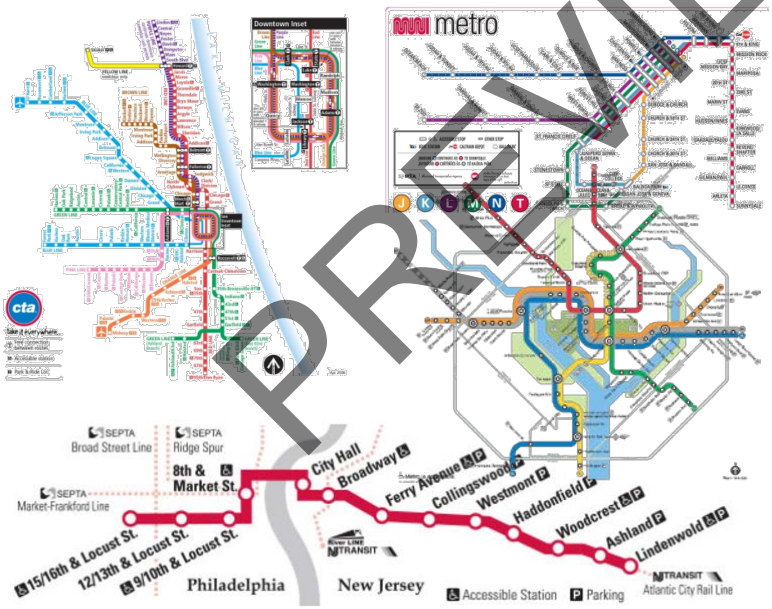
Troubleshooting

Friction Brakes

Course 305



PARTICIPANT GUIDE

RAIL CAR TRAINING CONSORTIUM

Friction Brakes

Troubleshooting and Repair

Course 305

Participant Guide

February 2018 DRAFT

Rail Car Training Consortium

REVISION INDEX

Any additions, deletions, or revisions are to be listed below.

Revision Number	Date	Section	Description of Change	Revision Author

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HOW TO USE THE PARTICIPANT GUIDE

Purpose of the Course

Course 305, Troubleshooting Friction Braking Systems, provides participants with the essential steps to approach troubleshooting and repair of friction braking systems on U.S. transit light and heavy rail vehicles.

Approach of the Book

Each course module begins with an outline, a statement of purpose and objectives as well as a list of key terms. The outline discusses the main topics addressed in the module. A list of key terms identifies important terminology that is introduced in each module. Learning objectives define the basic skills, knowledge, and abilities course participants should be able to demonstrate to show that they have learned the material presented in the module. Learning Applications are built in throughout the course materials to assist the participants in learning and reviewing key information.

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MODULE 1

Pneumatic Braking Systems

Outline

Outcome and Objectives

The purpose of this module is to provide participants with an overview to troubleshooting friction braking systems on rail cars within the context of general troubleshooting and best practices. This module also prepares participants for national qualification testing.

Following the completion of Course 300 *Troubleshooting Principles* as well as this module, the participant should be able to complete the objectives with an accuracy of 75% or greater:

- Troubleshoot the brake control unit
- Troubleshoot valves and piping systems
- Troubleshoot air compressors and main reservoir

1-1 OVERVIEW

Like all troubleshooting courses in the Rail Car Training Consortium series, this course on troubleshooting pneumatic braking systems builds on the principles outlined in Course 300 *Troubleshooting Principles.* In that course the participant was provided with an overview of the troubleshooting process along with related general strategies, tips and pitfalls. In that course, troubleshooting is defined as "a systematic approach to find the source of a problem in an effort to restore an operation or process." In other words, troubleshooting is complex problem-solving in a methodical and organized manner and an orderly and logical approach is required.

This module gets right into troubleshooting commonly reported problems with pneumatic braking systems on a rail car. This module will draw on the many years of combined experience of the subject matter experts in the Consortium as well as resources from their agencies. By the time you are taking this course, you would have already inspected, maintained, and even applied

1-5 VALVES AND PIPING

As the participant knows well, there are several types of valves associated with the pneumatic brake system. In an earlier course this diagram was presented and the types of valves were described.

