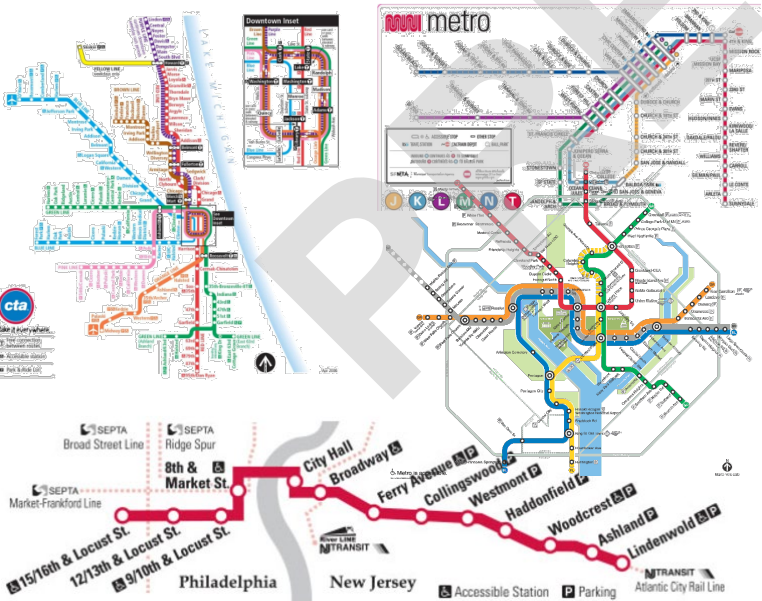


# Troubleshooting Current Collection Systems

Course 307



## PARTICIPANT GUIDE

 RAIL CAR TRAINING CONSORTIUM

## HOW TO USE THE PARTICIPANT GUIDE

### Purpose of the Course

Course 307 *Troubleshooting and Repair of Current Collection Systems* provides participants with essential steps to approach troubleshooting and repair of current collection systems specifically pantograph and third rail.

### Approach of the Book

Each course module begins with an outline, a statement of purpose and objectives, and a list of key terms. The outline will discuss the main topics to be addressed in the module. A list of *key terms* identifies important terminology that will be introduced in this 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. *Exercises* are built in throughout the course materials to assist the participants in learning and reviewing key information.

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# MODULE 1

## *Overhead Catenary Systems*

### Outline

- 1-1 Overview
- 1-2 Troubleshooting the Pan Head
- 1-3 Troubleshooting Raising and Lowering of Pantograph
- 1-4 Troubleshooting Lower and Base Frames
- 1-5 Troubleshooting No Power to Pantograph
- 1-6 Summary

### Outcome and Objectives

Participants will be able to apply to troubleshoot common problems overhead catenary power collection systems on a passenger rail vehicle.

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

- Identify steps to troubleshoot pantograph collector head
- Identify steps to troubleshoot electrical lowering device
- Identify steps to troubleshoot manual lowering device
- Identify steps to troubleshoot frame including insulated mounts and bearings
- Identify steps to troubleshoot raising mechanism (springs)

## 1-1 OVERVIEW

Like all troubleshooting courses in the Rail Car Training Consortium series, this course on troubleshooting current collection 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. Troubleshooting in that course 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 overhead catenary systems, specifically pantographs, 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 troubleshooting to the rail vehicle’s overhead catenary systems. You are therefore encouraged to draw on your own experiences as you go through this module on pantographs.

Because there are so many variances in rail car types and systems, this module cannot be a one-size-fits-all module on troubleshooting pantographs on all rail cars. Rather, the goal of this module is to highlight common troubleshooting scenarios that the rail car technician can analyze and apply to similar situations at his or her transportation agency. For the participant therefore, the approach to this course should be that of potentially reproducing the problem, applying their agency’s tools to the problem, and finally synthesizing their knowledge and skills.

