

Training Standards

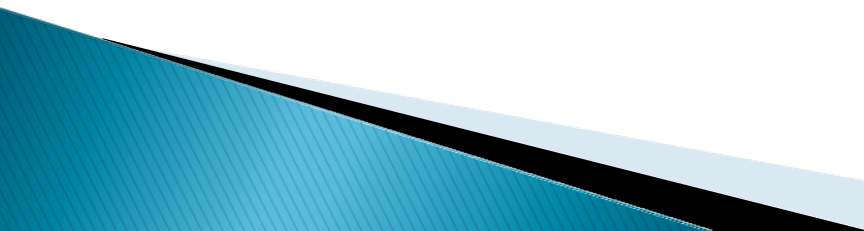
Kenneth Mall

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Training Standards

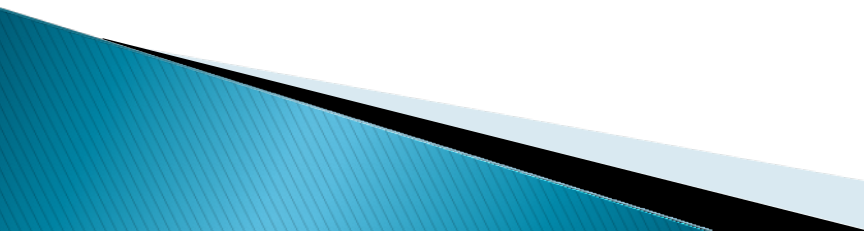
- **What are training standards and why are they important?**
 - **What training standards are being developed?**
 - **How are the standards being developed?**
 - **How can you use the training standard?**
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Training Standards

What are training standards and why are they important?

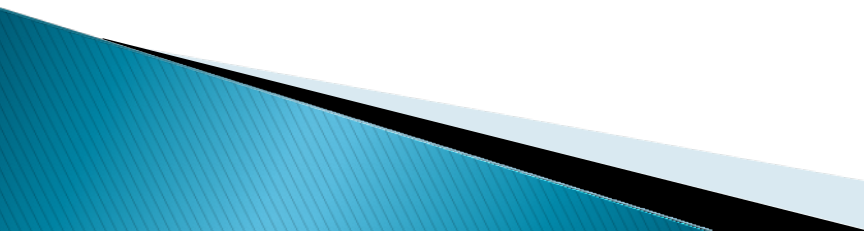
- A training standard defines the minimum requirements for the development, implementation and maintenance of training programs
 - A standard helps insure that personnel throughout the industry are provided with adequate training
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Training Standards

- Educational institutions develop standardized curriculum that details what students should be taught in order to graduate.
 - Training standards are industry's equivalent to a standardized curriculum showing what skills are necessary to perform job tasks successfully.
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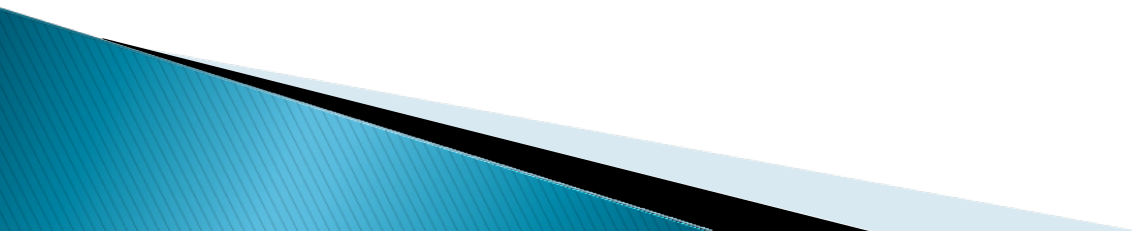
Bus Maintenance Training Standards

What training standards are being developed?

