the 15,000 (15K inspection), the PM chart shown in Figure 1.1 lists the checks that must be performed on the various components of the rail vehicle's friction brakes. This PM sheet shows the cross reference to the Running Maintenance and Servicing Manual (RMSM) to which the maintainer can reference. Space is provided for notes on each component, checks for pass or fail, as well as whether a potential issue is resolved.

Learning Application 1.1

For small group discussion

In what ways is the PM sheet in Figure 1.1 similar and different from the PM sheet you use in your agency for friction brakes?

MODULE 2

Pneumatic Braking Systems

Outline

Outcome and Objectives

Participants will be able to apply the steps involved in inspecting, maintaining, and testing major components of the pneumatic braking systems on rail cars used in major U.S. transportation agencies.

Following the completion of this module, the participant should be able to complete the objectives with an accuracy of 75% or greater:

- Inspect and maintain pneumatic control unit
- Inspect and maintain check valves
- Inspect and maintain air reservoir
- Inspect and maintain air compressor
- Inspect and maintain air gauges
- Inspect and maintain brake control unit

Key Terms

- R-1 Drain Valve
- Cut-out valve
- Check valve
- Drain valve

2-1 OVERVIEW

This module helps the participant examine maintenance procedures that can be modeled in their approach to inspect and maintain major components of a rail vehicle's pneumatic brake system. There are variations in a rail car's pneumatic braking system in terms of configuration as well as OEM design. This module uses a three-part approach in listing recommended practices for inspection and maintenance:

1. An overview of the component.
2. A guide showing general recommended inspection and maintenance steps for that component beside which the participant can note their agency-specific inspection and maintenance requirements for that component.
3. A case study from a Consortium rail agency listing the steps that agency follows for inspect and maintain that component. The intention of this case study is provide useful context for which the participant can approach inspection and maintenance of that component as well as consulting with their agencies documentation on such procedures.

In all the inspection and maintenance procedures listed in this module, the participant should refer to the OEM's maintenance manuals for particulars such as torque values, voltage settings, pass/fail criteria, condemning limits, clearance measurements and specific procedure methodology. Component failures or deficiencies should be noted by the rail car technician and resolved within the recommended procedures of the OEM in conjunction with the rail transportation agency.

This module organizes inspection and maintenance of pneumatic braking systems into four functional areas:

1. Electronic control
2. Brake control
3. Air supply

2-1 ELECTRONIC CONTROL

The electronic control unit is typically inspected daily by the train operator. The daily inspection procedure for the ECU consists of the daily self-test, which is performed upon keying in, and checking for logged-in faults from the ECU. Depending on the ECU design, faults may be on a LED display.

Learning Application 2.1

Working with a partner, examine the components labeled in Figure 2.2 in order to complete the following activities.

1. Using a highlighter, highlight ONE of the following on the diagram:
   - Choke valve
   - Solenoid valve
   - Tower valve
   - Separators check valve
   - Safety valve

2. How many valves are labeled on the diagram?

3. How many safety valves are shown on this diagram?

4. What is the psi for each safety valve?

5. Note the compressor governor in the diagram. What do you think is its purpose?

6. If available to you, compare this diagram to the similar one of the rail car on which you work. What, if any, are the major differences? Note them in the space below.

Valves

A valve is a mechanical device that controls or interrupts the flow of air a pipe in the pneumatic braking system. The participant may recall from Course 105 the many types of valves which make up the brake control system of air brakes. The types of valves that were described include feed, recharge, J-1 relay, load weigh, check, cut-out, and dump valves.

