



***TRANSIT
WORKFORCE
CENTER***

Making Connections 2022

The National Transit Workforce Conference

December 13 – 14, 2022 • Washington, D.C.





Engines to Inverters:

Preparing Technicians for ZEB Deployment

Moderators:

Lisa Jerram
Sr. Director of Bus
Operations and New
Vehicle Technologies
APTA

James Hall
Program Manager of
Technical Training
ITLC

Panelists:

Joseph Gamez
Assistant Chief
Maintenance Officer
Maintenance Training
New York City Transit

Obed Mejia
Sr. Bus Equipment
Maintenance Instructor
LA Metro

Walter Kirkland
Service Manager
StarMetro

Dinero
Washington
General Manager
SporTran





ZEB Maintenance Training Curriculum



APTA and ITLC Collaboration working to create national ZEB Maintenance Training Curriculum

- To be published through APTA Standards program
- ITLC supported by FTA funding

Working group with labor and management participants

Process is open, transparent, collaborative

Creating a recommended practice that outlines learning objectives, skills and knowledge that technicians should acquire as a result of the training for battery electric and fuel cell electric buses

- Goal to complete work in 1st half of 2023

Engines to Inverters

Preparing Technicians for ZEB
(Planning Stage)

Making Connections 2022



December 13, 2022
New York City Transit



Joseph Gamez

Assistant Chief Maintenance Officer
Maintenance Training

**ULTRA LOW
SULFUR 2,947**

**EXPRESS
1,049**

**Fleet
5,903**

**HYBRID
1160**

AEB 15

CNG 732



Person Power

2,905

SUPERVISOR
496

MAINTAINERS
1,718

HELPERS
270

CLEANERS
421

Preparing Technicians for ZEB (Planning Stage)

✓ Evaluation

- ✓ OEM Plant Visits
 - ✓ Review protocols
 - ✓ Review manuals
 - ✓ Walk the line
 - ✓ Meet vendors and subs



**Michael J. Quill
Bus Depot
Manhattan**

Preparing Technicians for ZEB (Planning Stage)

✓ Evaluation/Training

- ✓ HV Specialist/Consultant
 - ✓ Arc Flash Training
 - ✓ Bus Assessment
 - ✓ Train the Trainer
 - ✓ Reviewed and approved Arc Flash Course



Preparing Technicians for ZEB (Planning Stage)

✓ HR – Exams (New Hire – Promo)

- ✓ Written
- ✓ Practical





Preparing Technicians for ZEB (Planning Stage)

- ✓ Safety – Technical Training
 - ✓ Contact Release
 - ✓ High Voltage Awareness
 - ✓ Specialty Training





Obed Mejia

Sr. Bus Equipment
Maintenance Instructor
LA Metro



Training Alternative Needs



Facilitate Transition to ZEB's



Younger Workforce



Staffing Impacts



Information Access



eLearning Training



Voltage - Voltage Drop

Digital Multimeter

- Introduced 2018
- Self Paced
- Interactive
- On-Demand

Measuring voltage drop is one of the most useful tests you can perform. A voltage drop test checks for loss of voltage in each portion of the circuit while the circuit is connected, powered and operated.

Note: Voltage drop testing requires you to back probe, as all components are connected during testing.

A voltage drop test is done as follows:

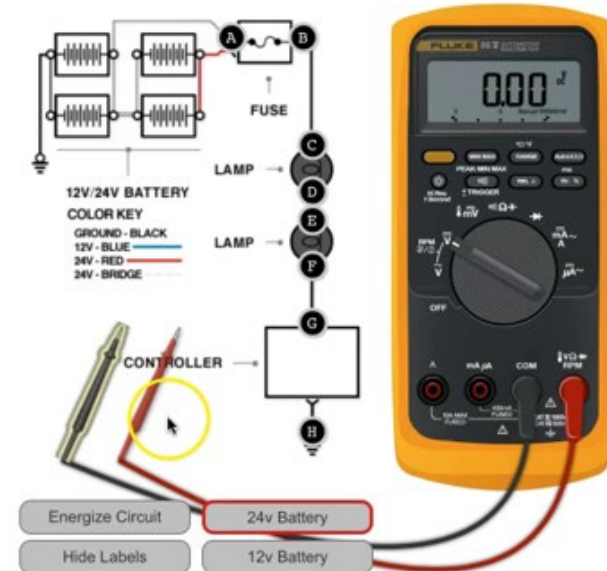
1. Place the positive lead in the most positive section of the circuit you are testing.
2. Place the ground lead on the most negative section of the circuit you are testing.
3. Operate the circuit with the meter leads in place and note the reading.