1. Bus Electronics
 2. Brakes
 3. Diesel Engines
 4. HVAC
 5. Trans. & Drivetrain
 6. Steering & Suspension
 7. PMI
 8. Adv. Diesel Engine Diag.
 9. Hybrids
 10. Alternative Fuels
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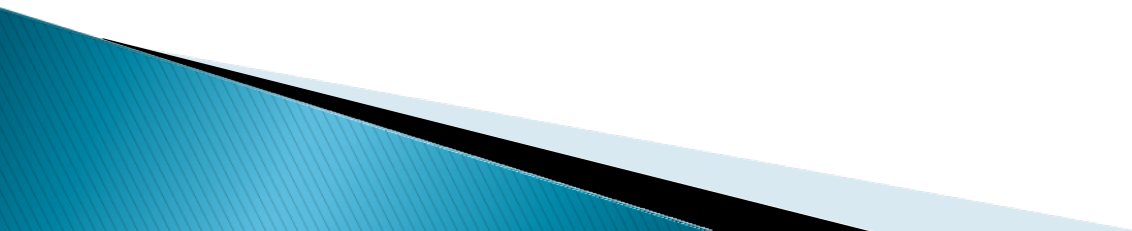
Training Standards

How can you use the training standard?

- If you currently have a training program . . .
 - If you need training . . .
 - If you are thinking about apprenticeship programs or mechanic certification . . .
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Training Standards

How are the standards being developed?

- Highly participative working group
 - Defining job tasks, learning objectives, etc.
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The training standards development process?

1. Determined job tasks performed

(1) Electronics/Electrical	✓
(2) Brakes (including ABS)	✓
(3) Diesel Engines	

TRANSIT BUS ELECTRICAL/ELECTRONIC SYSTEMS TEST TASK LIST

A. General Electrical Diagnosis (20 questions)

Task 1 – Verify operator complaint, reproduce the condition (including intermittent problems), and/or road test vehicle; determine necessary action.

Task 2 - Check continuity in electrical/electronic circuits using appropriate test equipment.

Task 3 - Check applied voltages, circuit voltages, and voltage drops in electrical/electronic circuits using a digital multimeter (DMM).

Task 4 - Check current flow in electrical/electronic circuits and components using an ammeter, digital multimeter (DMM), or a clamp-on ammeter.

Task 5 – Check electronic circuit waveforms using an oscilloscope or graphing multimeter (GMM); interpret readings and determine needed repairs.

Task 6 - Check resistance in electrical/electronic circuits and components using an ohmmeter or a digital multimeter (DMM).

The training standards development process?

1. Determined job tasks performed
2. Developed Learning Objectives

ASE Task	Electrical-Electronics Learning Objectives
A1	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)
A1	Use diagnostic software to troubleshoot equipment
A1	Troubleshoot controller (diagnose communication operation)
A2	Demonstrate proficient use of digital multimeters and other common test equipment
A2	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)
A3	Perform tests for voltage draws and drops using a DMM
A4	Demonstrate proficient use of digital multimeters and other common test equipment
A4	Inspect motors (use ammeter)
A5	Demonstrate use of lab scope/oscilloscope/graphing multimeter
A6	Use digital multimeters to check circuit voltage amperage and resistance
A6	Inspect and test resistors
A7	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)
A8	Perform battery load and capacity tests on batteries
A9	Inspect and test circuit breakers
A9	Inspect and test fuses
A9	Diagnose condition of fuses and circuit breakers and switches

The training standards development process?

1. Determined job tasks performed
2. Developed Learning Objectives
 - Determine Skill Level

Step 2 – Determine skill level

100 Level – Basic Knowledge

200 Level – Troubleshooting

300 Level – Advanced

400 Level – Vendor Specific

The training standards development process?

1. Determined job tasks performed
 - ASE Task Lists
2. Developed Learning Objectives
 - Determine Skill Level
 - Determine Order of Instruction

Step 3 – Determine order of instruction

100 Level – Basic Knowledge

101 – Taught first

102 – Taught second

103 – Taught third

200 Level – Troubleshooting

201 – Taught first

202 – Taught second

203 – Taught third

300 Level – Advanced

301 – Taught first

302 – Taught second

303 – Taught third

400 Level – Vendor Specific

401 – Taught first

402 – Taught second

403 – Taught third

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The training standards development process?