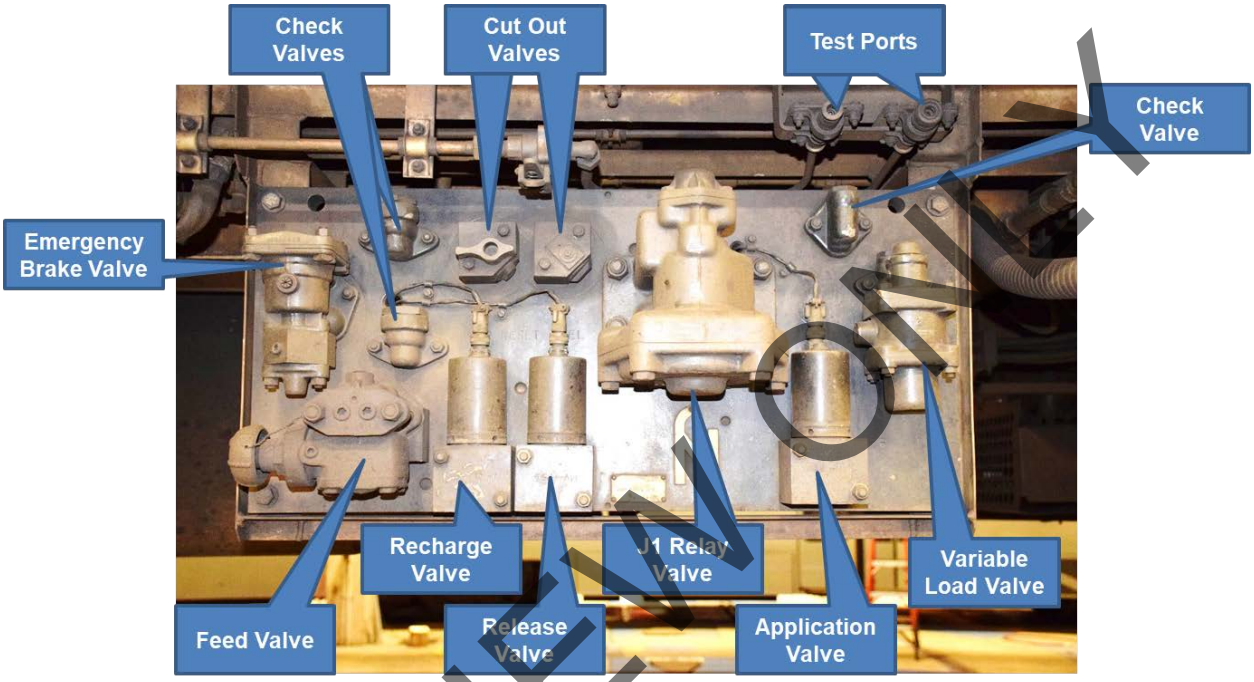


Figure 2.3 Air Valves on Brake Manifold –courtesy GCRTA

The following table is a list of general recommendations for inspecting valves.

Valves Inspection and Maintenance	
General Recommendations	Your Notes on Agency Requirements
• Inspect physical condition of valves. • Move valve handle to verify handle does not jam or bind. • Visually verify that the vented cutout valve is free of leaks. • When indicated, clean exterior of valves per OEM recommendations. • When indicated, inspect valve setting by attaching a pressure gauge at the recommended test point	

MODULE 3

Hydraulic Braking Systems

Outline

Outcome and Objectives

Participants will be able to apply the steps involved in inspecting, maintaining, and testing major components of the hydraulic braking systems on rail cars used in major U.S. transportation agencies.

Upon completing this module, the participant should be able to complete the following objectives with an accuracy of 75% or greater:

- Inspect and maintain flush cart
- Inspect and maintain electrical hydraulic unit
- Inspect and maintain motor assembly
- Inspect and maintain control valves
- Inspect and maintain pump-off circuit
- Inspect and maintain accumulators .

Following the completion of this module, the participant should be able to complete the objectives with an accuracy of 75% or greater:

Key Terms

- Flush cart
- Pump-off circuit

3-1 OVERIEW

This module helps the participant examine maintenance procedures that can be modeled in their approach to inspect and maintain major components of a rail vehicle's hydraulic brake system. There are variations in a rail car's hydraulic braking system in terms of configuration as well as OEM design. This module uses a three-part approach in listing recommended practices for inspection and maintenance:

1. An overview of the component.
2. A guide showing general recommended inspection and maintenance steps for that component beside which the participant can note their agency-specific inspection and maintenance requirements for that component.
3. If applicable, a case study from a Consortium rail agency listing the steps that agency follows for inspect and maintain that component. The intention of this case study is provide useful context for which the participant can approach inspection and maintenance of that component as well as consulting with their agencies documentation on such procedures.

The first thing to note in a course like this is that the configuration of hydraulic braking systems varies by rail car type. As such, the participant should be made to or become familiarize themselves with the layout of the friction brakes equipment on the rail car type with which they are working. Figure 3.1 shows a block layout of a hydraulic braking system on a three-truck light rail vehicle used by the Denver RTD.