Three sections in this module cover common reported problems with the rail vehicle’s pantograph:

1. Pan head
2. Raising and Lowering
3. Other major components

Within each of these three topics, this module presents a typical troubleshooting table with four columns:

- Symptom
- Probable cause
- Tests and checks
- Corrective action

Troubleshooting the Component			
SYMPTOM	PROBABLE CAUSE	TESTS AND CHECKS	CORRECTIVE ACTION

Figure 1.1 Outline of Sample Troubleshooting Table

MODULE 1: OVERHEAD CATENARY

Troubleshooting excessive arcing can involve a number of checks as the flow chart in Figure 1.2 shows.

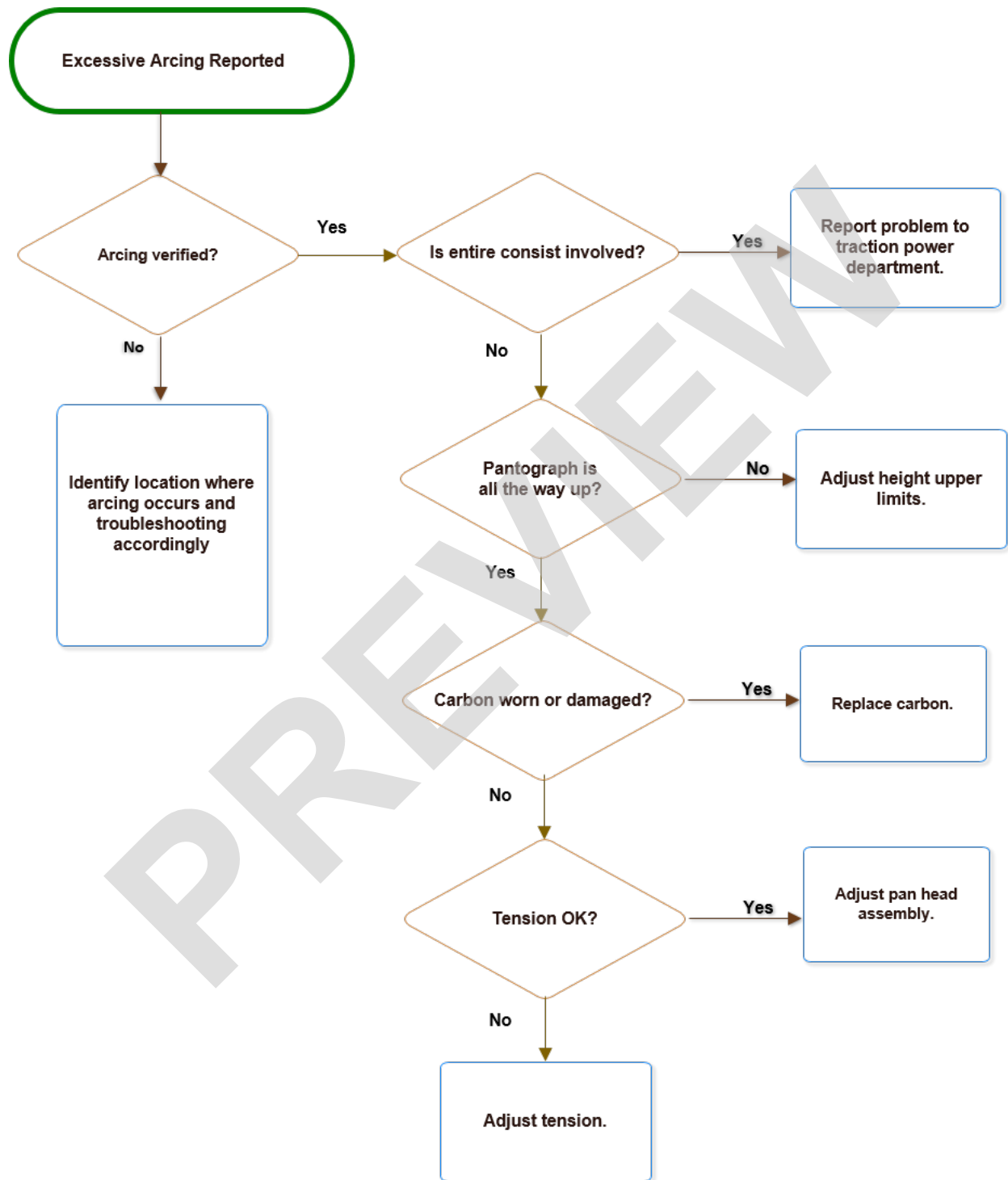


Figure 1.2 Decision Tree for Troubleshooting Excessive Arcing

### 1-3 RAISING AND LOWERING OF PANTOGRAPH

Subject matter experts agree that the most common problems reported with the pantograph involve its raising and lowering. Pantographs can be lowered electrically or pneumatically depending on their design. In the absence of electrical or pneumatic power, pantographs are lowered manually.