ASE Task	Skill Level	Electrical-Electronics Learning Objectives
A1	201	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)
A1	201	Use diagnostic software to troubleshoot equipment
A1	202	Troubleshoot controller (diagnose communication operation)
A2	103	Demonstrate proficient use of digital multimeters and other common test equipment
A2	201	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)
A3	103	Perform tests for voltage draws and drops using a DMM
A4	103	Demonstrate proficient use of digital multimeters and other common test equipment
A4	201	Inspect motors (use ammeter)
A5	203	Demonstrate use of lab scope/oscilloscope/graphing multimeter
A6	201	Use digital multimeters to check circuit voltage amperage and resistance
A6	201	Inspect and test resistors
A7	201	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)
A8	102	Perform battery load and capacity tests on batteries
A9	101	Inspect and test circuit breakers
A9	101	Inspect and test fuses
A9	102	Diagnose condition of fuses and circuit breakers and switches

The training standards development process?

1. Determined job tasks performed
 - ASE Task Lists
2. Developed Learning Objectives
 - Determine Skill Level
 - Determine Order of Instruction
3. Created and published the training standard

	Transit Bus Electrical/electronics - Learning Objectives	ASE Task Reference
101	Inspect and test circuit breakers	A9
101	Inspect and test fuses	A9
101	Inspect starters (motors and solenoids)	A11, C2, C3
101	Replace starter circuit relays	A11, C2, C3
101	Replace starter circuit solenoids	A11, C3
101	Read basic wiring diagrams	A12, E22, E23, E24, F1, F2, G2, G3, G5, G6, G7
101	Identify symbols used in electrical schematics	A12
101	Read single circuit electrical schematics	A12
101	Adjust or replace alternator components (belts, gears, fans, etc.)	A17,D12
101	Electrical safety procedures and Personal protective equipment	A17
101	Measure battery voltage/surface charge	B2, D8, D9
101	Clean and check battery and terminal connections	B3, C5
101	Replace batteries	B3
101	Inspect batteries	B3, C5, D8, D9
101	Safe handling of batteries and acid	B3
101	Check battery box construction for stress cracks/welds	B4
101	Perform voltage drop tests on starter circuits using tester unit	C1
101	Replace starter circuit switches	C2, C3
101	Replace starter motor	C4
101	Remove and replace alternators	D6
101	Visually check wiring for exterior lights	E11, E14, E16
101	Replace headlights, LED, fluorescent, and incandescent lights	E12
101	Visually check wiring for interior lights	E16
101	Replace fuses	E23, F3
101	Understand basic electrical theories and laws	A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17
101	Replace circuit breakers	A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17
101	Check batteries for water	B1, B2, B3, B4, B5, B6

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TRANSIT BUS ELECTRICAL/ELECTRONIC SYSTEMS TEST TASK LIST

A. General Electrical Diagnosis (20 questions)

Task 1 – Verify operator complaint, reproduce the condition (including intermittent problems), and/or road test vehicle; determine necessary repairs.

Task 2 - Check continuity in electrical/electronic circuits using appropriate equipment.

Task 3 - Check applied voltages, circuit voltages, and voltage drops in electrical/electronic circuits using a digital multimeter (DMM).

Task 4 - Check current flow in electrical/electronic circuits and compare with manufacturer's specifications using an ammeter, digital multimeter (DMM), or a clamp-on ammeter.

Task 5 – Check electronic circuit waveforms using an oscilloscope or digital multimeter (DMM); interpret readings and determine needed repairs.