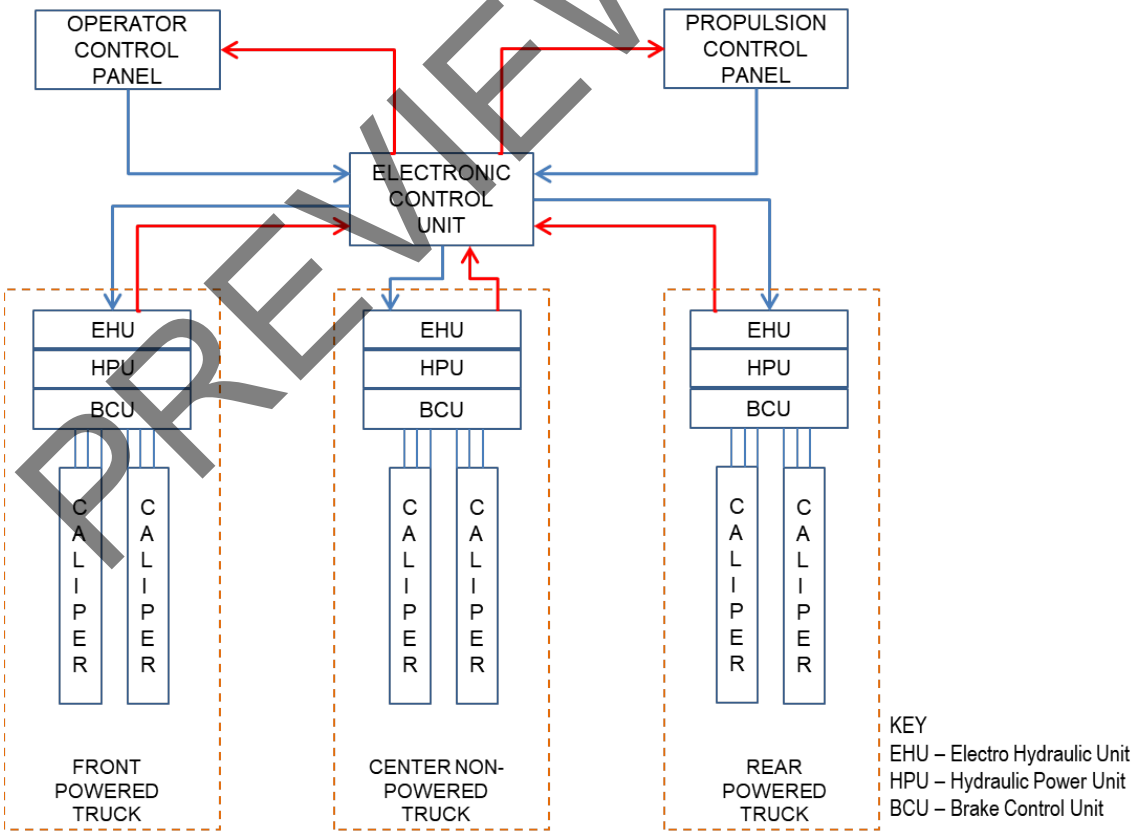


Figure 3.1 LRV Hydraulic System Block Diagram –courtesy Denver RTD

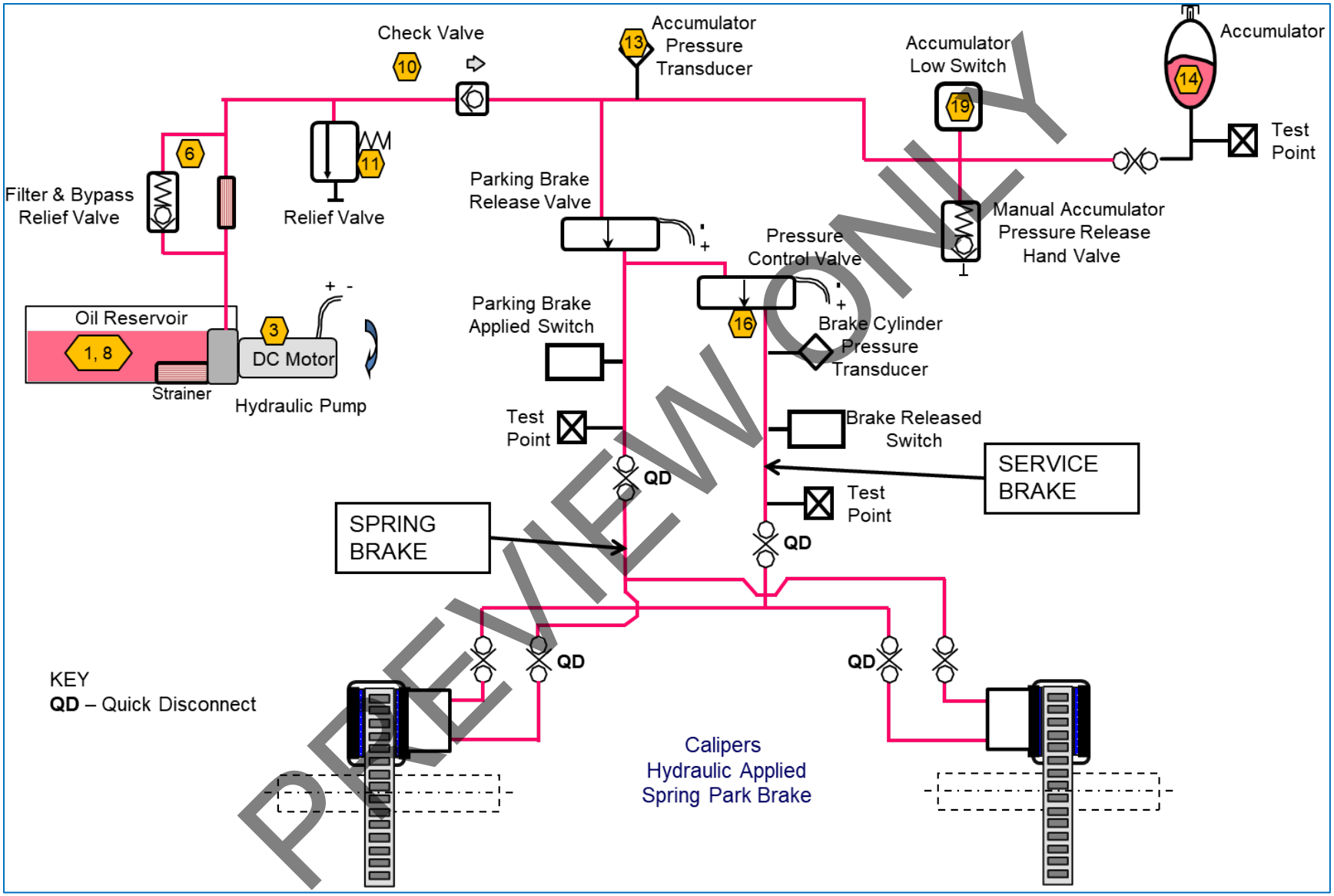


Figure 3.2 Hydraulic Braking System Schematic –courtesy Denver RTD

Case Study 3.2: VTA, Santa Clara, CA

10,000 Mile Inspection

Specific OEM parts and supplies needed:

