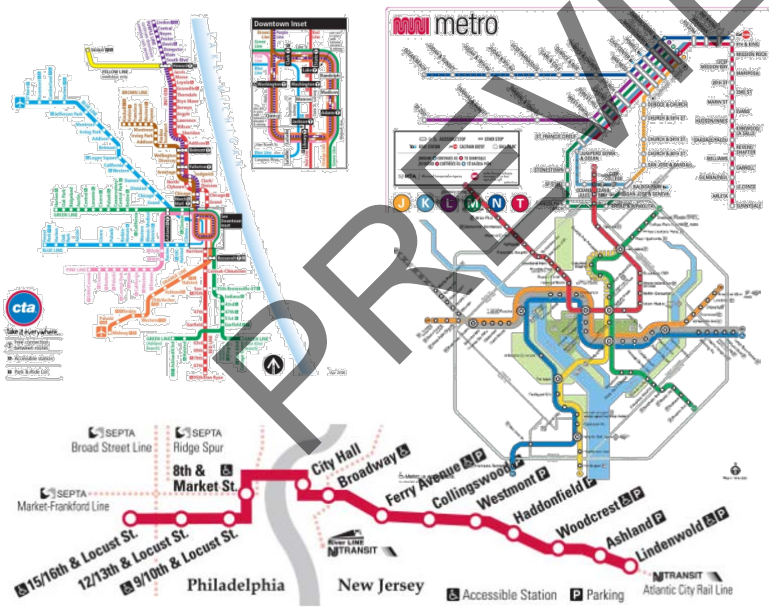
Troubleshooting Propulsion and Dynamic Braking Systems

Course 303



PARTICIPANT GUIDE

RAIL CAR TRAINING CONSORTIUM

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MODULE 1

Troubleshooting Propulsion Systems

Outline

Purpose and Objectives

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.

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

Key Terms

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

1-2 PROPULSION CONTROL LOGIC DIAGNOSTICS

Though the monitoring and detecting capabilities of the propulsion control logic vary by rail car configuration, most include:

- Monitoring capability: real-time, sensor-based monitoring of performance and condition.
- Fault judging capability: real-time assessment of whether subsystems are operating within normal parameters and performance.
- Diagnostics capability: the system has the ability to identify common and likely causes of abnormal performance.

This course uses the term **Propulsion Control Unit** or PCU[1] to describe the container for the rail vehicle's propulsion control logic. The PCU contains programmable logic controller (PLC) devices and input/output boards or modules on to which portable test equipment (PTE), such as a laptop, can be connected to check or diagnose the train's propulsion systems.

The maintainer can generate data logs and fault logs using an application designed to interface between the PCU and the PTE as illustrated in Figure 1.1.