ASE Task	Skill Level	Electrical-Electronic
A1	201	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)
A1	201	Use diagnostic software to troubleshoot equipment
A1	202	Troubleshoot controller (diagnose and repair)
A2	103	Demonstrate proficient use of digital multimeter to check circuit voltage, amperage and resistance
A2	201	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)
A3	103	Perform tests for voltage draws and current flow in electrical/electronic circuits
A4	103	Demonstrate proficient use of digital multimeter to check circuit voltage, amperage and resistance
A4	201	Inspect motors (use ammeter)
A5	203	Demonstrate use of lab scope/oscilloscope to check electronic circuit waveforms
A6	201	Use digital multimeters to check circuit voltage, amperage and resistance
A6	201	Inspect and test resistors
A7	201	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)
A8	102	Perform battery load and capacity tests on batteries
A9	101	Inspect and test circuit breakers
A9	101	Inspect and test fuses
A9	102	Diagnose condition of fuses and circuit breakers and switches

	Transit Bus Electrical/electronics - Learning Objectives	ASE Task Reference
201	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)	A1, A2, A7, E22, E23, E24, F1, F2, G2, G3, G5, G6, G7
201	Use diagnostic software to troubleshoot equipment	A1
201	Inspect motors (use ammeter)	A4
201	Use digital multimeters to check circuit voltage amperage and resistance	A6, E22, E23, E24, F1, F2, G2, G3, G5, G6, G7
201	Inspect and test resistors	A6, A10
201	Inspect and test diodes	A10
201	Inspect and test capacitors	A10
201	Replace solenoids	A11
201	Draw basic wiring diagrams	A12
201	Use wiring diagrams to troubleshoot electrical problems	A12
201	Apply digital logic to reading and interpreting ladder diagrams	A13, A14
201	Understand the functions of the controller and its related components	A14
201	Use LED's to troubleshoot system	A14
201	Use logic (ladder) diagrams to troubleshoot a multiplex system	A14
201	Operate Windows based computer for diagnostic purposes	A15
201	Distinguish between mechanical and electrical causes of starter problems	C4, C6
201	Diagnose cause and repair for various charging conditions	D1
201	Perform alternator output tests (amp draw test) using tester unit	D1, D3
201	Inspect overall charging system operation	D3
201	Perform alternator voltage drop tests using tester unit	D4
201	Inspect and repair connectors and wires in charging circuits	D7, D8
201	Diagnose lighting systems and circuits	E13, E14, E15, E21, E22, E23, E124, F4
201	Demonstrate knowledge of equalizer system	A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17
201	Diagnose, inspect, troubleshoot complex traditional electrical circuits (non electronic)	F1, F2, F3, F4, F5
201	Basic PC knowledge.	A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17

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TRANSIT BUS ELECTRICAL/ELECTRONIC SYSTEMS TEST TASK LIST

A. General Electrical Diagnosis (20 questions)

Task 1 – Verify operator complaint, reproduce the condition (including intermittent problems), and/or road test vehicle; determine necessary repairs.

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Task 4 - Check current flow in electrical/electronic circuits and compare with manufacturer's specifications using an ammeter, digital multimeter (DMM), or a clamp-on ammeter.

Task 5 – Check electronic circuit waveforms using an oscilloscope or digital multimeter (DMM); interpret readings and determine needed repairs.

ASE Task	Skill Level	Electrical-Electronic
A1	201	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)
A1	201	Use diagnostic software to troubleshoot equipment
A1	202	Troubleshoot controller (diagnose and repair)
A2	103	Demonstrate proficient use of digital multimeter to check circuit voltage, amperage and resistance
A2	201	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)
A3	103	Perform tests for voltage draws and current flow in electrical/electronic circuits
A4	103	Demonstrate proficient use of digital multimeter to check circuit voltage, amperage and resistance
A4	201	Inspect motors (use ammeter)
A5	203	Demonstrate use of lab scope/oscilloscope to check electronic circuit waveforms
A6	201	Use digital multimeters to check circuit voltage, amperage and resistance
A6	201	Inspect and test resistors
A7	201	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)
A8	102	Perform battery load and capacity tests on batteries
A9	101	Inspect and test circuit breakers
A9	101	Inspect and test fuses
A9	102	Diagnose condition of fuses and circuit breakers and switches