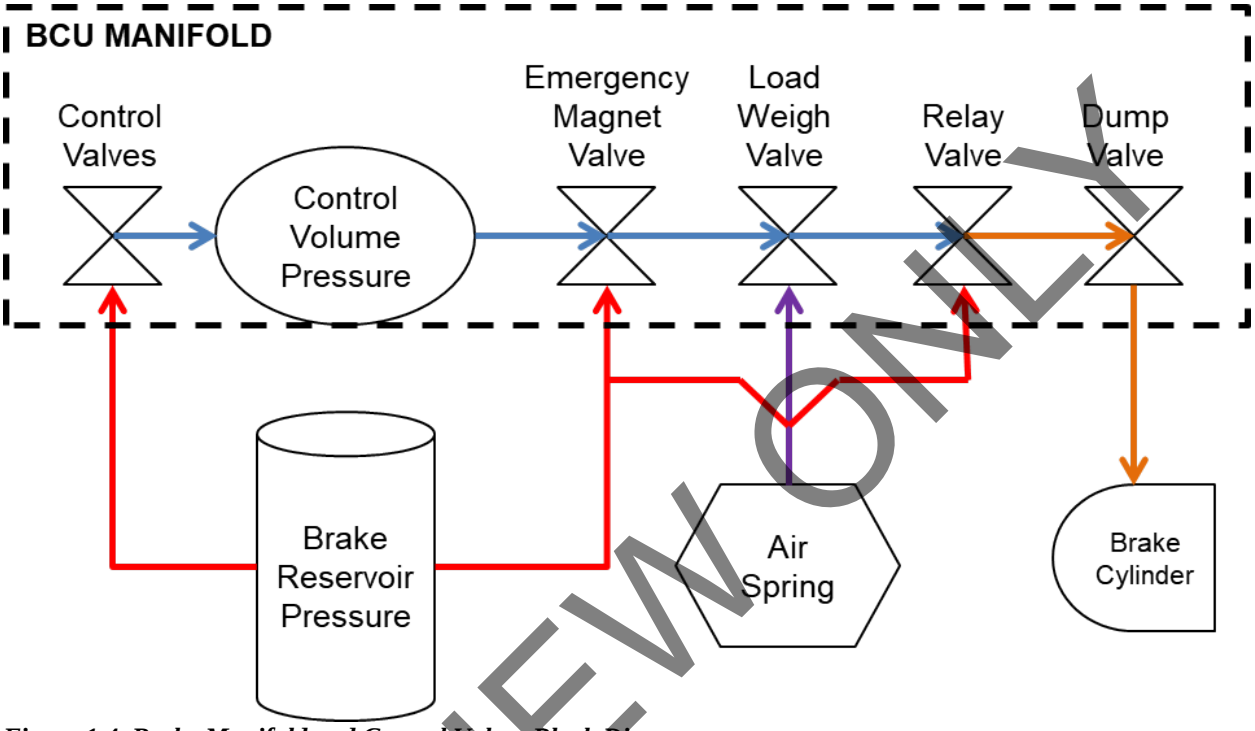

Figure 1.4 Brake Manifold and Control Valves Block Diagram

Generally, control valve problems are expressed when troubleshooting the air compressor and main reservoir which are highlighted in Section 1-4 of this module.

This section focusses on troubleshooting two types of valves: the J-1 relay valve and the R-1 drain valve.

J-1 Relay Valve

The J-1 relay valve is a pneumatic valve that inputs a low capacity control air flow and changes it to a high capacity air flow at a one-to-one ratio.

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
J-1 relay valve has continuous venting of air through exhaust port	1. Air leaking past seat	Remove and replace J-1 relay valve as indicated.

R-1 Drain Valve Troubleshooting			
SYMPTOM	**PROBABLE CAUSE**	**TESTS AND CHECKS**	**CORRECTIVE ACTION**
R-1 drain valve is not operating properly	Drain jammed with debris	Inspect for debris clogging drain or check valve.	Clear drain as needed with an air jet with recommended psi to blow debris from drain.
	Worn or damaged piston, seals or diaphragms.	Inspect for damaged or worn pistons, torn seals or diaphragms.	Replace parts as indicated.
	Frozen material clogging drain.	Check for heater functionality.	Replace heater as indicated.
Air leaking continuously through R-1 drain valve muffler (compressor is operating).	Torn drain valve diaphragm.	Inspect drain valve.	Remove and replace drain valve as indicated.
	Check valve leaking.	Inspect piston seal for cuts.	Remove and replace air dryer as indicated.
	Defective timer.	Inspect time connections and operation.	Tighten connections or replace timer as indicated.
	Defective solenoid.	Check for air in fitting. If air is present, check if solenoid valve is energized.	If solenoid valve is energized, replace solenoid as indicated.
R-1 drain valve does not purge during compressor shutdown.	No pneumatic signal from solenoid valve operation in the control box/governor.	Check for proper solenoid valve operation on compressor control box/governor.	Replace governor as indicated.

