

Course 304

Auxiliary Power Supply and Battery Systems Troubleshooting and Repair

Module 1: Troubleshooting APS Systems

INSTRUCTOR GUIDE

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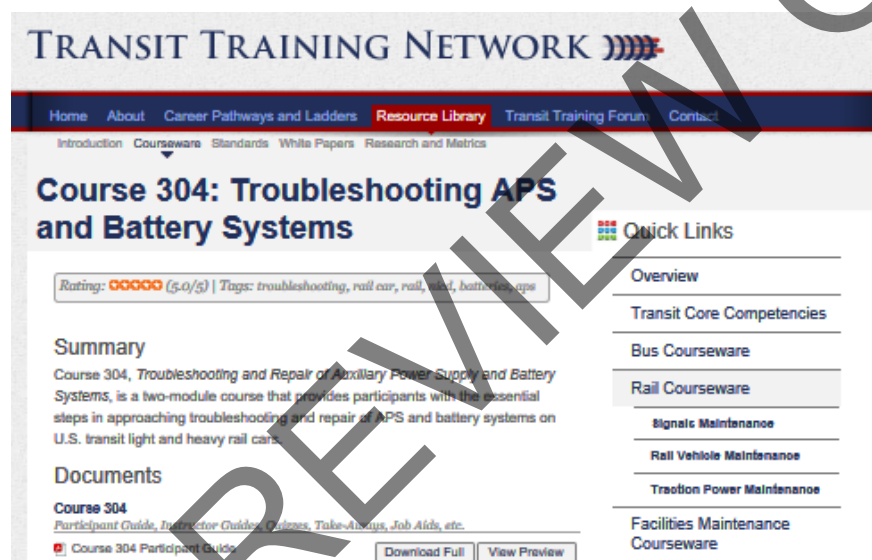
PREVIEW ONLY

- If you have access to your agency's Maintenance Management Software or diagnostic software, find examples of reported problems that were tracked back to lost phase situations. You will need this to demonstrate to participants in Slide 27.
- Find a troubleshooting decision tree similar the one on page 21 of the Participant Guide in one of the rail car and APS manuals used at your agency. Make copies for each participant. They will need it for an activity on Slide 30.

All materials can be downloaded from www.transittraining.net. Click this [link](#).

- Click on the **Resource Library** tab.
- In lower right under **Useful & Helpful Links** click on **Courseware**.
- In middle right under **Quick Links** click on **Rail Courseware**.
- Click on **Rail Vehicle Maintenance**.
- Scroll down to **Course 304: Troubleshooting APS and Battery Systems**

Follow relevant links to download files.

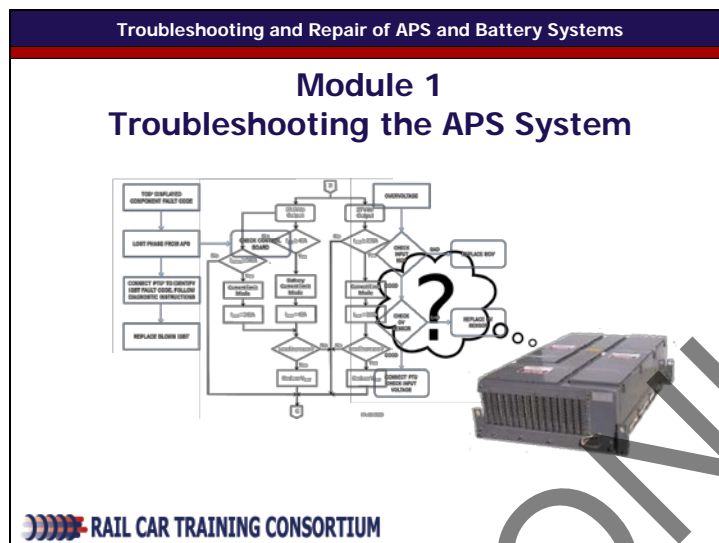


1 Screen Print of Transit Training Network

Overview to Module 1

- Duration of this module: 366 minutes (6 hours 5 minutes)
- PowerPoint slides: 33
- This module has a quiz for participants.

