



**APTA PR-E-RP-020-26**

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PRESS Electrical Working Group

# Convenience Outlets

**Abstract:** This recommended practice provides guidance for 120 Vac convenience outlets and USB receptacles on passenger rail vehicles.

**Keywords:** 120 Vac outlets, convenience outlets, USB power

**Summary:** This document provides guidance regarding the performance, installation and testing requirements of passenger convenience outlets. It addresses GFCI grounding implementation, commonality of receptacle parts, load distribution and outlet spacing standards.



## Foreword

The American Public Transportation Association is a standards development organization in North America. The process of developing standards is managed by the APTA Standards Program's Standards Development Oversight Council (SDOC). These activities are carried out through several standards policy and planning committees that have been established to address specific transportation modes, safety and security requirements, interoperability, and other topics.

APTA used a consensus-based process to develop this document and its continued maintenance, which is detailed in the [manual for the APTA Standards Program](#). This document was drafted in accordance with the approval criteria and editorial policy as described. Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

This document was prepared by the Electrical Working Group as directed by the Passenger Rail Equipment Safety Standards Policy and Planning Committee.

This document represents a common viewpoint of those parties concerned with its provisions, namely transit operating/planning agencies, manufacturers, consultants, engineers and general interest groups. The application of any recommended practices or guidelines contained herein is voluntary. APTA standards are mandatory to the extent incorporated by an applicable statute or regulation. In some cases, federal and/or state regulations govern portions of a transit agency's operations. In cases where there is a conflict or contradiction between an applicable law or regulation and this document, consult with a legal adviser to determine which document takes precedence.

This is a new document.



## Table of Contents

Foreword .....	ii
Participants.....	v
Introduction.....	vi
Scope and purpose .....	vi
<b>1. Definition and purpose of 120 Vac outlets .....</b>	<b>1</b>
<b>2. Power distribution.....</b>	<b>1</b>
2.1 Transformer configuration .....	1
2.2 Grounding protection .....	1
2.3 Branch circuitry .....	2
<b>3. Receptacle hardware .....</b>	<b>2</b>
3.1 Outlets – general .....	2
3.2 USB outlets .....	2
3.3 Serviceability .....	3
3.4 Receptacle wiring.....	4
3.5 Labeling .....	4
<b>4. Convenience outlet locations .....</b>	<b>5</b>
4.1 Passenger use .....	5
4.2 Crew use.....	5
4.3 Equipment maintenance.....	5
<b>5. USB locations .....</b>	<b>6</b>
<b>6. Servicing .....</b>	<b>6</b>
6.1 Testing intervals.....	6
6.2 Receptacle pull strength test .....	6
6.3 USB replacement .....	7
Related APTA standards .....	8
References.....	8
Definitions.....	8
Abbreviations and acronyms.....	8
Document history .....	9



## List of Figures and Tables

<b>Figure 1</b>	Hospital-Grade Tamper-Resistant Outlet .....	2
<b>Figure 2</b>	Combination Receptacle and USB-C Device .....	3
<b>Table 1</b>	Receptacle Features per Location.....	3
<b>Figure 3</b>	Wiremold Installation .....	4
<b>Figure 4</b>	Typical Receptacle Wiring .....	4
<b>Figure 5</b>	Example Decals .....	5
<b>Figure 6</b>	General Three-Prong Receptacle Tester .....	6
<b>Table 2</b>	Outlet Minimum Pull Force, In Service .....	6
<b>Figure 7</b>	Outlet Tension Tester.....	7
<b>Table 3</b>	USB Rated Mating Cycles .....	7



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### **Introduction**

*This introduction is not part of APTA PR-E-RP-020-26, "Convenience Outlets."*

This standard applies to all:

1. Railroads that operate intercity or commuter passenger train service on the general railroad system of transportation; and
2. Railroads that provide commuter or other short-haul rail passenger train service in a metropolitan or suburban area, including public authorities operating passenger train service.

This standard does not apply to:

1. Rapid transit operations in an urban area that are not connected to the general railroad system of transportation;
2. Tourist, scenic, historic or excursion operations, whether on or off the general railroad system of transportation;
3. Operation of private cars, including business/office cars and circus trains; or
4. Railroads that operate only on track inside an installation that is not part of the general railroad system of transportation.

### **Scope and purpose**

This Standard provides requirements for 120Vac convenience outlets and USB outlets on passenger rail vehicles. It included requirements for power distribution, GFCI, receptacle hardware, location guidance, and servicing.