1-6 AIR COMPRESSOR AND MAIN RESERVOIR

When the air compressor is malfunctioning there can be many indicating symptoms. This section describes the steps taken to identify and resolve common reported malfunctions of components of the rail car's air compressor.

Air Compressor and Main Reservoir Troubleshooting			
SYMPTOM	**PROBABLE CAUSE**	**TESTS AND CHECKS**	**CORRECTIVE ACTION**
Compressor vibrates excessively.	Mounting hardware is loose.	Inspect for loose mounting bolts.	Tighten mounting fasteners to recommended torque.
	Loose hanger fasteners.	Inspect for loose hanger fasteners.	Tighten hanger fasteners to recommended torque.
	Frame is loose.	Inspect for loose frame fasteners of broken weld on frames.	Tighten frame fasteners to recommended torque or remove and replace broken frame members.
Compressor operates continuously. Does not recycle.	Air leaks in compressor unit.	Inspect for signs of leakage.	Isolate air leaks and tighten fittings for replace damaged components.
	Continuous air flow through safety valves.	Inspect for continuous air flowy from any safety valve.	Replace safety valve as required.
	Excessive leakage through piping and main reservoir.	Inspect for leaks in piping.	Isolate leaks, tighten fixtures, and replace or repair parts as required.
	Leak from drain valve silencer.	Use multimeter to verify absence of recommended voltage in control box. Inspect for debris in air dryer drain valve check	Repair and replace control box components as required. Remove and clean check valve as required.

MODULE 2

Hydraulic Braking Systems

Outline

2-1 Overview – Fluid flash point and safety. Causes of fluid breakdown

2-2 Line Replaceable Unit

2-3 Electronic Control Unit

2-4 Electro Hydraulic Unit

2-5 Troubleshooting Chart

2-6 Summary

Outcome and Objectives

The purpose of this module is to provide participants with an overview to troubleshooting friction braking systems on rail cars within the context of general troubleshooting and best practices. This module also prepares participants for national qualification testing.

Following the completion of Course 300 *Troubleshooting Principles* as well as this module, the participant should be able to complete the objectives with an accuracy of 75% or greater:

- Demonstrate ability to diagnose transducer problems
- Troubleshoot the EHU
- Troubleshoot motor assembly
- Troubleshoot control valves
- Troubleshoot accumulators

2-3 ELECTRONIC CONTROL UNIT DIAGNOSTICS

The purpose of the electronic control unit (ECU) is to interface between the propulsion system and the friction braking system. The participant should recall from Course 105 *Introduction and Overview to Friction Brakes* that the ECU is described as a logic controller that monitors many functions of the rail vehicle including those which provide friction brake service and wheel-slide control. On newer rail cars, the ECU is a microprocessor-based device with extensive fault detection and annunciation capabilities to which portable test equipment (PTE) can be connected to report specific faults as Figure 2.2 illustrates.

Figure 2.2 Portable Test Equipment Interface with ECU –courtesy Santa Clara VTA

The ECU runs diagnostics using software specific to the rail vehicle. If your agency has this capability on its rail cars, the instructor will guide you through this diagnostic system either through a simulation or hands-on lesson.

Listed below are some questions which you should be able to take away from that lesson:

1. How do you interpret the meaning of the ECU's fault or event codes?
2. Are fault events annunciated to the train operator's panel?
3. How do you resolve and analyze the event codes? What are the steps involved in resolving and / analyzing the reported faults?
4. What are some common fault codes and how are they resolved by the rail car technician?
5. What steps are there for the rail car technician to take as far as checking that the ECU is operational?

As you participate in that lesson, you may want to use the space on the following page for your notes.