- Hydraulic fluid
- Locking wire
- Clean cloth
- Filler unit and filler adapter

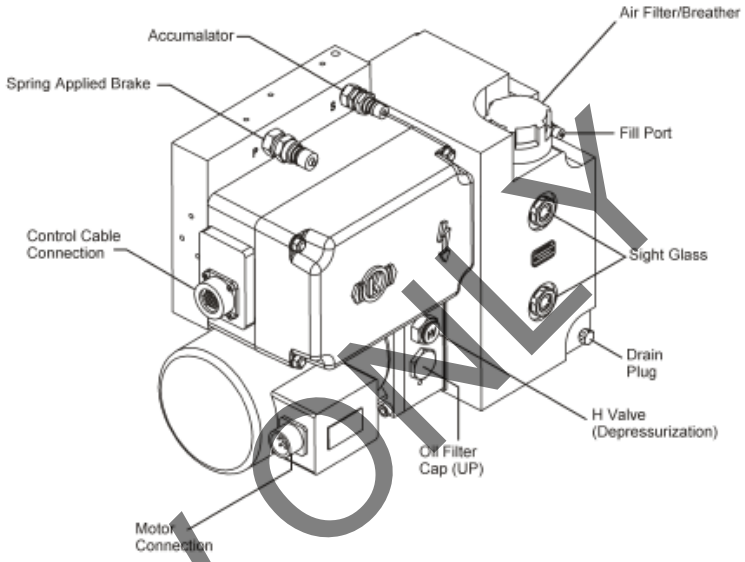


Figure 3.4 EHU Preventive Maintenance Checks –courtesy VTA

1. Check hydraulic fluid level in EHU as follows
    a. Chock the vehicle wheels
    b. Shut off power to EHU
    c. Remove H valve cap and release hydraulic pressure in accumulators by pressing H valve.
    d. Check hydraulic fluid level in EHU reservoir. Hydraulic fluid level should be even with the upper sight glass on side of EHU reservoir.
    e. If hydraulic fluid cannot be seen in the upper sight glass, clean EHU reservoir quick disconnect with a clean cloth, connect hydraulic filler unit to quick disconnect and add hydraulic fluid to EHU until it is even with the upper sight glass.
    f. Disconnect hydraulic filler unit and clean quick disconnect before installing cover.
    g. Install H valve cap and torque to 19 ± 3 ft.-lbs.

60,000 Mile Inspection

Specific OEM parts and supplies needed:

- Breather with ring seal
- Approximately one gallon hydraulic fluid
- Oil filter
- Oil filter cap O-ring
- Locking wire

Figure 3.7 Flush Unit Connected to LRV –courtesy Denver RTD

Figure 3.8 CM20 Particle Counter Mounted on Flush Unit –courtesy Denver RTD

MODULE 4

Electromechanical Brakes

Outline

Outcome and Objectives

Participants will be able to apply the steps involved in inspecting, maintaining, and testing major components of the electromechanical braking systems on rail cars used in major U.S. transportation agencies.

Upon completing this module, the participant should be able to complete the following objectives with an accuracy of 75% or greater:

- Inspect and maintain track brakes including:
    - Measure track brake
    - Test track brake
    - Check suspension clearance and height
    - Check for corrosion on wear plate
    - Explain isolation
    - Clean debris
    - Replace rusty components.

Following the completion of this module, the participant should be able to complete the objectives with an accuracy of 75% or greater:

Key Terms

- Track brake

4-1 OVERIEW

The focus of this module is on the inspection and maintenance of track brakes. Track brakes are used during emergency brake applications, maximum braking, and when requested by the vehicle operator.

4-2 TRACK BRAKES

The **track brake system** is comprised of electromagnet track brakes mounted on the rail vehicle. Its purpose is to provide adhesion to the rail that is independent of the dynamic/friction braking force on the vehicle. A magnetic field generated by the track brake causes the track brake to be pulled down to the rail.

Figure 4.1 Track Brake Applied –courtesy MBTA

The main components of the track brake are the rail shoes, tie bar, magnet, cable for the electrical connection, and suspension springs used to hold the magnets suspended over the running rail.