Remember that voltage dropped is voltage consumed by resistance.

Interaction Instructions:

Energize the circuit in the interaction and select each component to view voltage drops.

Show Note



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Diagnostic Simulations



Current Failure Simulations

- Multiple diagnostic scenarios
- Reduces diagnostic time
- Improves miles between road calls

[Click to view video](#)



Animation and Voice Over



- To increase content understanding
 - Video
 - Animation
 - Narrations



[Click to view video](#)



Augmented and Virtual Reality

- Real world scenarios
- Immerses learner/Highly interactive
- Added resources
- Safe learning environment for ZEB's





Lessons Learned



- Not one size fits all
- May need navigational instructions
- Multi medium important part
- Multi generational workforce



Walter Kirkland

Service Manager
StarMetro
Tallahassee, FL



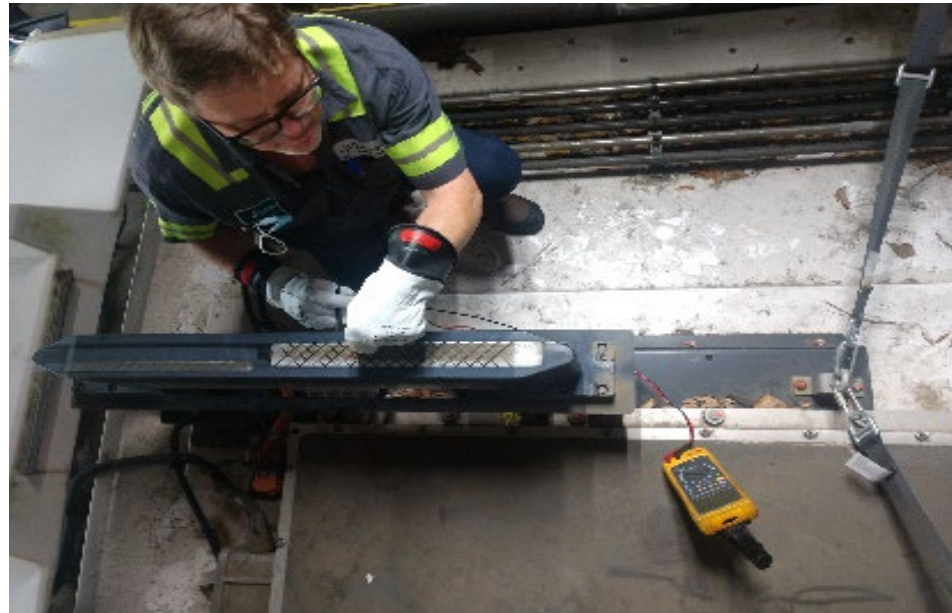
Engines to Inverters: Preparing Technicians for ZEB Deployment



FLEET MANAGEMENT

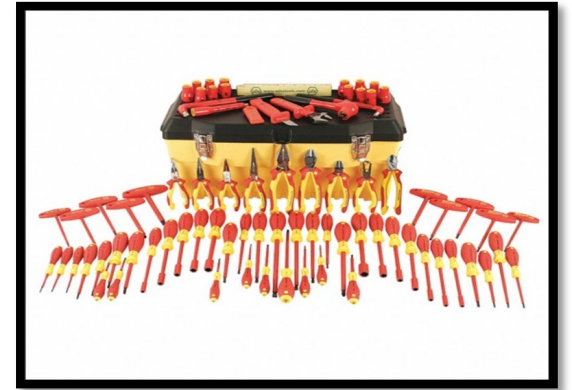
Introduction & Background

- Project started in 2011
- Electronics Technician hired in 2012
- Train the Trainer approach



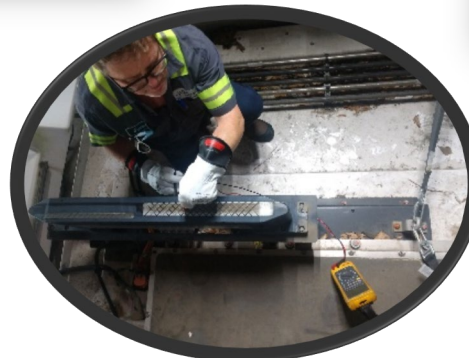
Transit Workforce Training

- Training processes and programs
- Easy transition for skilled technicians
- Training must be continuous
- **Safety! Safety! Safety!**
- OEM Training
- Partnership with local Technical College
- Career Progression
- Employee Engagement
- First Responder Training



Skills & Credentials

- Same baseline skills
- Closing knowledge gaps
- Constant review of skills and performance
- Introducing new technicians