2-4 ELECTRO HYDRAULIC UNIT

Troubleshooting the electro hydraulic unit itself is challenging. The most common problem reported with the EHU is that the oil level is low which expresses problems elsewhere in the friction brake system on the rail car. Some agencies use OEM-recommended portable test equipment that has the necessary hydraulic and electrical accessories to test the EHU in accordance with the OEM's test specifications. Some agencies refer to portable test equipment as "portable test unit" or "portable test box." More on portable test equipment is discussed later in this course in Module 4.

Depending on OEM design, rail car EHUs are typically installed on each truck of the rail vehicle. An example is shown in Figure 2.3 of the EHU installations on a Siemens© light rail vehicle used in Charlotte.

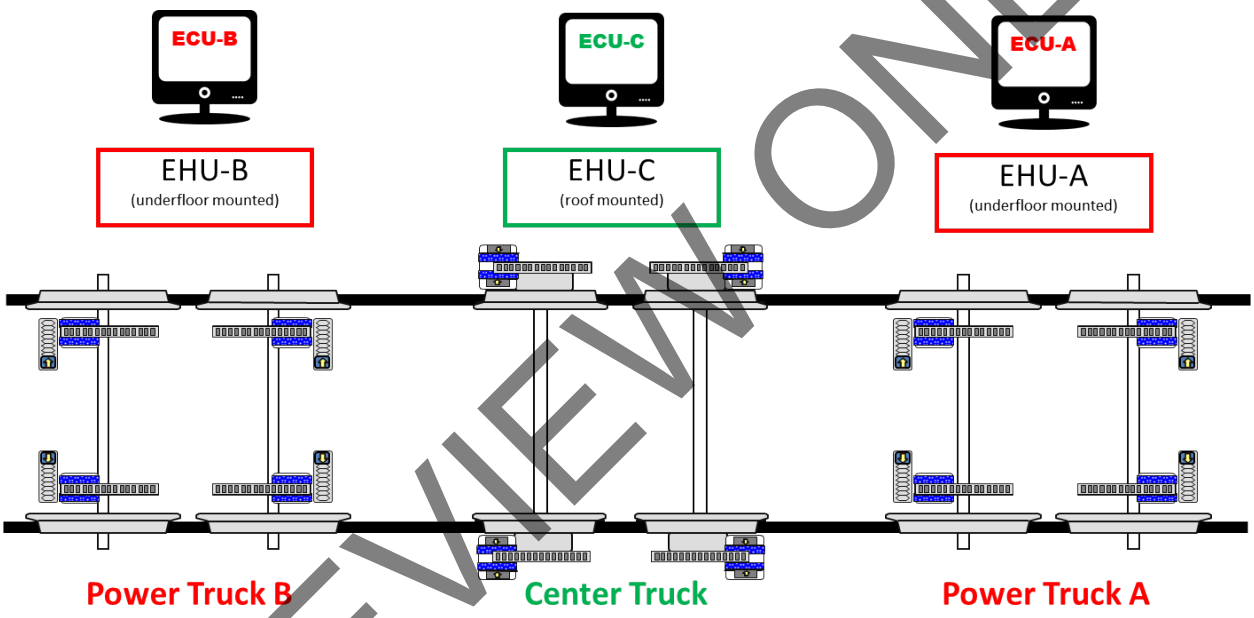

Figure 2.3 ECU and EHU Braking Configuration on Siemens© LRV –courtesy CATS

Whenever a problem with the EHU itself has been isolated and confirmed, the EHU can be removed and a new unit installed. EHU removal and replacement are important tasks for rail car technicians. Learning Application 2A is a case study of these procedures from a Consortium rail car agency.

Hydraulic Friction Braking System Troubleshooting			
SYMPTOM	**PROBABLE CAUSE**	**TESTS AND CHECKS**	**CORRECTIVE ACTION**
(continued from previous page)		Check fluid level in EHU.	Fill EHU reservoir as indicated.
		Validate supply pressure transducer is functioning properly by checking it with PTE.	Check wiring. Replace EHU if indicated.
	Faulty brake cylinder pressure transducer.	Validate brake cylinder pressure with PTE.	Check wiring. Replace EHU if indicated.
	Faulty analog control valve.	Manually release the brakes by applying pressure to the brake line through the service function of the PTE.	Check wiring. Replace EHU if indicated
Brake failure. Brakes do not apply.	Brake release cutout enabled.	Verify that friction brake cutout is enabled.	Not applicable.
	No brake demand received by the ECU.	Verify that a requested brake effort was commanded by the vehicle control unit.	Not applicable.
	No brake T/L received by the ECU in rescue mode.	Check wiring connections. Verify that ECU acknowledges the T/L by checking the PTE I/O screen.	Not applicable.
Overbraking.	Pressure regulator error.	Measure brake cylinder pressure with PTE and compare with target/demand pressure.	Correct per OEM recommendations.