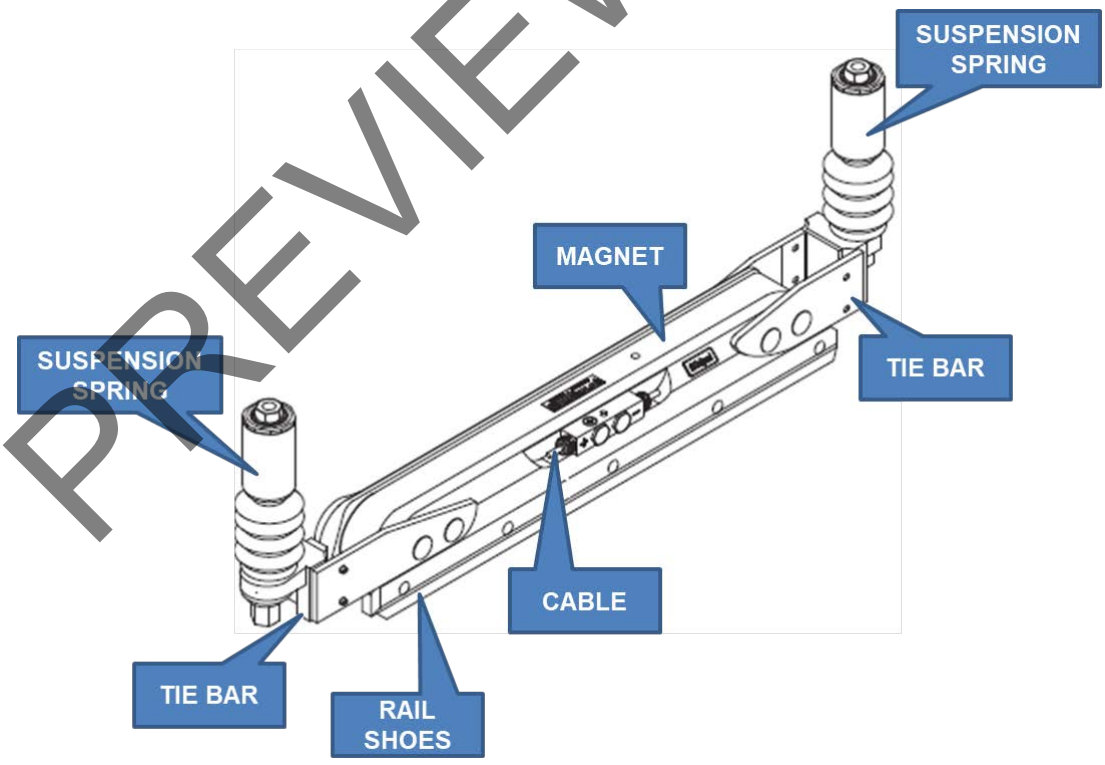


Figure 2 Track Brake Assembly –courtesy CATS

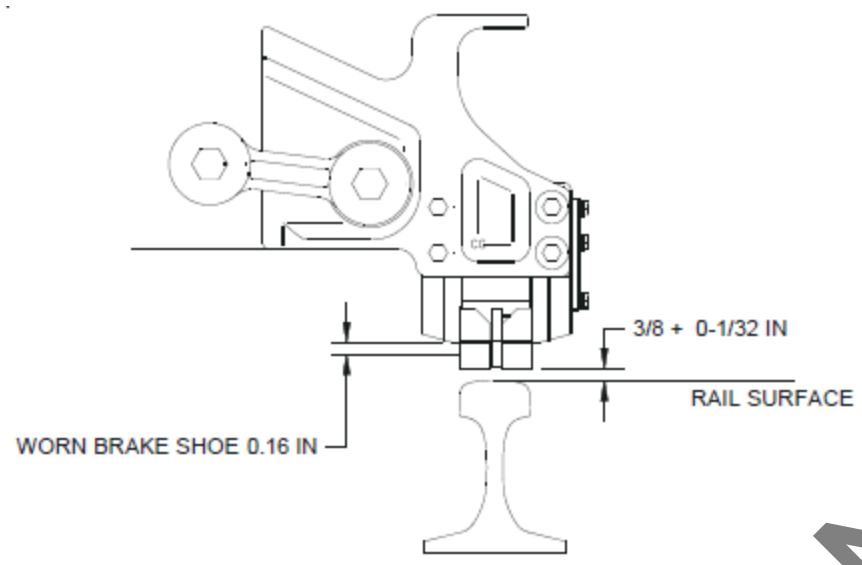


Figure 4.3 Track Brake Height Check –courtesy CTA

4-3 SUMMARY

This module provided a framework for rail car technicians to approach inspection and maintenance of track brakes. The steps and recommendations in this module should be applied in conjunction with those of the participant's rail agency.

MODULE 5

Foundation Brake Equipment

Outline

Outcome and Objectives

Participants will be able to apply the steps involved in inspecting, maintaining, and testing major components of foundation brake equipment on rail cars used in major U.S. transportation agencies.

Following the completion of this module, the participant should be able to complete the objectives with an accuracy of 75% or greater:

- Inspect and maintain
  - Brake Actuator
  - Spring
  - Hand or Parking Brake
  - Varistors/Pressure Transducers
  - Brake Transducers
  - Hand or Parking Brake
  - Disc Brakes, Tread Brakes
  - Brake Calipers
  - Brake Rotors (Brake Discs)
  - Brake Pads/Shoes
  - Manual Brake Release
  - Sanding System

Key Terms

- Brake head
- Brake pad
- Brake rotor (brake disc)
- Brake shoe
- Disc brake unit
- Rotor or Friction Ring
- Tread brake unit (TBU)