Raising/Lowering Pantograph Troubleshooting Table			
SYMPTOM	PROBABLE CAUSE	TESTS AND CHECKS	CORRECTIVE ACTION
Pantograph does not raise or lower by vehicle control.	No current supply from the vehicle.	Test voltage level of vehicle batteries.	Replace defective batteries.
		Loose or damaged electrical connections.	Inspect electrical cabling for loose connections or damage.
		Inverter malfunction.	Check operation of inverter.
	The inner friction of the pantograph is too high.	Visually inspect pantograph for damage or obstruction.	Repair any damaged components. Clear any obstructions.
		Inspect upper frame and lower frame bearings for damage.	Replace worn or damaged bearings.
Broken or weak springs.	Inspect springs for damage.	Replace springs as necessary per OEM recommendations and agency practice.	
Pantograph raises or lowers slowly.	The inner friction of the pantograph is too high.	Visually inspect pantograph for damage or obstruction.	Repair any damaged components. Clear any obstructions.
		Inspect upper frame and lower frame bearings for damage.	Replace worn or damaged bearings.
	Friction in the motor flexible shaft is too high.	Check for proper routing of the flexible shaft and no sharp bends.	Correct cable routing problems as required.
Electrical lowering device stops in mid stroke. Clutch slips.	Motor overloaded.	Check pantograph for damage or binding condition.	Repair any damaged components per OEM recommendations and agency practice.
Electrical lowering device stops in mid stroke. Clutch does not slip.	Blown fuse or tripped circuit breaker.	Check fuse and circuit breaker.	Replace fuse or reset circuit breaker.
	Motor thermal breaker activated from overheating.		Allow motor to cool. Check duty cycle.