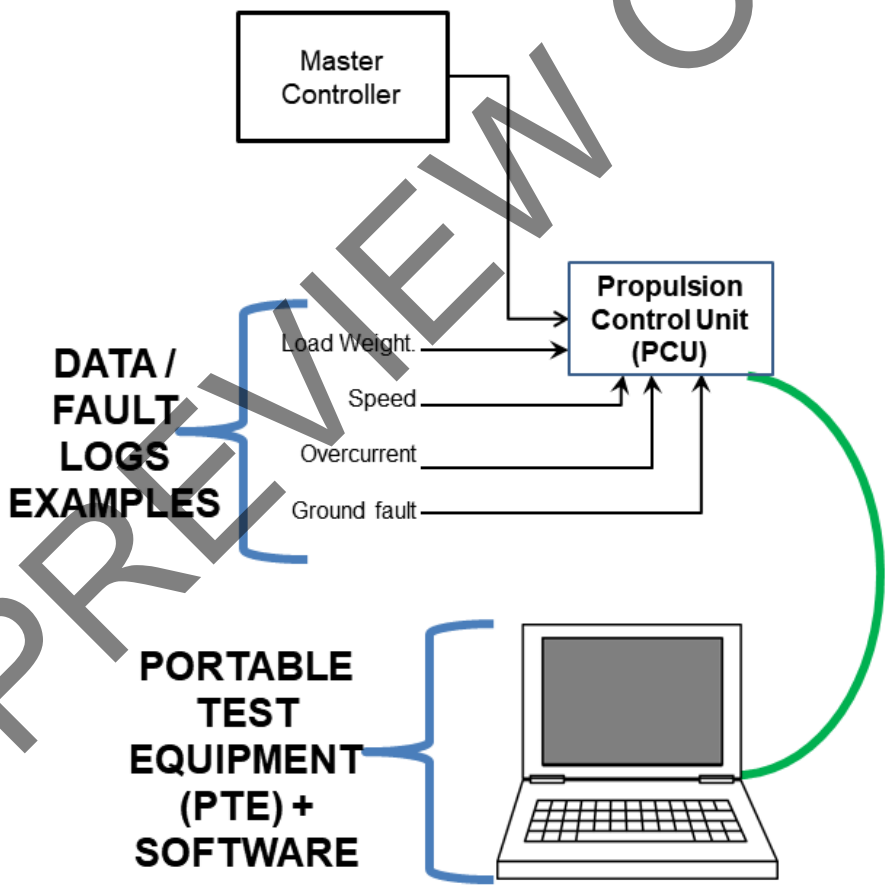

Figure 1.1 Propulsion Control Logic Diagnostic System

[1] Some agencies use the term Vehicle Control Unit or VCU.

1-5 PROPULSION BLOWER

This section describes some recommended ways to identify and resolve some common reported malfunctions of the rail car's propulsion blower system. Remember to observe all agency safety procedures. Some checks will require that dangerous voltage be present during troubleshooting, be sure to follow your agency's safety and Lock-Out Tag-Out procedures. Before attempting any actual repairs of the propulsion blower, disable all power to the rail vehicle.

Propulsion Blower Troubleshooting

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.

AC Traction Motor Troubleshooting, continued			
SYMPTOM	**PROBABLE CAUSE**	**TESTS AND CHECKS**	**CORRECTIVE ACTION**
Local overheating	Soldered joint between cable lug and coil connector is loose.	Move out the rotor with the bearing shield (N-end) and check the soldered joint	• If necessary, replace the cable lug and renew the soldered joint between the cable lug and the coil connector
	Winding insulation damaged. Cause could be due to foreign bodies in the motor.	Check the insulation resistances	• Repair per OEM recommendation
	Bearing dirty	Remove the bearing cover. Check the bearing seal	• Replace the bearing • Re-grease • Replace bearing seal if necessary
	Incorrect bearing clearance	Lift the shaft and measure the clearance with dial or feeler gauge	• Install a bearing with the correct clearance, check the seating.
	Bearing seized. Failure of lubrication. Excessive loading	Remove the bearing cover, check for discoloration or deformation.	• Repair or replace per OEM recommendation
	Cooling ducts blocked in motor		• Clean the ducts
	Air inlet blocked		• Check and clear the air inlet

AC Traction Motor Troubleshooting, continued			
SYMPTOM	**PROBABLE CAUSE**	**TESTS AND CHECKS**	**CORRECTIVE ACTION**
Smoke development	Bearing seized. Failure of lubrication. Excessive loading	Remove the bearing cover, check for discoloration or deformation.	• Repair or replace per OEM recommendation
	Shaft bent. Stator / rotor core assembly, stator winding, shaft accessories (e.g. internal fan for speed sensor)	Can be determined only after dismantling	• Repair or replace per OEM recommendation
Scorched smell	Connecting lead damaged	Check the connecting lead	• Replace the lead
	Winding insulation damaged	Check the winding resistances, check the insulation resistances, measure the impedance	• Repair per OEM recommendation
Humming noise	Connecting lead interrupted	Check the connecting lead	• Replace the lead
	Terminal loose	Open the terminal box and check the terminals	• Fasten terminal, replace cable lug if necessary
Rubbing noise	Incorrect bearing clearance	Lift the shaft and measure the clearance with a dial gauge	• Install a bearing with correct clearance. Check the seating.
Knocking noise	Internal fan for speed sensor loose	Remove the cover, check the seating connection.	• Secure the speed sensor
	Current flow at bearing		• Determine cause of current flow and take suitable steps per OEM recommendation