5-3 BRAKE CALIPER

The brake caliper is the assembly on disc brakes that holds the disc pads and straddles the disc. Typically caliper maintenance follows the OEM recommended intervals. For example Denver's RTD follows this schedule for performing maintenance on brake calipers on their light rail vehicles:

ACTIVITY	INTERVAL
✓ Safety inspection ✓ Check brake pad wear	2 months or 15K km
✓ Grease caliper and support rod ✓ Bleed caliper	1 year or 100K km
✓ Overhaul	5 years or 500K km
Source: *Training Manual for the LRV, Denver RTD*	

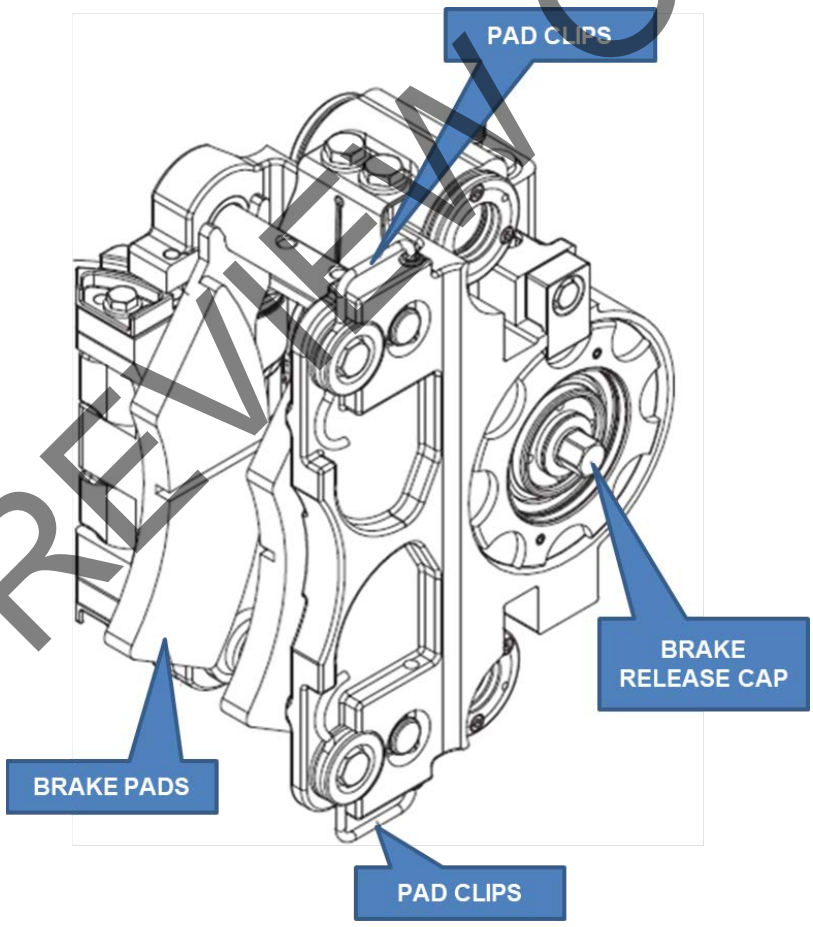


Figure 5.4 Power Truck Brake Caliper on LRV –courtesy CATS

5-6 BRAKE ACTUATOR, SPRING

The brake actuator is a relay device that is part of the brake assembly that stores energy. Its sole purpose is to ensure that the brakes are applied at the same instance to all of the rail vehicle wheels.

The brake actuator is enabled after the air, hydraulic and electrical lines from the front of the rail vehicle are attached to the correct connectors to each brake assembly on the rail car. On activation, the front brakes act almost instantly, while there would be a bit of lag time to the rear and other brake assembly, the brake actuator eliminates this lag time. Spring-applied actuators provide the fail-safe elements of the safety system in rail vehicles. If the energy supply fails, the braking force is provided with the force of a mechanical spring.

The main requirements for inspection and maintenance include the following:

- Check spring
- Adjust spring
- Replace spring as indicated per OEM recommendation

5-7 SUMMARY

Foundation brake equipment is where the vehicle technician will spend a lot of time when inspecting and maintaining train brake systems!

While your rail transportation agency most assuredly will have more specific steps and procedures than those covered in this module, the participant is encouraged to use this module as a base for acquiring a solid approach to inspection and maintenance of rail vehicles.