	Transit Bus Electrical/electronics - Learning Objectives	ASE Task Reference
201	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)	A1, A2, A7, E22, E23, E24, F1, F2, G2, G3, G5, G6, G7
201	Use diagnostic software to troubleshoot equipment	A1
201	Inspect motors (use ammeter)	A4
201	Use digital multimeters to check circuit voltage amperage and resistance	A6, E22, E23, E24, F1, F2, G2, G3, G5, G6, G7
201	Inspect and test resistors	A6, A10
201	Inspect and test diodes	A10
201	Inspect and test capacitors	A10
201	Replace solenoids	A11
201	Draw basic wiring diagrams	A12
201	Use wiring diagrams to troubleshoot electrical problems	A12
201	Apply digital logic to reading and interpreting ladder diagrams	A13, A14
201	Understand the functions of the controller and its related components	A14
201	Use LED's to troubleshoot system	A14
201	Use logic (ladder) diagrams to troubleshoot a multiplex system	A14
201	Operate Windows based computer for diagnostic purposes	A15
201	Distinguish between mechanical and electrical causes of starter problems	C4, C6
201	Diagnose cause and repair for various charging conditions	D1
201	Perform alternator output tests (amp draw test) using tester unit	D1, D3
201	Inspect overall charging system operation	D3
201	Perform alternator voltage drop tests using tester unit	D4
201	Inspect and repair connectors and wires in charging circuits	D7, D8
201	Diagnose lighting systems and circuits	E13, E14, E15, E21, E22, E23, E124, F4
201	Demonstrate knowledge of equalizer system	A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17
201	Diagnose, inspect, troubleshoot complex traditional electrical circuits (non electronic)	F1, F2, F3, F4, F5
201	Basic PC knowledge.	A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17

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Task 4 - Check current flow in electrical/electronic circuits and compare with manufacturer's specifications using an ammeter, digital multimeter (DMM), or a clamp-on ammeter.

Task 5 – Check electronic circuit waveforms using an oscilloscope or digital multimeter (DMM); interpret readings and determine needed repairs.

ASE Task	Skill Level	Electrical-Electronic
A1	201	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)
A1	201	Use diagnostic software to troubleshoot equipment
A1	202	Troubleshoot controller (diagnose and repair)
A2	103	Demonstrate proficient use of digital multimeter to check circuit voltage, amperage and resistance
A2	201	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)
A3	103	Perform tests for voltage draws and current flow in electrical/electronic circuits
A4	103	Demonstrate proficient use of digital multimeter to check circuit voltage, amperage and resistance
A4	201	Inspect motors (use ammeter)
A5	203	Demonstrate use of lab scope/oscilloscope to check electronic circuit waveforms
A6	201	Use digital multimeters to check circuit voltage, amperage and resistance
A6	201	Inspect and test resistors
A7	201	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)
A8	102	Perform battery load and capacity tests on batteries
A9	101	Inspect and test circuit breakers
A9	101	Inspect and test fuses
A9	102	Diagnose condition of fuses and circuit breakers and switches

