



Course 303

## Troubleshooting Propulsion and Dynamic Braking Systems

Includes AC Traction Motors

### INSTRUCTOR GUIDE

Table of Contents



**RAIL CAR TRAINING CONSORTIUM**

<b>CHECKLIST FOR INSTRUCTION</b> .....	<b>3</b>
<b>SUPPLIES, AUDIO-VISUAL EQUIPMENT, INTERNET ACCESS</b> .....	<b>3</b>
<b>BEST PRACTICES FOR DELIVERING TRAINING</b> .....	<b>4</b>
<b>OVERVIEW TO COURSE 303</b> .....	<b>5</b>
<b>MATERIALS FOR INSTRUCTION</b> .....	<b>5</b>
<b>OVERVIEW TO MODULE 1</b> .....	<b>6</b>
<i>Order of Instruction for Module 3</i> .....	6
<i>Demonstrations and Take-aways</i> .....	6
<i>Outline of PowerPoint Presentation</i> .....	7
<i>Learning Objectives for Module 1</i> .....	7
<b>SLIDE-BY-SLIDE INSTRUCTION</b> .....	<b>8</b>
<i>Overview</i> .....	8
<i>Propulsion Control Logic Diagnostics</i> .....	14
<i>Diagnostic Software Lesson</i> .....	17
<i>Master Controller</i> .....	19
<i>Propulsion Blower</i> .....	21
<i>AC Traction Motors</i> .....	22
<i>Brake Resistors</i> .....	28
<i>Summary</i> .....	30

PREVIEW ONLY

### Outline of PowerPoint Presentation

Topic Title	Slides	Duration (Minutes)
Overview	1-6	27
Propulsion Control Logic Diagnostics	7-9	60
Diagnostic Software Lesson	10-11	60
Master Controller	12-13	20
Propulsion Blower	14	30
Traction motors	15-20	70
Brake resistors	21-22	25
Summary, Quiz	23-25	15
<b>TOTAL</b>		<b>307 minutes (5.1 hours)</b>

### Learning Objectives for Module 1

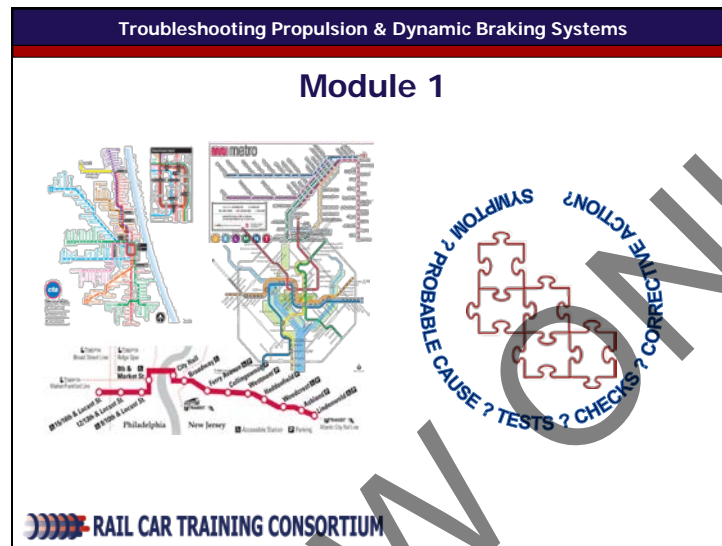
Following the completion of this module, the participant should be able to complete the objectives with an accuracy of 75% or greater:

- Troubleshoot master controller
- Troubleshoot Propulsion Control logic
- Troubleshoot propulsion ventilation
- Troubleshoot braking resistors
- Troubleshoot traction motor