# Convenience Outlets

## 1. Definition and purpose of 120 Vac outlets

Convenience outlets were originally installed on passenger equipment as something that would primarily be used for the crew and maintenance personnel in the cleaning and maintenance of the equipment. As the number of personal electronics has grown, passenger rail equipment has been outfitted with convenience outlets for the benefits of passengers as well. Both cases of convenience outlets use 120 Vac power that is stepped down from the trainline 480 Vac HEP. As these outlets can be inside or outside the equipment, as well as crew- or customer-facing, care must be taken to ensure that they are properly integrated into the car and will ensure the safety of the end user.

## 2. Power distribution

All power distribution should be provided by 480 Vac three-phase power following APTA PR-E-RP-016-99, “480 Vac Head End Power System.”

### 2.1 Transformer configuration

Following the recommended practices in APTA PR-E-RP-016-99, convenience outlets should be classified as secondary loads. Secondary loads should be configured using a delta-connected primary and grounded secondary.

### 2.2 Grounding protection

Proper grounding protection is essential for convenience outlets to prevent passengers and crew members from being exposed to potentially hazardous shocks from ground faults. There are two primary types of devices, GFCIs and RCBOs, that are used to provide this protection.

#### 2.2.1 GFCIs

GFCIs (ground fault circuit interrupters) are the prevailing standard for grounding protection in North America. These are electronic devices that work by sensing a current imbalance on the output load of the device. Generally, the GFCI is integrated into the receptacles themselves, but they can also exist as standalone devices.

GFCI devices used for convenience outlets should be Class A as defined by UL 943:

- Rated to 120 Vac, 208Y/120 Vac, 120/240 Vac, 60 Hz operation
- Rated maximum fault current of 6 mA
- Auto-monitoring function including a TEST push button

#### 2.2.2 RCBOs

RCBOs (residual-current circuit breakers) are more common in the European market but can be used as an alternative to provide grounding protection. They are electromechanical devices that also work by sensing a

current imbalance on the output load of the device. RCBO devices will only be circuit breakers and not installed in the receptacles themselves.

As defined by IEC 61009-1:

- Rated to 120 Vac, 60 Hz operation
- Rated maximum fault current of 30 mA
- Include embedded TEST push button
- Class Type A for which tripping is ensured for residual sinusoidal alternative currents and residual pulsating direct currents (up to 6 mA)
- Compliant to IEC 60077-1 (railway environmental conditions including shock/vibe, EMC)

### 2.3 Branch circuitry

Each car should have convenience outlets separated into a minimum of four separate power circuits, each of which should support 20 A distribution. An individual duplex receptacle may be rated for 15 A if at least two are present on each individual 20 A power circuit. The passenger area convenience outlets on each car should be evenly divided into the total number of power circuits. The locations and number of outlets are further explained in Section 4.

## 3. Receptacle hardware

### 3.1 Outlets – general

Receptacle hardware should be commonly available duplex convenience receptacles using NEMA 5-15R or 5-20R receptacles as defined by UL 498. Receptacles for passenger use should be UL hospital-grade receptacles that are denoted with a green dot affixed to the faceplate (**Figure 1**). Hospital-grade receptacles are manufactured to a higher tolerance and offer better long-term reliability compared with standard receptacles. Outlets used for crew and car servicing can use commercial grade receptacles with embedded GFCI protection as defined per UL 943. All customer-facing receptacles should also be tamper-resistant to prevent unintended shocks. The various combinations are shown in **Table 1**.

**FIGURE 1**  
Hospital-Grade Tamper-Resistant Outlet



### 3.2 USB outlets

It is recommended to use USB power devices that use existing duplex form factor either as standalone devices or combined with receptacle outlets ([Error! Reference source not found.](#)). If using a combination receptacle

**APTA PR-E-RP-020-26**  
**Convenience Outlets**

and USB receptacle, ensure that USB ports are uniquely identified or mechanically different from the receptacles to avoid passenger confusion and potential damage to the outlet. The USB outlets should be certified to UL 1310.

**FIGURE 2**

Combination Receptacle and USB-C Device



**TABLE 1**

Receptacle Features per Location

Location	Hospital-Grade	Tamper-Resistant	USB Receptacle	Integrated GFCI	NEMA
Passenger receptacle	X	X			5-15R
Passenger receptacle with USB	X	X	X		5-15R
Passenger standalone USB receptacle			X		n/a
Bathroom receptacle		X		X	5-20R
Service receptacle		X			5-20R
Interior maintenance receptacle	X	X		X	5-20R
Exterior maintenance receptacle				X	5-20R

### 3.3 Serviceability

Receptacles should be installed in a way that allows easy release and requires minimal disassembly for change-out. Where practical, receptacles should be mounted from the front. Because of the heavy use anticipated, receptacles should be mounted robustly so the mounting does not fail and the receptacle does not become loose over time from rough handling. This includes both inserting the plug as well as removing it.