AC Traction Motor Troubleshooting, continued			
SYMPTOM	**PROBABLE CAUSE**	**TESTS AND CHECKS**	**CORRECTIVE ACTION**
Radial vibrations, cont'd	Motor suspension broken	Check the suspension	• Localize consequential damage including shaft bearing, gear coupling to motor
Axial vibrations	Incorrect bearing clearance	See earlier tests and checks.	• See earlier corrective action recommendations.
	Bearing damage	See earlier tests and checks.	• See earlier corrective action recommendations.
	Motor suspension loose or broken	See earlier tests and checks.	• See earlier corrective action recommendations.
Machine loses torque	Connecting lead interrupted	Check the connecting lead	• Replace the lead
	Soldered joint between cable lug and coil connector is loose.	Move out the rotor with the bearing shield (N-end) and check the soldered joint	• If necessary, replace the cable lug and renew the soldered joint between the cable lug and the coil connector
Motor running unevenly	Soldered joint between cable lug and coil connector is loose.	Move out the rotor with the bearing shield (N-end) and check the soldered joint	• If necessary, replace the cable lug and renew the soldered joint between the cable lug and the coil connector
Varying speed signals	Lead to speed sensor interrupted	Check the lead, check the plug connections	• Replace the lead, repair the plug connections
	Speed sensor loose or defective	Check fastening. Check seals	• Secure the speed sensor. • Replace if defective

DC Traction Motors

The following table lists some of the common problems when troubleshooting DC traction motors. Brush sparking and flashovers are common symptoms with DC traction motors.

DC Traction Motor Troubleshooting			
SYMPTOM	**PROBABLE CAUSE**	**TESTS AND CHECKS**	**CORRECTIVE ACTION**
Discoloration of bearing cap (excessively hot bearing cap)	Lack of lubrication.	Check for damage to bearing and labyrinth seals.	• Replace defective parts. Re-lubricate.
	Bent shaft	Check for cause	• Replace shaft
	End thrust	Check for cause	• Replace defective parts
	Rough bearing	Check for damaged bearing	• Replace bearing
No motor output torque	Worn, chipped, or broken brushes		• Replace brushes
	Winding insulation failure		• Replace motor
	Bad commutator		• Replace motor
	Bad connection	Check terminations for tightness	• Tighten terminations per OEM recommended torque. Replace cabling if necessary.
	Low brush pressure		• Replace brush-holder.
Excessive heat being generated between the motor lead and vehicle wiring	Loose connections		• Inspect hardware, replace if needed. Install screws using OEM recommended hardware locking technique and tighten to specified torque.

	Short or broken brushes	Check commutator runout. Grind if out-of-round	• Replace brushes

DC Traction Motor Troubleshooting, continued

SYMPTOM	PROBABLE CAUSE	TESTS AND CHECKS	CORRECTIVE ACTION
Flashover, continued	Weak, damaged brush-holder springs		• Replace brush holders
	Dirty brush-holders		• Clean per OEM
	Dirty commutator V-ring extensions (string band)		• Clean per OEM
Other?			•
Other?			•
Other?			•

Source: Heavy Repair Manual for LRV, NFTA

1-8 SUMMARY

Troubleshooting is an integral part of rail car maintenance work. This module reviewed computer-aided diagnostic systems that are commonly used to localize faults with the rail car Propulsion and Dynamic Braking system. This module also presented some common troubleshooting scenarios that the rail car technician can analyze and apply to similar situations at their transportation agency. The classroom activities in this module helped the participant enhance the approach to troubleshooting common Propulsion and Dynamic problems, identifying likely causes, and taking steps to resolve the problem.