## Slide-by-slide Instruction

### Overview

#### Slide 1



**INSTRUCTIONAL EVENT:** Gain attention

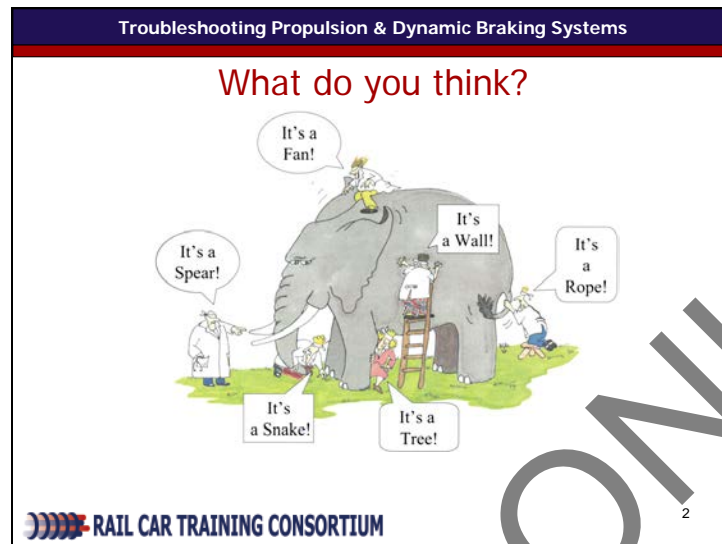
**TIME:** 1 minute

**SAY:** Welcome to Course 303: *Troubleshooting Propulsion and Dynamic Systems*. Course 303 has one module! Module 1 The purpose of this module is to provide participants with an overview to troubleshooting propulsion and dynamic braking systems on rail cars within the context of general troubleshooting and best practices. This module also prepares participants for national qualification testing. **We will have knowledge checks throughout this class as well as a quiz at the end.**

**DO:** Make sure that each participant has a Participant Guide. If this is your first time teaching these class participants, tell them a little about yourself – how long have you been with the agency, how long have you been teaching, etc. Ask participants to introduce themselves telling the class their name, department, previous work experience, and other information that you think is relevant.

**OTHER:** System maps for Muni (San Francisco, CA); CTA (Chicago, IL); WMATA (Washington, DC) PATCO (Port Authority, Lindenwold, NJ)

## Slide 2



**INSTRUCTIONAL EVENT:** Gain attention

**TIME:** 10 minutes

**SAY:** There's an old story of six persons who, blindfolded, are led to an elephant. Their assignment was to figure out what it is that they cannot see. The one who just feels the trunk thinks an elephant looks like a snake. Other people who feel the different parts think the elephant is a fan, rope, spear, wall, tree, etc. What do you think this cartoon is illustrating here? Here's a short exercise for each of you. Come with a short statement that describes this image.

**DO:** Facilitate group discussion. You may suggest that one statement could be "Everyone should look at the big picture" or something similar. You may get some funny responses which will help relax participants and gain their attention to the course topic. Start the discussion with an example such as, Ask for a volunteer to write each participant's statement on a flipchart or presentation board. Then ask the participants to choose which statement, in their opinion, best summarizes the image.

**SAY:** These are certainly some good (and funny) statements. So this ONE statement is, in your opinion, best summarizes the image. My own statement is "**Troubleshooting is subjective**". <<CLICK TO ADVANCE SLIDE>> Why do you think I say that? In what ways does this quote (and even the image!) apply to troubleshooting rail car propulsion and dynamic braking systems?

**PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE:**

## Slide 5

**Troubleshooting Propulsion & Dynamic Braking Systems**

## Key Terms and Overview

- Train Control Management System (TCMS)
- Propulsion Control Logic
- Propulsion Control Unit

**MODULE 1** Troubleshooting Propulsion Systems

**Outline**

- 1.1 Overview
- 1.2 Propulsion Control Logic (Propulsion)
- 1.3 Diagnostic Software Layout
- 1.4 Master Controller
- 1.5 Propulsion Blower
- 1.6 Traction Motor
- 1.7 Brake Resistor
- 1.8 Summary

**Purpose and Objectives**

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

Following the completion of this module, participants will be able to:

- Troubleshoot master controller
- Troubleshoot Propulsion Control Logic
- Troubleshoot propulsion blower
- Troubleshoot braking resistor
- Troubleshoot traction motor

**Key Terms**

- Train Control Management System (TCMS)
- Propulsion Control Logic
- Propulsion Control Unit

**RAIL CAR TRAINING CONSORTIUM**

5

**INSTRUCTIONAL EVENT:** Present content.

**TIME:** 5 minutes

**SAY:** Here are some three key terms that we will use in this module. Each of these terms is defined in your coursebook. I am pretty sure at this stage you are already familiar with each of these three terms but, just to be sure, which one do you think needs further explanation?