Pantograph Will Not Raise

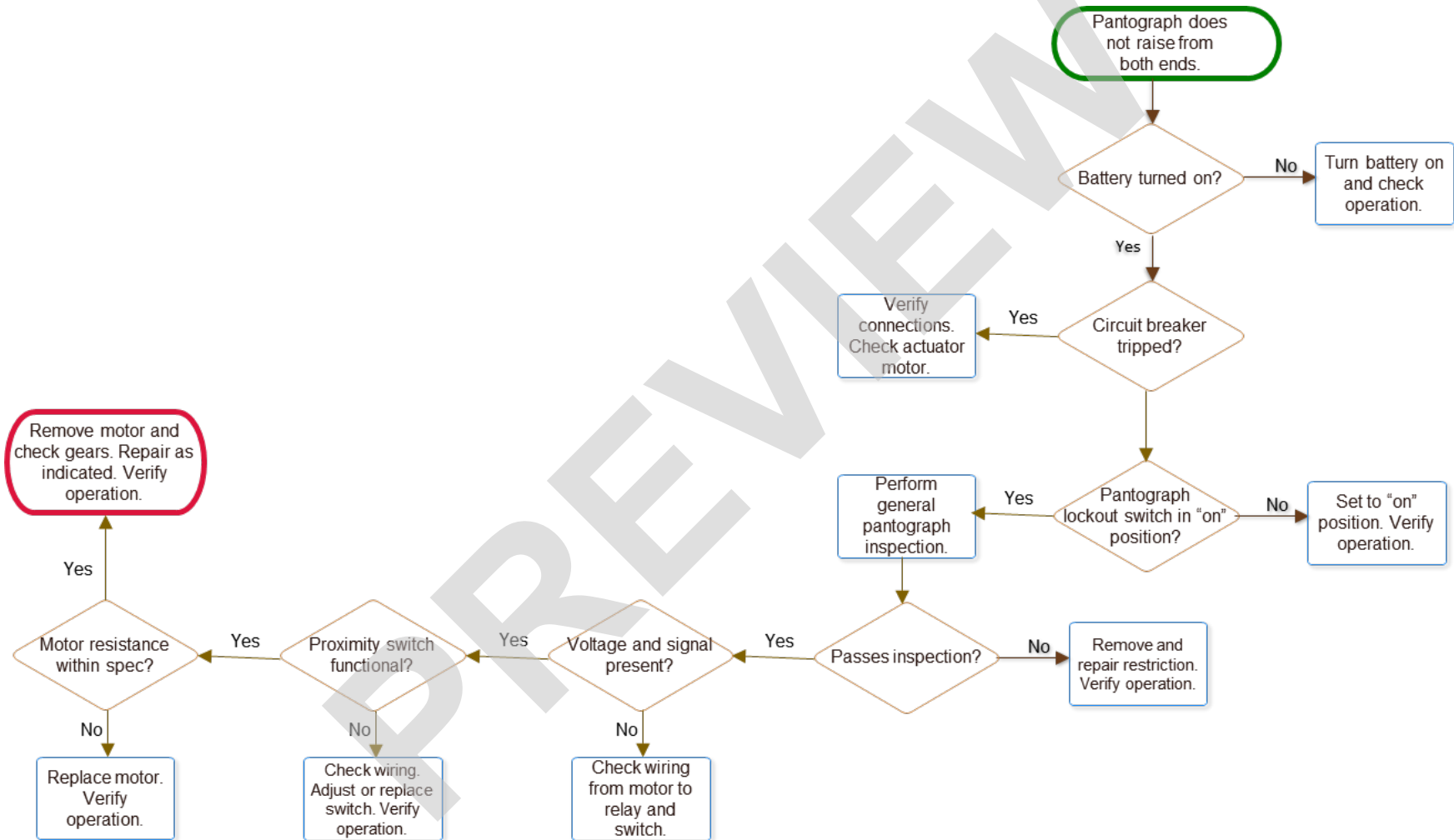


Figure 1.3 Flow Chart for Troubleshooting Pantograph Not Raising as Expected



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### Learning Application 1C

Whole class discussion:

For either the pneumatic or electrical lowering devices decision charts, what, in your opinion, may not have been addressed the decision trees for troubleshooting problems reported with raising or lowering the pantograph?

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Which step may be missing from either flow chart shown in Figure 1.4 or Figure 1.5?

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Which step would you exclude from either of these flow charts?

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PREVIEW

## 1-5 SUMMARY

Troubleshooting is an integral part of rail car maintenance work. This module outlined some of the common troubleshooting scenarios that the rail car technician can analyze and apply to similar situations at their transportation agency. The learning activities in this module helped the participant enhance the approach to troubleshooting common reported problems with the pantograph, identifying likely causes, and recommending corrective actions to resolve these reported problems.

PREVIEW

## MODULE 2

# Third Rail Systems

### Outline

- 2-1 Overview
- 2-2 Current Collector Assembly
- 2-3 Summary

### Outcome and Objectives

Participants will be able to apply the steps involved in inspecting, maintaining, and testing major components of the third rail power collection systems on a passenger rail vehicle.

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

- Troubleshoot collector paddle assembly.
- Troubleshoot loss of power to rail vehicle.

## 2-3 CURRENT COLLECTOR TROUBLESHOOTING

Third Rail Current Collector Troubleshooting Table		
SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Excessive paddle wear	Paddle pressure too high.	Adjust paddle pressure according to OEM recommendation and agency practice.
Arcing, pitting, or excessive burning of paddle.	Paddle pressure too low.	Adjust paddle pressure according to OEM recommendation and agency practice.
	Improper off-rail height.	Adjust off-paddle rail height according to OEM recommendation and agency practice.
Excessive paddle break-offs.	Paddle off-rail height too low.	Adjust off-paddle rail height according to OEM recommendation and agency practice.
Collector not picking up current	Blown fuse.	Replace fuse.
	Defective blown fuse indicator.	Replace blown fuse indicator
Trucking or flashover on mounting brackets, fuse box, or arc shield.	Parts need cleaning.	Clean according to OEM recommendation and agency practice.