	Transit Bus Electrical/electronics - Learning Objectives	ASE Task Reference
201	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)	A1, A2, A7, E22, E23, E24, F1, F2, G2, G3, G5, G6, G7
201	Use diagnostic software to troubleshoot equipment	A1
201	Inspect motors (use ammeter)	A4
201	Use digital multimeters to check circuit voltage amperage and resistance	A6, E22, E23, E24, F1, F2, G2, G3, G5, G6, G7
201	Inspect and test resistors	A6, A10
201	Inspect and test diodes	A10
201	Inspect and test capacitors	A10
201	Replace solenoids	A11
201	Draw basic wiring diagrams	A12
201	Use wiring diagrams to troubleshoot electrical problems	A12
201	Apply digital logic to reading and interpreting ladder diagrams	A13, A14
201	Understand the functions of the controller and its related components	A14
201	Use LED's to troubleshoot system	A14
201	Use logic (ladder) diagrams to troubleshoot a multiplex system	A14
201	Operate Windows based computer for diagnostic purposes	A15
201	Distinguish between mechanical and electrical causes of starter problems	C4, C6
201	Diagnose cause and repair for various charging conditions	D1
201	Perform alternator output tests (amp draw test) using tester unit	D1, D3
201	Inspect overall charging system operation	D3
201	Perform alternator voltage drop tests using tester unit	D4
201	Inspect and repair connectors and wires in charging circuits	D7, D8
201	Diagnose lighting systems and circuits	E13, E14, E15, E21, E22, E23, E124, F4
201	Demonstrate knowledge of equalizer system	A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17
201	Diagnose, inspect, troubleshoot complex traditional electrical circuits (non electronic)	F1, F2, F3, F4, F5
201	Basic PC knowledge.	A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17

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A1	201	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)
A1	201	Use diagnostic software to troubleshoot equipment
A1	202	Troubleshoot controller (diagnose and repair)
A2	103	Demonstrate proficient use of digital multimeter to check circuit voltage, amperage and resistance
A2	201	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)
A3	103	Perform tests for voltage draws and current flow in electrical/electronic circuits
A4	103	Demonstrate proficient use of digital multimeter to check circuit voltage, amperage and resistance
A4	201	Inspect motors (use ammeter)
A5	203	Demonstrate use of lab scope/oscilloscope to check electronic circuit waveforms
A6	201	Use digital multimeters to check circuit voltage, amperage and resistance
A6	201	Inspect and test resistors
A7	201	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)
A8	102	Perform battery load and capacity tests on batteries
A9	101	Inspect and test circuit breakers
A9	101	Inspect and test fuses
A9	102	Diagnose condition of fuses and circuit breakers and switches

	Transit Bus Electrical/electronics - Learning Objectives	ASE Task Reference
201	Diagnose circuit malfunctions (short circuits, grounded circuits and open circuits)	A1, A2, A7, E22, E23, E24, F1, F2, G2, G3, G5, G6, G7
201	Use diagnostic software to troubleshoot equipment	A1
201	Inspect motors (use ammeter)	A4
201	Use digital multimeters to check circuit voltage amperage and resistance	A6, E22, E23, E24, F1, F2, G2, G3, G5, G6, G7
201	Inspect and test resistors	A6, A10
201	Inspect and test diodes	A10
201	Inspect and test capacitors	A10
201	Replace solenoids	A11
201	Draw basic wiring diagrams	A12
201	Use wiring diagrams to troubleshoot electrical problems	A12
201	Apply digital logic to reading and interpreting ladder diagrams	A13, A14
201	Understand the functions of the controller and its related components	A14
201	Use LED's to troubleshoot system	A14
201	Use logic (ladder) diagrams to troubleshoot a multiplex system	A14
201	Operate Windows based computer for diagnostic purposes	A15
201	Distinguish between mechanical and electrical causes of starter problems	C4, C6
201	Diagnose cause and repair for various charging conditions	D1
201	Perform alternator output tests (amp draw test) using tester unit	D1, D3
201	Inspect overall charging system operation	D3
201	Perform alternator voltage drop tests using tester unit	D4
201	Inspect and repair connectors and wires in charging circuits	D7, D8
201	Diagnose lighting systems and circuits	E13, E14, E15, E21, E22, E23, E124, F4
201	Demonstrate knowledge of equalizer system	A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17
201	Diagnose, inspect, troubleshoot complex traditional electrical circuits (non electronic)	F1, F2, F3, F4, F5
201	Basic PC knowledge.	A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17

Available Training Standards

Building capacity for transit training and development:

- Bus Maintenance Training
- Rail Vehicle Maintenance Training
- Railway Signaling Maintenance Training
- Traction Power
- Elevator/Escalator Maintenance Training