MODULE 3

Electromagnetic Brakes

Outline

3-1 Overview

3-2 Track Brakes

3-3 Summary

Outcome and Objectives

The purpose of this module is to provide participants with an overview to troubleshooting electromagnetic brake systems on rail cars within the context of general troubleshooting and best practices. This module also prepares participants for national qualification testing.

Following the completion of Course 300 *Troubleshooting Principles* as well as this module, the participant should be able to complete the objectives with an accuracy of 75% or greater:

- Troubleshoot the rail vehicle's track brake.
- List common problems reported with track brakes.

3-1 OVERVIEW

Track brakes are used during emergency brake applications, maximum braking, and when commanded by the vehicle operator. The track brake assembly is an electromagnetic system (Figure 3.1) which consists of spring-mounted articulated pole pieces and a spring suspension.

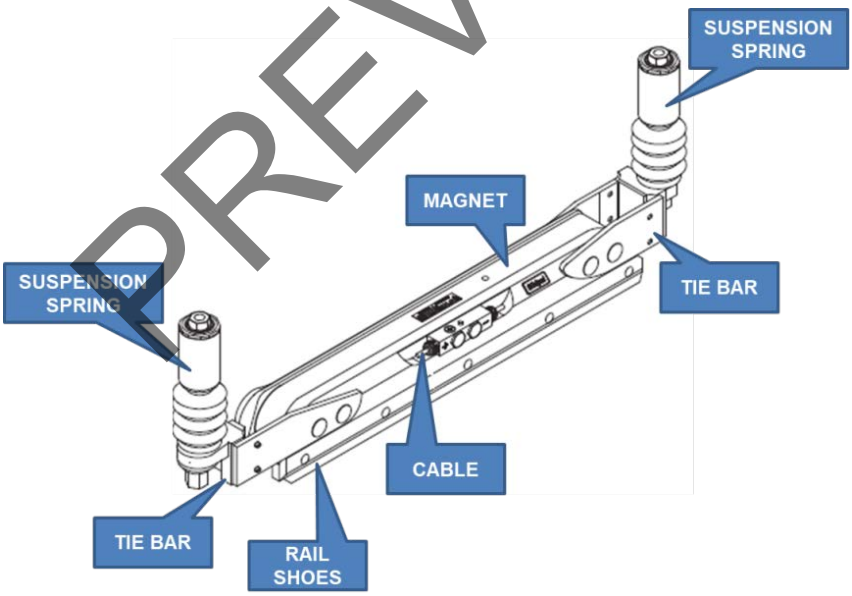

Figure 3.1 Track Brake Assembly –courtesy CATS

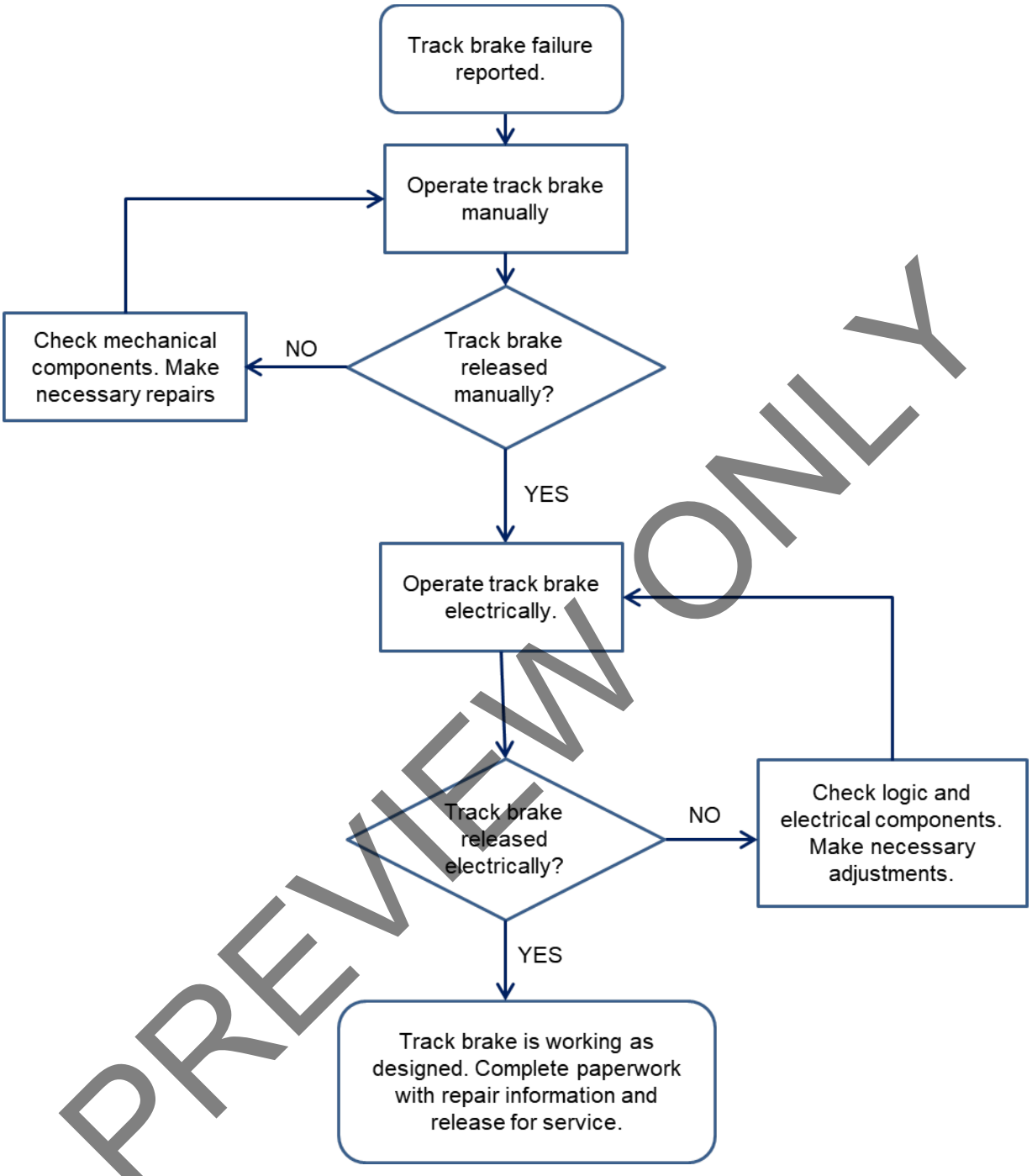

Figure 3.2 Troubleshooting Track Brake Failure with Flow Chart

Typical track brake troubleshooting procedures are listed in the table on the following page.

MODULE 4

Foundation Braking Equipment

Outline

Following the completion of *Course 300 Troubleshooting Principles* as well as this module, the participant should be able to complete the objective with an accuracy of 75% or greater:

- Troubleshoot calipers
- Troubleshoot disc brake units
- Perform checks and tests of a rail vehicle's sanding system
- Troubleshoot brake calipers
- Explain anti-spinslide circuits

4-2 BRAKE CALIPERS

Symptoms such as an unusual brake odor or brakes overheating can be caused by faulty brake caliper as shown in the two Troubleshooting Note Record samples below.

Troubleshooting Note Record	
Initial Problem or Complaint	Unusual brake odor
Information Collected:	Reported by operator. Inspection of train confirms odor.
Systems or Subsystems Involved:	Friction brake units, air valves, propulsion system, calipers, parking brake.
All Possible Causes:	• Stuck air valve • Brake caliper stuck • Loss of dynamic brake • Parking brake not releasing
Tests to Perform:	✓ Visual check of brake units and release ✓ Check parking brake ✓ Check propulsion logic and propulsion system

Troubleshooting Note Record	
Initial Problem or Complaint:	Brakes overheating
Information Collected:	Problem reported by operator. Inspection confirms odor and smoke from brakes.
Systems or Subsystems Involved:	EHU, Tachometer, Master controller, p-signal generator, brake calipers
All Possible Causes:	• Faulty tach • Faulty wiring • Loss of p-signal • Frozen caliper
Tests to Perform:	✓ PTU – test tach with ohmmeter ✓ Try releasing caliper manually