APTA STANDARDS DEVELOPMENT PROGRAM
RECOMMENDED PRACTICE
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APTA Bus Maintenance Training Working Group

Training Syllabus to Instruct Bus Technicians on Door and Interlock Operations and Maintenance

Abstract: This *Recommended Practice* provides guidelines for establishing a standardized bus maintenance training program related to the theory of operation, maintenance and troubleshooting of transit bus doors, interlocks and related equipment.

Keywords: APC sensors, APTA Safe Bus program, control valves, door controller, doors, interlocks, stop request

Summary: This *Recommended Practice* provides transit bus maintenance training and departments with typical information to evaluate, develop or enhance current training programs for the diagnosis, repair and maintenance of transit bus doors and interlocks. Individual operating agencies should modify these guidelines to specifically teach the coach and OEM manufacturers and modes of operation on their local equipment. The training assumes prerequisite knowledge in basic electrical, air operational controls, basic mechanical aptitude, and schematics reading electrical/electronics, including PLC where applicable. The depth of module development should be consistent with the operating agency's level of repair requirements as defined by the agency's Vehicle Engineering and Maintenance Department.

Scope and purpose: This *Recommended Practice* reflects the consensus of the APTA Bus Standards Program members in conjunction with transit labor organizations, including ATU and TWU, on the subject material, manuals and textbooks, test equipment, methods and procedures that have provided the best performance record based on the experiences of those present and participating in meetings of the program task forces and working groups. APTA recommends the use of this document by organizations that have a training department or conduct training for the maintenance of transit buses; organizations that contract with others for transit bus maintenance training; and organizations that influence how training for transit bus maintenance is conducted.

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Participants

The American Public Transportation Association greatly appreciates the contributions of the **Bus Maintenance Training Working Group**, which provided the primary effort in the drafting of this document.

At the time this standard was completed, the working group included the following members:

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Training Syllabus to Instruct Bus Technicians on Door and Interlock Operations and Maintenance

1. Learning environment

For best application of this *Recommended Practice*, a combination of classroom lectures, mentoring, practical training and practice tests should be included in the training program.

2. Computer skills

Basic computer skills are now a standard for transit bus technicians. Basic skills and knowledge in the operation of a computer in a Microsoft Windows environment are essential.

3. Course learning objectives

The modules listed below implement the door and interlock standards and learning objectives (see Appendix A) by providing a comprehensive overview of components, operations and hands-on practice in diagnosing and repairing doors, interlocks and related equipment. The underlying learning objectives, organization of the modules and order of instruction of the various tasks have been developed through a labor-management committee of subject matter experts. When a transit bus mechanic demonstrates proficiency in the learning objectives of these modules, he or she should be capable of demonstrating consistent competence in maintaining doors, interlocks and related equipment on the particular buses of the local fleet.

- **Module I: Door Operations Overview:** The objective of this module is to provide technicians with knowledge of door components, operation and inspection procedures for transit bus doors and interlocks.
- **Module II: Door Schematics and Controls:** The objective of this module is to provide technicians with knowledge of door and interlock controls and schematics, and hands-on practice of proper procedures for using schematics for troubleshooting and maintaining transit bus door systems. Emphasis will be placed on properly identifying problems, determining necessary repair and performing routine preventive maintenance.
- **Module III: Door Mechanical Components and Adjustments:** The objective of this module is to provide technicians with knowledge and hands-on practice of proper procedures for inspecting and maintaining transit bus door mechanical components. Emphasis will be placed on hands-on practice of mechanical adjustments of doors.

4. Exam requirements

The minimum acceptable grade to pass the course and all practical tests is 75 percent. Students must pass written tests with a minimum grade of 80 percent. ASE has not developed tests in this subject area. Delivery of training should include written pre- and post-training tests and practical demonstrations from the students to confirm that the learning objectives have been achieved.

Definitions

interlock: Safety device used on transit buses.

pneumatics: The study of air systems.

Abbreviations and acronyms

APC Automatic Passenger Counter
ASE Automotive Service Excellence
ATU Amalgamated Transit Union
CLASS Contact-Less Acoustic Sensing System
EDSI Educational Data Systems, Inc.
NATSA North American Transit Service Association
OEM original equipment manufacturer
PM preventive maintenance
PPE personal protective equipment
TWU Transport Workers Union
PLC Programmable Logic Controller

Document history

Document Version	Working Group Vote	Public Comment/ Technical Oversight	CEO Approval	Policy & Planning Approval	Publish Date
First published	June 1, 2016	July 7, 2016	Sept. 6, 2016	Sept. 30, 2016	Oct. 6, 2016
First revision					
Second revision					