Slide 1



INSTRUCTIONAL EVENT: Gain attention

TIME: 1 minute

SAY: Welcome to Course 304: *Troubleshooting and Repair of Auxiliary Power Supply and Battery Systems*. Course 304 has two modules. Module 1 provides you with an overview to troubleshooting auxiliary power supply systems on rail cars within the context of general troubleshooting and best practices. We will have knowledge checks throughout this class as well as a quiz at the end.

DO: Make sure that each participant has a coursebook. 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.

Last edited by AHJ 4/4/2-17 @ 4:47 PM

Slide 5

Troubleshooting and Repair of APS and Battery Systems

Key Terms

COURSE 304: TROUBLESHOOTING AND REPAIR OF APS AND BATTERY SYSTEMS
MODULE 1: TROUBLESHOOTING AND REPAIR

MODULE 1
Troubleshooting the APS System

- Line Replaceable Unit (LRU)
- Portable Test Equipment (PTE)
- Portable Test Unit (PTU)
- Troubleshooting

Outline

- 1.1 Overview
- 1.2 Computer Aided Diagnostics
- 1.3 Line Replaceable Unit
- 1.4 Common Electrical Problems with APS
- 1.5 Advanced APS Troubleshooting
- 1.6 Summary

Purpose and Objectives

The purpose of this module is to provide participants with a series of troubleshooting exercises that will enable them to identify and correct common electrical problems with APS systems.

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

- Explain the use of computer aided diagnostics
- Recognize and replace the APS components
- Troubleshoot common electrical problems with the APS system, including the APS, the APS, and the APS
- Apply troubleshooting principles to the APS system
- Apply troubleshooting principles to other APS components

Key Terms

- Line Replaceable Unit (LRU)
- Portable Test Equipment (PTE)
- Portable Test Unit (PTU)
- Troubleshooting

RAIL CAR TRAINING CONSORTIUM

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INSTRUCTIONAL EVENT: Present content.

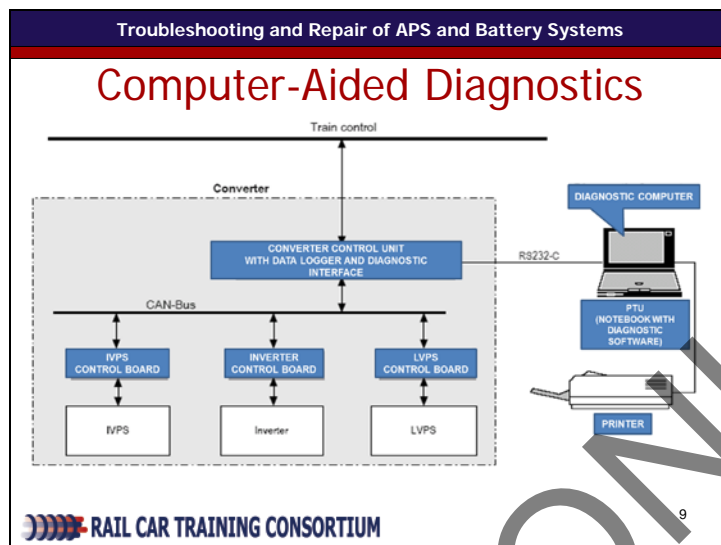
TIME: 3 minutes

SAY: Here are some key terms that we will use in this module. Each of these terms is defined in your coursebook. Have a look at these terms. Turn to page 1 of your coursebook and circle those terms you would like to know more about. If you participated in the previous course, Course 204 on inspection and maintenance of APS systems, you would be familiar with some of these terms.

DO: Encourage participants to actively seek terms they may not completely understand or know about. Give participants time to read through the key terms and circle them. If time permits, ask participants to share some of the key terms they circled.

PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE: 1

Slide 9



INSTRUCTIONAL EVENT: Present new content.

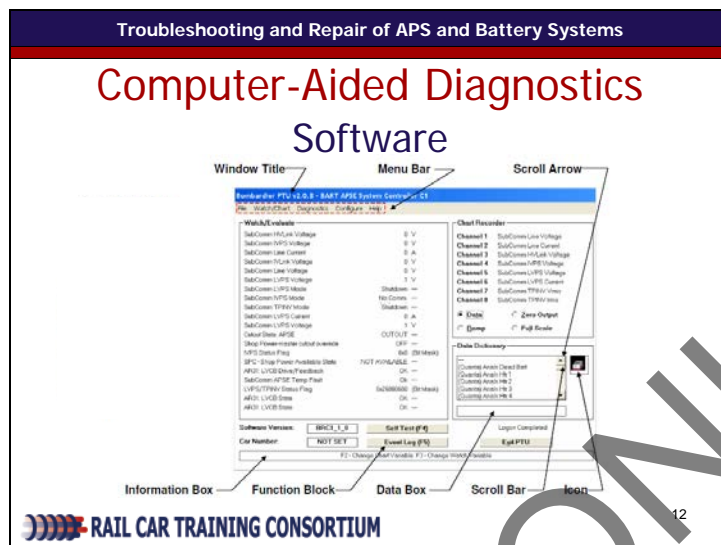
TIME: 10 minutes

SAY: Here is a layout of a computer-aided diagnostic system. It is similar to our system here at agency name in that we have compare your system to the one illustrated here. Now let us see if you can tell where the four sections. Close your coursebook (Participant Guide) for a moment. Now, based on the four sections I asked you to write down earlier, where do you think each section applies to this layout.

DO: Encourage discussion. Ask each learner to write **put each number – 1, 2, 3, 4 – on each sticky note** and put that note where on the projected chart where they think it should be. Learners may have more than one notes of 1s, 2s, 3s, 4s. Once they are satisfied with their placement on the projected chart, ask them to return to their seats. Advance slide.

PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE: 3

Slide 12



INSTRUCTIONAL EVENT: Present new content

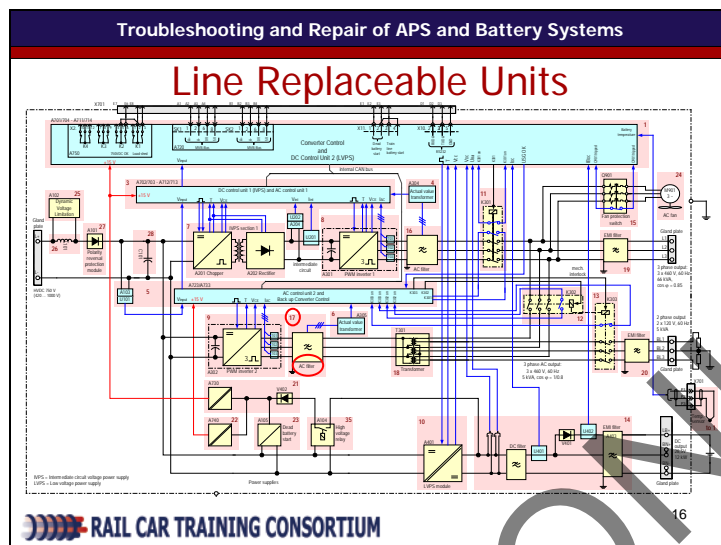
TIME: 5 minutes

SAY: The controller board relays information via some kind of diagnostic visual display software. Here at _____ (your agency) we use _____ (name of software). This image that is shown here is used by BART in San Francisco and is developed by Bombardier which is also the manufacturer of their APS. In many cases the manufacturers or OEMs develop their own diagnostic software product.

DO: Ask learners to open their coursebooks to page 4 where there is a Classroom Activity at the bottom of the page. On a display board, write the name of the diagnostic software used at your agency and ask learners to write this information down in their coursebooks.

PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE: 4

Slide 16



INSTRUCTIONAL EVENT: Present new content. Provide learning guidance. Application feedback

TIME: 10 minutes

SAY: This diagram looks complicated, doesn't it? Well, let's break it down. This is a schematic that identifies all LRUs in a Siemens™ APS system in use by the Charlotte Area Transit System. Each LRU on this diagram is shaded with a salmon-color (pink?) around it. **ADVANCE TO SHOW ANIMATION AROUND THE "17."** That number is tracked in the agency's computer-aided diagnostic system and corresponds to an LRU. Should a fault with the number "17" appear on the PTU, it is traced to the LRU. Can you tell which LRU?

DO: Ask for a volunteer to go to the projected screen, point to the animated "17" and trace the component to the AC filter. **ADVANCE TO SHOW ANIMATION AROUND THE "AC FILTER."**

PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE: 9

Slide 21

Troubleshooting and Repair of APS and Battery Systems

Troubleshooting Common Reported Problems

Replacing a Fan Blower on an APS

 **PLAY**

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INSTRUCTIONAL EVENT: Provide learning guidance

TIME: 10 minutes

SAY: Let's have a look at a video of technicians removing and installing a fan blower unit in a rail car's APS system.

DO: Play video provided by Rail Car Training Consortium. After video, facilitate discussion by guiding participants on similarities and differences between the procedures in the video and those used in your agency.

OTHER: Video link is embedded in slide and available here on Vimeo here <https://vimeo.com/191561949>. Type in "railcar" for the password

PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE: 11

Slide 25

Troubleshooting and Repair of APS and Battery Systems

Troubleshooting Common Reported Problems

Classroom Activity – Sympathy Overload

Case Study 1.2: Bay Area Rapid Transit (BART)	
Sympathy Overload	
RED	Occasionally a car will be reported as having an overload even though there has been no actual equipment failure on the car. This is known as a sympathy overload. Sympathy overloads are the result of transient voltages on the third rail caused by a legitimate overload on another car in the consist or on a car in a nearby consist.
GREEN	Sympathy overloads can also be the result of short circuits on the third rail from shopping carts or other metallic debris. A short circuit can cause an abrupt drop in third rail voltage. The filter capacitors on the car in the overload are feeding into the short circuit as indicated by the line current which is negative.
PURPLE	When the fuse blows on the nearby car, which had the initial short circuit, the third rail voltage suddenly rises. Now the line current becomes positive into the car in the download. This positive current comes from the recharging of the filter capacitors but also for another reason. The C-Car propulsion logic will fire the T5 thyristor in the propulsion mode anytime the third rail voltage goes above 1500 volts in order to clip the transient voltage by dissipating some of the transient energy in the R5 braking resistor. However, in this case, the additional current into the car caused the OLA to momentarily open the auxiliary contacts although the relay did not latch.
BLUE	In extreme cases of sympathy overloads, equipment damage can occur on the affected car in the form of blown filter capacitors, shorted thyristors and diodes and traction motor flashovers.
Source: BART's C-Car Manual	

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INSTRUCTIONAL EVENT: Provide learning activities (Application Feedback 2)

TIME: 20 minutes

SAY: This time for a classroom activity we are going to look at a case study from BART. Turn to page 15 in your course book. For this exercise, I am going to divide the class into four groups: Red, Green, Purple, and Blue. Each group will take a portion of this case study, discuss it (I will give you some sample topics to discuss), then report back to the entire class. You will therefore need to select the person from your group who will report back to the class. Some background to this case study: BART's collected power is sourced from the third rail. Our system is sourced from _____ (catenary, for e.g.). OK, now form yourselves into four groups.

DO: Once participants have organized themselves into four groups, assign a color (Red, Green, Purple, and Blue) to each group. You can refer to them as "red team", "green team", etc.