**DO:** If a participant responds, ask others to help explain that key term and/or you explain it to them.

**SAY:** So this is how we're going to go this course. There are four main topics in this course. These are presented along with the most common reported problems with the rail vehicle's propulsion system. The topics are: Master Controller, Propulsion Blower, Traction Motors (AC and DC), and Brake Resistor. Within each of these four topics, this course presents a typical troubleshooting table with symptom, probable cause, tests and checks, and corrective action. **While these tables are useful, they are not detailed.** They should be used to encourage the participant to examine symptoms from many angles as well as to stimulate discussion and participation in the classroom and during the hands-on demonstration of the learning objectives.

**PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE:** 2

## Slide 6

Troubleshooting Propulsion & Dynamic Braking Systems

Overview

What is the purpose of troubleshooting?

RAIL CAR TRAINING CONSORTIUM

6

**INSTRUCTIONAL EVENT:** Recall of prior learning

**TIME:** 5 minutes

**SAY:** From previous courses and experience, what do you already know about troubleshooting? What is the purpose of troubleshooting?

**DO:** Ask participants the question on the slide. Encourage discussion. If they completed in Course 300 *Troubleshooting Principles* encourage them to draw up on what they learned in that course. Allow participants to think about their answers for 30 seconds to 1 minute.

**Answer:** The purpose of troubleshooting is to systematically detect faults and to identify components that need to be repaired or replaced.

**PARTICIPANT GUIDE PAGE REFERENCE:** 2

## Slide 9



**INSTRUCTIONAL EVENT:** Application Feedback

**TIME:** 45 minutes

**SAY:** It is time for a small group exercise.

**DO:** Give each participant a printout of **303 Learning Application 1A PATCO PBECU System**.

**SAY:** Let us examine a Propulsion Logic Control system software that is used by PATCO, the Port Authority Transit Corporation, which operates between Philadelphia, PA, and Camden, NJ. I am going to give each of you your own copy of sections from PATCO's manual which describes how to use PATCO's Propulsion and Brake Electronic Control Unit (PBECU). **Don't worry, the objective is NOT to learn specifics of this system.** Rather, I'd like us to read this and discuss some **main concepts** and **take aways** on how we approach diagnostic troubleshooting. You're going to work in teams of 2 or 3. So let's count off by 1, 2, 3.

**DO:** The first participant counts 1, the next 2, the third 3. The next person starts with 1, etc. Once everyone has counted off, suggest that all the 1's huddle together, all the 2's together, and all the 3's together.

**SAY:** In your groups, each person should read the packet I just handed you. Once you've all read this, discuss the answers to **Learning Application 1A** found on page 4 of the participant guide. Be prepared to present your findings to the entire group.

**DO:** Allow 30 minutes for participants to read and discuss the answers in the exercise. After 30 minutes ask the entire group if they are ready to report on their findings. If they are not, ask them if they need another five minutes. Once all groups are ready, ask Group 2 to report their findings on Questions 1-3. Ask Group 3 to report on Questions 4-6. Ask Group 1 to report on Questions 7-9. Then ask the entire group to suggest the possible responses or answers to Question 10. Encourage discussion among participants.

**PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE:** 4-5



## Propulsion Blower

Slide 14

Troubleshooting Propulsion & Dynamic Braking Systems			
Propulsion Blower			
SYMPTOM	PROBABLE CAUSE	TESTS AND CHECKS	CORRECTIVE ACTION
Blower does not run	No power to motor caused by breaker or severed wiring.	Check for voltage at the motor.	If no voltage present reset breaker. Repair damaged wiring.
	Defective wiring	Check for voltage of the motor	If voltage is present, replace motor.
Blower is noisy	Mounting hardware is loose.	Check for tightness	Tighten mounting hardware to specified torque.
	Blades are unbalanced	Check for dirt build-up on blades.	Clean blades.
	Blower is rubbing against housing.	Check clearance between blower and housing and examine for bearing failure.	Replace blower fan or bearings.
	Blower bearing is damaged	Rotate blower by hand to detect bent motor shaft and listen for excessive bearing noise.	Replace blower bearings, shaft or entire blower motor.
Blower is not cooling sufficiently	Inlet or exhaust ducts are blocked.	Remove screens and open ducts to check for debris or obstacles.	Clear inlet and exhaust screens, ducts and filters.
Blower rotation is in the wrong direction	Improper wiring	With power removed, check wiring with an ohm meter. Refer to wiring diagram.	Change wiring connections.