Workforce Training Resources

- Utility and Safety Departments
- Lively Technical College, Tallahassee
- On The Job training
- OEM and Suppliers
- Closing Statement





Dinero Washington

General Manager
SporTran
Shreveport, LA



Workforce Development and Fleet Transition SporTran and ATU Local 558

- Smaller urban transit agency
- Frontline workforce of bus operators and technicians
- Maintain our own buses and electrical charging equipment
- Went through two fleet transitions
 - The first to Compressed Natural Gas (CNG) buses
 - The second to Zero Emission Buses (ZEBs)
- Learned from issues in the first transition how to best do the second transition



Key Elements to Successful Fleet Transition

- Fully involve frontline workforce throughout process
- Frontline worker participation throughout process, including in focus groups and initial meetings with vendors, ensured:
 - Important questions were asked
 - Critical elements were covered in final procurement agreement
 - Vendor supplied substantial on-site technical assistance and training to current workforce
- Work collaboratively to document entire process, including maintenance issues
- Focus on safety issues, with full participation of labor and management safety experts
- Bring other key partners into the process, including:
 - Local utility and fire department for awareness and training on high-voltage safety issues
 - Local community college, working together on electrical/electronics courses for technicians



Underlying Lesson Learned

The collective effort, with a strong labor-management partnership at its core, was central to a successful ZEB transition.

The transition worked, because we worked together.



New Training Course **Battery-Electric Bus**

Familiarization Training



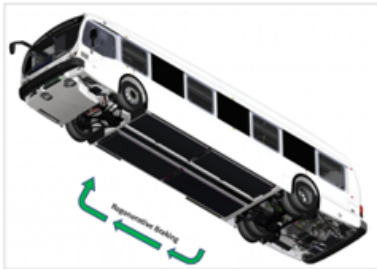
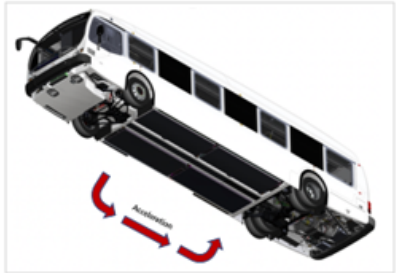
Course Preview

Regenerative Braking

Before we take a closer look at the components, let's examine a principle unique to BEBs and hybrid buses: **regenerative braking**. What is regenerative braking you ask?

Well typically, with BEBs during normal driving conditions the high voltage batteries will provide energy to the traction motor, which supplies torque effort to turn the wheels on the drive axle.

During regenerative braking however (example being coasting to a stop), the flow of energy is reversed. The traction motor then becomes a generator, where the motion of the wheels on the drive axle turns the transmission and traction motor, charging the high voltage batteries and extending the drive time. Regenerative braking undergoes a deceleration similar to that of a traditional retarder. Keep in mind that regenerative braking will stop as soon as the operator reapplies the accelerator, in turn requesting torque from the propulsion system.

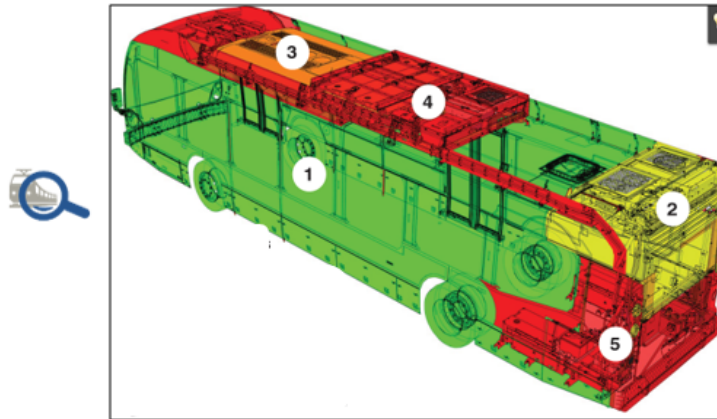


It is absolutely vital to a BEB that regenerative braking be working efficiently. As mentioned, it is a process that begins anytime the driver starts to reduce acceleration, and turns the motor into a generator and try and recuperate that energy. In that regard it kind of works like a hybrid, as we decelerate, trying and recover some of that power.



Learning Application 1D - Identify areas associated risk

Review the following image:



Without referring back to your notes and/or guide, list out the associated areas for each of the corresponding colors in the rows below:

High Risk (shown in Red):

Turn OFF 12/24 VDC Battery Disconnect for the bus and apply a multi-lockout device and a lock and tag on the switch to prevent it from becoming energized.





Project Timeline

Course
Development
January –
December 2022

Pilot tests –
Coming January
2023

Course open to
public –
February/March
2023



Thank you to our partners:



Q&A