### Learning Application 2B

With instructor guidance and using agency manuals, add other troubleshooting symptoms in the blank columns in the above chart. For each symptom, write in the probable causes and corrective actions in the corresponding blank rows.

Troubleshooting excessive arcing can involve a number of checks as the flow chart below (Figure 2.3) illustrates.

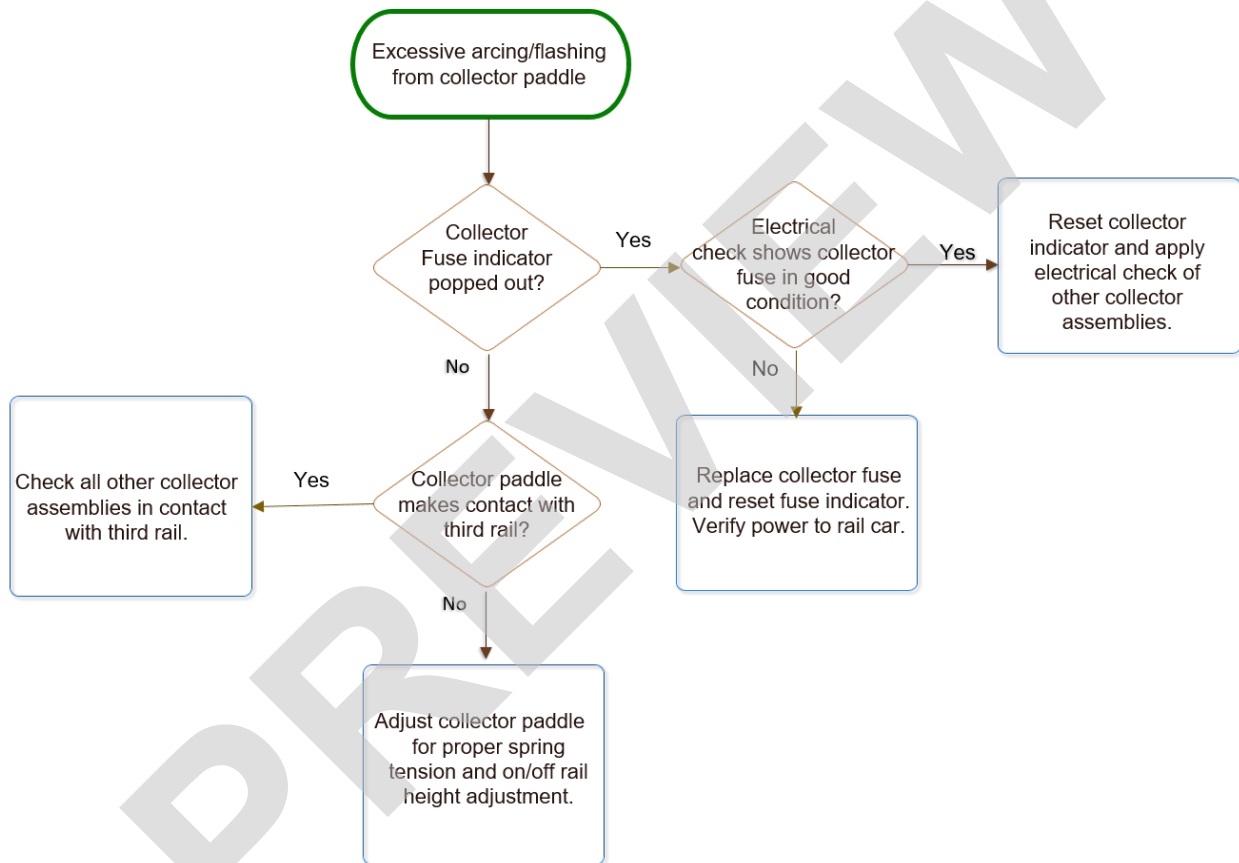


Figure 2.9 Flow Chart for Troubleshooting Excessive Arcing from the Collector Paddle