RAIL CAR TRAINING CONSORTIUM 14

**INSTRUCTIONAL EVENT:** Present new content.

**TIME:** 30 minutes

**SAY:** This chart on possible symptoms with the propulsion blower is on page 8 in your Participant Guide. Lets go through each of these symptoms and their cause, tests, and corrective actions, together. If there are additional notes to what is here and in your Participant Guide, please jot them down in the appropriate column.

**DO:** Address each of these symptoms with as much participation as possible. If you have a personal story with a difficult troubleshooting situation involving the propulsion blower (ventilation) system that no one could figure out, please relate it.

**PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE:** 8

**NOTE:** This lesson is greatly enhanced with agency-specific references such as on-line manuals, job bulletins, and the like.


Slide 16

Troubleshooting Propulsion & Dynamic Braking Systems

## AC Traction Motors

### Sensory Inspection

1. Visual
2. Auditory
3. Smell
4. Touch



RAIL CAR TRAINING CONSORTIUM 16

**INSTRUCTIONAL EVENT:** Present content. Application feedback

**TIME:** 15 minutes


**SAY:** Now I know we approach problem solving with at least these four senses: visual, auditory, smell, and touch. What's the fifth sense? That's right, it is **taste**. That's one sense I hope we don't use too much around here (laugh). Anyway, what I want us to do look at the charts on pages 9-14 in your Participant Guide. They all relate to symptoms (and probable cause, tests and checks, and corrective actions) for AC traction motors. Most of these symptoms are visual, would you agree? Good. Which ones do you think pertain to smell? **[CLICK TO ANIMATE SLIDE]**

**DO:** Allow participants to look through the pages. They will likely choose **Scorched Smell** on page 11. Have a volunteer read the first probable cause, and then the recommended tests and checks, and then the corrective action. Ask everyone if they agree with the corrective action and if there are other things they can add. Have a second volunteer read the second probable cause for Scorched Smell.

**PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE:** 9

## Brake Resistors

Slide 21




Troubleshooting Propulsion & Dynamic Braking Systems

### Brake Resistors

#### Common Symptoms

- Insulation loss
- Overheating



RAIL CAR TRAINING CONSORTIUM 21

**INSTRUCTIONAL EVENT:** Present content

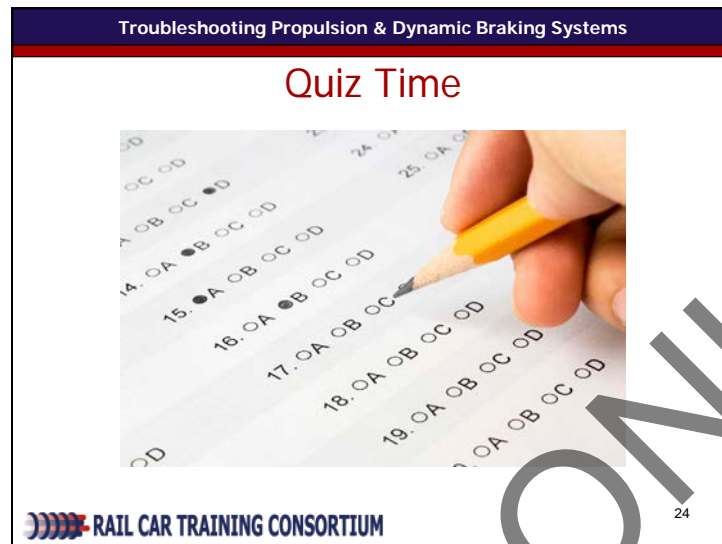
**TIME:** 5 minutes

**SAY:** Common reported symptoms with brake resistors are insulation loss and overheating. Do you agree? What other **common** symptoms are usually associated with brake resistors.

**DO:** Read each bullet. Encourage discussion and add your own insight/experience with common symptoms of brake resistors

**PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE:** 18

Slide 24



**INSTRUCTIONAL EVENT:** Assess performance

**TIME:** 12 minutes

**SAY:** It's time to take a quiz.

**DO:** Provide quizzes to participants

**PARTICIPANT GUIDE PAGE REFERENCE:** N/A