Receptacles that don't have an integrated cover as part of the installation of assembly should use a stainless steel receptacle plate. One example of integrated covers would be a surface-mounted raceway type installation along the side of the vehicle, as shown in [Figure 3](#).

**FIGURE 3**  
Surface-Mounted Raceway Installation

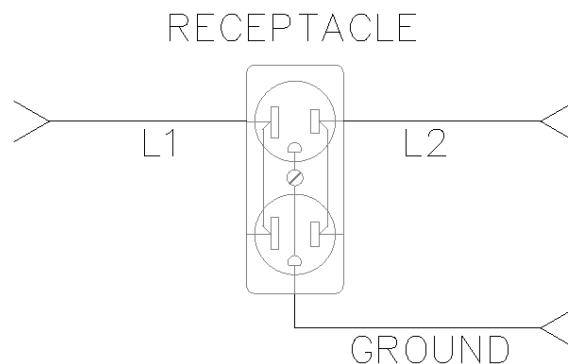


Externally mounted receptacles, such as undercar or in equipment rooms, should be equipped with robust metal weather-resistant covers, with spring-closing lids to protect the receptacles when not in use.

### 3.4 Receptacle wiring

Wiring should be done in accordance with APTA PR-E-S-005-98, “Grounding and Bonding.” This includes the use of a dedicated grounding wire. Receptacles should not use the metal case of the housing as their primary ground. Installation of the wiring should follow the receptacle manufacturer’s recommendations, such as standard screw terminals requiring the use of ferrules, ring lugs or other termination method with stranded wire.

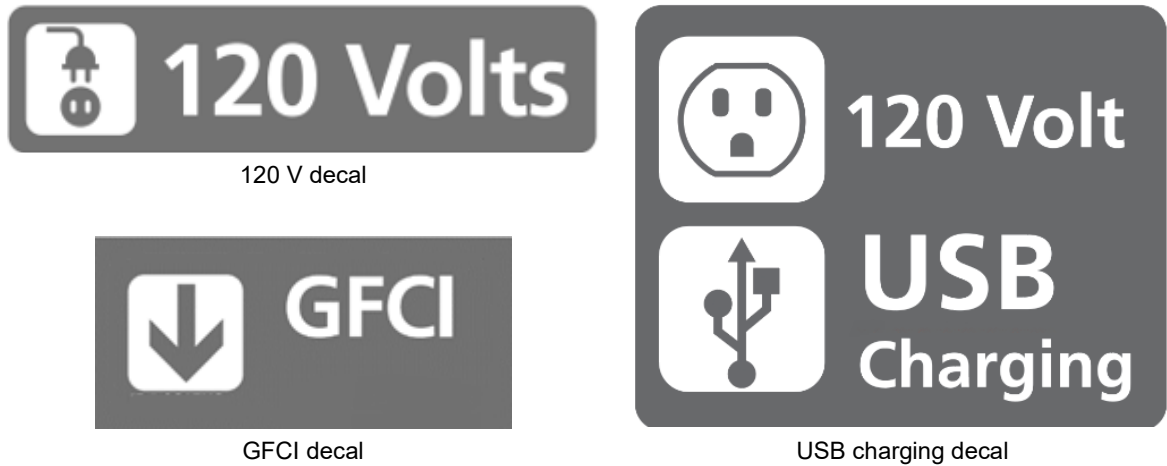
**FIGURE 4**  
Typical Receptacle Wiring



### 3.5 Labeling

Labeling should be provided in accordance with the railroad signage standards indicating that the outlet is 120 V or USB as applicable. Capacity ratings are not required to be noted on standard receptacles. USB outlets can be noted with their maximum current, as it affects their charging abilities for various devices. See **Figure 5** for examples.

**FIGURE 5**  
Example Decals



## 4. Convenience outlet locations

### 4.1 Passenger use

Each seating position should have access to a receptacle. Common locations for receptacles are either between the individual seats or along the outside wall of the car. This applies to general coach seating as well as lounge and dining cars. In passenger rooms, a duplex receptacle should be provided for each passenger seat position.

Care should be taken that outlets are within appropriate reach distance that they can still be used by those using mobility devices. Receptacles should be placed such that charging cords in use will not create tripping hazards for other passengers and crew.

### 4.2 Crew use

#### 4.2.1 Operating crew

If equipped, the crew office or designated crew area should have an outlet available for the exclusive use of the crew. Crew members use the outlets to charge phones, radios, diagnostic equipment and other railroad-supplied items.

#### 4.2.2 Galley area

Galley outlets and receptacles are outside the scope of this document and should be on their own dedicated circuit breakers. Generally, galley outlets power 120 Vac, 208 Vac and other larger appliances.