SAY: Red team, you will work on paragraph 1 **[ADVANCE TO SHOW RED RECTANGLE AROUND FIRST PARAGRAPH]**. Green team, you will work on paragraph 2 **[ADVANCE]**.

Purple team, don't worry. You are getting just the first part of the third paragraph. **[ADVANCE]** And finally, Blue team, you get the last paragraph. **[ADVANCE]**

DO: Give participants about a few minutes to organize themselves. Answer questions they may have about which paragraph they will be working on. Tell them that you are about to suggest some discussion questions will be on the next slide.

OTHER:


PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE: 15

Slide 27

Troubleshooting and Repair of APS and Battery Systems

Troubleshooting Common Reported Problems
Classroom Activity – Lost Phase

Lost Phase Troubleshooting Note Record	
Initial Description of Complaint:	Describe the problem (plan, investigate, fix, test, document, report).
Other Available Information:	Describe the problem (plan, investigate, fix, test, document, report).
All Possible Causes:	Describe the problem (plan, investigate, fix, test, document, report).
Task to Perform:	Describe the problem (plan, investigate, fix, test, document, report).
Actual Resolution:	Describe the problem (plan, investigate, fix, test, document, report).



RAIL CAR TRAINING CONSORTIUM

27

INSTRUCTIONAL EVENT: Provide learning guidance (Application Feedback 1)

TIME: 20 minutes

SAY: Using the Lost Phase Troubleshooting Note Record found on page 16 and 17 of your course book, let us discuss some of the likely findings and resolution to a lost phase situation in the rail car's auxiliary power supply system. In the space below the notes in each row, write down comparable information pertinent to your agency..

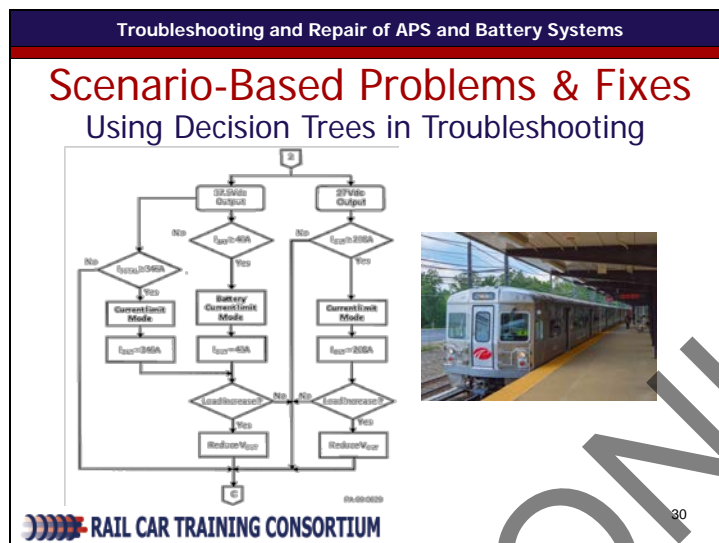
DO: Do this exercise with the entire class encouraging discussion. Once the class settles on a good answer for each row on the Lost Phase Troubleshooting Note Record, encourage them to write that answer in their Participant Guide before moving on to the next row.

DO: If available, share printouts of maintenance records that showed that the reported problems were tracked back to lost phase situations.

OTHER: If anyone asks, the photo is of a CTA vehicle (Chicago Transit Authority)

PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE: 16

Slide 30



INSTRUCTIONAL EVENT: Provide Feedback. Application Feedback 3.

TIME: 20 minutes

SAY: Please turn to page 20 of your Participant Guide (coursebook). This is a short circuit decision algorithm is a sequence of actions to be performed when trying to solve a problem. In this case, this diagram helps the rail car technician to follow the sequence of actions that the LVPS is programmed to take in case there is a short circuit. What happens when the short circuit condition continues?

DO: Allow enough time for participants to read the case study text on page 21. Then ask a volunteer to go to this projected slide at the front of the classroom and trace the sequence of operation while the other participants guide him as they read the text.

PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE: 20-21