Appendix A: Doors and interlocks learning objectives/training standards

Transit bus doors and interlocks learning objectives

Accessory air system

Air flow door closing and opening

Maintain accessory air system
Diagnose accessory air system
Repair accessory air system components
Replace accessory air system components

Automatic passenger counter sensors

Maintain automatic passenger counter sensors
Repair automatic passenger counter sensors
Diagnose automatic passenger counter sensors
Replace automatic passenger counters sensors

Door controller (switches and valves)

Maintain door controller
Repair door controller components
Replace door controller
Diagnose door controller

Indicator lights

Maintain indicator lights
Replace indicator lights
Diagnose indicator lights

Control valves (dump valves, front and rear)

Maintain control valves (dump valves, front and rear)
Repair control valves (dump valves, front and rear)
Replace control valves (dump valves, front and rear)
Diagnose control valves (dump valves, front and rear)

Stop request components

Maintain, replace and/or diagnose stop request switches
Maintain, replace and/or diagnose stop request bells, alarms, chimes
Maintain, replace and/or diagnose lamps (“stop requested”)

Door mechanical components

Adjust, repair and/or replace door frame/opening
Replace door glass
Maintain, replace and/or diagnose step well lights
Inspect, maintain and/or replace door bearings, shafts and U-joints
Inspect, maintain and/or replace linkage/turnbuckle
Inspect, maintain and/or replace door seals and brushes
Inspect, maintain, repair and/or replace pneumatic motors
Inspect, adjust and/or replace rear door spring
Inspect, repair and/or replace emergency pull cable

Door switches

Diagnose, repair and/or replace touch tape/pull cords
Diagnose, repair and/or replace touch bar
Diagnose, repair and/or replace CLASS system (specific to Vapor doors)
Diagnose and/or replace sensitive edges
Diagnose and/or replace safety door alarm/door annunciation (door alarm on dash, "drunk alarm")
Diagnose, maintain and/or replace micro switches
Diagnose, maintain and/or replace proximity switches
Diagnose and/or replace brake pressure switches
Diagnose and/or replace interlock override switch
Diagnose and/or replace brake light switch
Diagnose and/or replace fast idle switch (energizes throttle and brake interlock)

Sensors

Diagnose and/or replace proximity sensors
Diagnose, maintain and/or replace speed sensor
Diagnose and/or replace sonar sensors (from Vapor doors' CLASS system)

Interlocks

Diagnose throttle interlock problem
Diagnose brake interlock problem
Diagnose wheelchair interlock problem (ramp or lift)
Diagnose kneel system interlock problem
Diagnose and/or replace park brake switch
Diagnose and/or replace interlock override alarm
Diagnose, maintain and/or replace air pressure regulator
Diagnose, maintain and/or replace brake interlock solenoids

Solenoids

Diagnose, maintain and/or replace rear door lock solenoid (energize to unlock)
Diagnose and/or replace door air solenoid (valves)

Other topics

Remote location with remote wheelchair controller (MCI)
Controls
- Laptop
- PLC interface

Wiring and connectors
Schematics and ladder logic
Door mirrors
Stanchions and grab rails (handles)

Appendix B: Sample curriculum

Doors and Interlocks Module I
Door Operations Overview

Goal: Participants should understand and be able to identify door and interlock components, explain how the systems work, and inspect those components and related systems.

Objectives:
Following the completion of this module, the technician should be able to:

- understand how components of the door system interface with the rest of the bus;
- identify various door system subcomponents, such as controls, switches, sensors, valves, interlocks and indicator lights;
- identify air system components and understand door air flow; and
- inspect door system and sub components.

Course description: Participants will receive classroom instruction and demonstrations on a bus, where a qualified instructor will provide knowledge and hands-on practice of proper procedures for inspecting transit bus doors and interlocks and various subcomponents. Participants should leave the course with confidence in understanding how door systems operate and inspecting the system and components.

Recommended class size: Five if on-coach training; if strictly classroom, then 10 to 12

Prerequisites (electrical/electronics, including PLC where applicable): Basic Electrical, Basic Air Operations, Schematic Reading, Basic Mechanical)

Delivery method (e.g., lecture, hands-on, online, lab): Hands-on and classroom

Course duration: A one-day (eight-hour) course, split between classroom and hands-on, should be sufficient for those who have the above prerequisites.