### 4.3 Equipment maintenance

#### 4.3.1 Cleaning

Local GFCI receptacles rated for 20 A should be located in each half of the car to allow plugging in vacuums and other similar cleaning equipment. They should be located low to the floor, often on bulkheads or seat pedestals. They should be spaced so cleaners do not require overly long cords on their equipment.

#### 4.3.2 Maintenance

Local GFCI maintenance receptacles should be provided on the exterior of the car for power during maintenance to avoid the need for excessively long extension cords. These must be mounted in weatherproof

enclosures and protected as much as practical from potential debris damage. They should be evenly spaced along the exterior of the car. On cars with equipment rooms, a conveniently located outlet should be provided in each room to power tools required in equipment servicing. Likewise, an outlet should be provided in the car switch/electric locker.

## 5. USB locations

USB outlets should be integrated as part of the passenger use outlets if installed. Integrating into existing receptacles allows for easier serviceability and replicability.

## 6. Servicing

### 6.1 Testing intervals

The functionality of each GFCI device (GFCI receptacle and GFCI circuit breaker) should be verified periodically in accordance with the manufacturer's recommendations.

The railroad should identify the procedure and the periodicity of the test. GFCI receptacles and GFCI circuit breakers can be tested using the self-test of each unit. Testing of each branch circuit or individual GFCI receptacle can be done using a handheld three-prong test device as shown in **Figure 6**.

**FIGURE 6**

General Three-Prong Receptacle Tester



### 6.2 Receptacle pull strength test

Receptacles are wear devices and need to be inspected periodically to ensure that they are retaining the correct amount of tension on electrical outlet prongs. Railroads should develop an inspection procedure that tests each receptacle as part of their periodic maintenance plan. **Table 2** shows the minimum recommended acceptable values for electrical prongs and grounding pins. Receptacles can be tested using mechanical tension devices, as shown in **Figure 7**. Since the number of receptacle cycles will vary greatly between operations, this document does not offer specific intervals for this testing.

**TABLE 2**

Outlet Minimum Pull Force, In Service

Type	Ounce-Force (Newton)
Prongs	10ozf (2.78N)
Grounding pin	10ozf (2.78N)

**FIGURE 7**  
Outlet Tension Tester



### 6.3 USB replacement

Each railroad should develop a replacement plan based on the estimated number of mating cycles of the type of USB receptacles used. Each type has a recommended maximum number of mating cycles, as noted in [Table 3](#).

**TABLE 3**  
USB Rated Mating Cycles

USB Type	Rated Mating Cycles
USB-C	10,000
USB-A	1500

## Related APTA standards

APTA PR-E-S-005-98, “Grounding and Bonding”

APTA PR-E-RP-016-99, “480 Vac Head End Power System”

## References

IEC standards:

IEC 60077-1, “Railway applications - Electric equipment for rolling stock - Part 1: General service conditions and general rules ”

IEC 61009-1, “Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) - Part 1: General rules ”

IEC 62680-1-3, “ Universal serial bus interfaces for data and power - Part 1-3: Common components - USB Type-C® cable and connector specification”

IEEE standards:

IEEE Std 100-1996, “The IEEE Standard Dictionary of Electrical and Electronics Terms”

IEEE 16-2020, “IEEE Standard for Electrical and Electronic Control Apparatus on Rail Vehicles”

UL standards:

UL 498, “Attachment Plug and Receptacle Safety Evaluations”

UL 943, “Ground-Fault Circuit-Interrupters”

UL 1310, “Class 2 Power Units”

## Definitions

**convenience outlet:** A point on the vehicle wiring system that offers electrical charging capabilities to crew members and passengers.

**outlet:** A point on the wiring system where current is taken to supply electrical equipment.

**plug:** A device that, by insertion in a receptacle, establishes a connection between the conductors of the attached flexible cord and the conductors connected permanently to the receptacle.

**railroad:** A passenger rail operator or maintainer of passenger rail equipment.

**receptacle:** A contact device installed at the outlet for the connection of an attachment plug, or for the direct connection of electrical utilization equipment designed to mate with the corresponding contact device.

## Abbreviations and acronyms

<b>A</b>	ampere
<b>ADA</b>	Americans with Disabilities Act
<b>EMC</b>	electromagnetic compatibility
<b>GFCI</b>	ground fault current interrupter
<b>HEP</b>	head end power
<b>Hz</b>	hertz
<b>IEC</b>	International Electrotechnical Commission
<b>IEEE</b>	Institute of Electrical and Electronics Engineers
<b>mA</b>	milliampere
<b>N</b>	newton
<b>ozf</b>	ounce-force
<b>RCBO</b>	residual-current circuit breaker

**APTA PR-E-RP-020-26**  
**Convenience Outlets**

**V** volts  
**Vac** volts alternating current  
**USB** Universal Serial Bus

**Document history**

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