Target audience: All new and existing bus technicians

Classroom equipment and supplies: Notepads, pens/pencils, flip chart or whiteboard (and markers), classroom, laptop, projector, highlighters, note cards and name cards

Course materials, training aids and references: Student workbooks, manuals, handouts, PowerPoint, pre- and post-training questions; laptops with OEM software, buses for use in diagnostic practice, worksheet for hands-on exercise

Instructor:

Course developer: Brian Lester, EDSI

Subject matter experts: Darryl Desjairlais (New Flyer); John Webster (ATU Local 382); Kevin Barrett (ATU Local 85); Russell Anderson (VTA)

Revision date: 5/15/13

Follow-up: Feedback by SMEs, scheduled for committee review May 2013

Instructor and course evaluation: Local course evaluation sheets should be used if present.

Job tasks/learning objectives/OJT checklist: The concrete tasks that can be performed to apply the knowledge taught in this course and reinforce the content are found within the learning objectives in Appendix A.

Doors and Interlocks Module II

Schematics and Controls

Goal: Participants should understand and be able to identify door schematics and controls and apply this knowledge to troubleshooting and maintaining door systems.

Objectives:
Following the completion of this module, the technician should be able to:

- identify various control components for doors and interlocks;
- use door schematics to explain electrical and air operation of door systems and identify various symbols; and
- troubleshoot door system problems and make necessary repairs.

Course description: Participants will receive classroom instruction and demonstrations on a bus, where a qualified instructor will provide knowledge and hands-on practice of proper procedures for interpreting transit bus doors and interlock schematics and maintaining control components. Participants should leave the course with confidence in using door schematics for door system maintenance and troubleshooting.

Recommended class size: Five if on-coach training; if strictly classroom, then 10 to 12

Prerequisites (electrical/electronics including PLC where applicable): Basic Electrical, Basic Air Operations, Schematic Reading, Basic Mechanical

Delivery method (e.g., lecture, hands-on, online, lab): Hands-on and classroom

Course duration: A one-day (eight-hour) course, split between classroom and hands-on, should be sufficient for those who have the above prerequisites.

Target audience: All new and existing bus technicians

Classroom equipment and supplies: Notepads, pens/pencils, flip chart or whiteboard (and markers), classroom, laptop, projector, highlighters, note cards and name cards

Course materials, training aids and references: Student workbooks, manuals, handouts, PowerPoint, pre- and post-training questions; laptops with OEM software, buses for use in diagnostic practice

Instructor:

Course developer: Brian Lester, EDSI

Subject matter experts: Darryl Desjairlais (New Flyer); John Webster (ATU Local 382), Kevin Barrett (ATU Local 85); Russell Anderson (VTA)

Revision date: 2/14/13

Follow-up: Feedback by SMEs, scheduled for committee review May 2013

Instructor and course evaluation: Local course evaluation sheets should be used if present.

Job tasks learning objectives/OJT checklist: The concrete tasks that can be performed to apply the knowledge taught in this course and reinforce the content are found within the learning objectives in Appendix A.

Doors and Interlocks Module III

Mechanical Components and Adjustments

Goal: Participants should understand and be able to identify door and interlock mechanical components, explain how the systems work, and adjust and maintain these components.

Objectives:
Following the completion of this module, the technician should be able to:

- understand how mechanical components of the door system work together with other door subsystems and with the rest of the bus; and
- perform door linkage and other mechanical adjustments.

Course description: Participants will receive classroom instruction and demonstrations on a bus, where a qualified instructor will provide knowledge and hands-on practice of proper procedures for adjusting door mechanical components.

Recommended class size: Five if on-coach training; if strictly classroom, then 10 to 12

Prerequisites (electrical/electronics including PLC where applicable): Basic Electrical, Basic Air Operations, Schematic Reading, Basic Mechanical

Delivery method (e.g., lecture, hands-on, online, lab): Hands-on and classroom

Course duration: A one-day (eight-hour) course, split between classroom and hands-on, should be sufficient for those who have the above prerequisites.

Target Audience: All new and existing bus technicians

Classroom equipment and supplies: Notepads, pens/pencils, flip chart or whiteboard (and markers), classroom, laptop, projector, highlighters, note cards and name cards

Course materials, training aids and references: Student workbooks, manuals, handouts, PowerPoint, pre- and post-training questions; laptops with OEM software, buses for use in diagnostic practice

Instructor:

Course developer: Brian Lester, EDSI

Subject matter experts: Darryl Desjairlais (New Flyer); John Webster (ATU Local 382), Kevin Barrett (ATU Local 85); Russell Anderson (VTA)

Revision date: 5/15/13

Follow-up: Feedback by SMEs, scheduled for committee review May 2013

Instructor and course evaluation: Local course evaluation sheets should be used if present.

Job tasks learning objectives/OJT checklist: The concrete tasks that can be performed to apply the knowledge taught in this course and reinforce the content are found within the learning objectives in Appendix A.

