APTA STANDARDS PROGRAM

RECOMMENDED PRACTICE

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Electrical Working Group

27-Point Jumper and Receptacle Hardware for Locomotives, Locomotive-Hauled Equipment and MUs

Abstract: This document defines the recommended practices for 27-point MU control and communication jumper and receptacle hardware for use on new and rebuilt locomotives, locomotive-hauled vehicles and MUs.

Keywords: 27-point, communication trainline, control command, hardware, trainline, MU trainline

Summary: This recommended practice defines the performance requirements, design features and hardware interface dimensions of the 27-point MU control and communication trainline jumper cables and receptacles.

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 document supersedes APTA PR-E-RP-019-99, Rev. 1, which has been revised. Below is a summary of changes from the previous document version:

- Retitled document from "27-Point Jumper and Receptacle Hardware for Locomotives and Locomotive-Hauled Equipment" to "27-Point Jumper and Receptacle Hardware for Locomotives, Locomotive-Hauled Equipment and MUs."
- Updated working group roster; format updated to latest APTA standards format.
- Addition of Summary section.
- Addition of Foreword section.
- Added applicability language in the Introduction.
- Added power car as a vehicle type throughout document.
- Merged former sections 1.1, Scope, and 1.2, Purpose, into Scope and Purpose.
- Revised figures in former section 10, Illustrations. Redistributed revised figures in appropriate places within document.
- Moved former section 2, References, to the new sections Related APTA standards and References.
- Moved former section 3, Definitions, abbreviations and acronyms into new sections Definitions and Abbreviations and Acronyms.
- Renamed and renumbered former section 4, General, to new section 1, Performance requirements.
    - Added new section 1.1, General. Added functional description of 27-point jumper and receptacle hardware for locomotives, locomotive-hauled equipment and MUs.
    - Added new section 1.2, Application to vehicles, illustrating arrangement between vehicles and receptacle positions.
    - Added new Figure 1, Typical Consist 27-Point Jumper Cable Arrangement.

  - Added new Figure 2, 27-Point Receptacle Positions.
  - Added new section 1.8, Watertightness and weatherproofness. Added recommendations for watertightness and weatherproofing.
  - Renumbered former section 4.6, Environment. Clarified recommended service environment considerations.
- Renumbered and renamed former section 5, Receptacle considerations, to new section 2, Receptacles.
  - Revised, renumbered and renamed former Figure 2, Basic Receptacle, to new Figure 3, Basic 27-Point Receptacle.
  - Added new Figure 4, Basic Receptacle Contact Wiring.
  - Revised, renumbered and renamed former Figure 3, Receptacle Types, to new Figure 5, Types of 27-Point Receptacles.
  - Revised and renumbered former Figure 1, Receptacle Contact Block, to new Figure 6.
- Renumbered former section 6, Jumper cables, to new section 3.
  - Revised, renumbered and renamed former Figure 4, Basic 27-Point Jumper Cable, to new Figure 7, Basic 27-Point Jumper Cable.
  - Added new Figure 8, Basic Jumper Cable Contact Wiring.
  - Revised and renumbered former figure 5, Jumper Cable Types, to new Figure 9.
- Renumbered former section 7, Tests to new section 4.
  - Renumbered and renamed former section 7.1, Acceptance tests, to new section 4.1, Production tests. Changed acceptance test recommendations to production test recommendations.
  - Added new section 4.1.1, Insulation. Added insulation production test recommendations.
  - Added new section 4.1.2, Continuity. Added continuity production test recommendations.
  - Added new section 4.1.3, Mechanical. Relocated mechanical test recommendations.
- Added PRIIA Specifications to References.

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Introduction

This introduction is not part of APTA PR-E-RP-019-99, "27-Point Jumper and Receptacle Hardware for Locomotives, Locomotive-Hauled Equipment and MUs."

This recommended practice applies to all:

- railroads that operate intercity or commuter passenger train service on the general railroad system of transportation; and
- 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 recommended practice does not apply to:

- rapid transit operations in an urban area that are not connected to the general railroad system of transportation;
- tourist, scenic, historic or excursion operations, off the general railroad system of transportation;
- operation of private cars, including business/office cars and circus trains unless otherwise required by other standards or regulations;
- railroads that operate only on track inside an installation that is not part of the general railroad system of transportation; or
- vehicle-to-vehicle interfaces that are permanently or semi-permanently coupled within trainsets; however, the exposed ends are still subject to this recommended practice.

Scope and purpose

This document defines the recommended practices for 27-point jumper cables and receptacle hardware for new and rebuilt equipment. APTA PR-E-RP-017-99, "27-Point Control and Communication Trainlines for Locomotives and Locomotive-Hauled Equipment," covers associated vehicle and system recommended practices.

The purpose is to define recommended practices for 27-point jumper cables and associated receptacles, both for construction standards and to ensure mutual mechanical compatibility among products manufactured by different vendors.

27-Point Jumper and Receptacle Hardware for Locomotives, Locomotive-Hauled Equipment and MUs

1. Performance requirements

1.1 General

Jumper cables and receptacles are used for transmission of control, communication and audio signals locomotive-to-locomotive, locomotive-to-car, car-to-car and with MUs. In this arrangement, typically one cable of each functional type is connected between each pair of vehicles.

1.2 Application to vehicles

Figure 1 and **Figure 2** illustrate the typical arrangement of 27-point jumper cables between vehicles and the relative receptacle positions on the rolling stock.

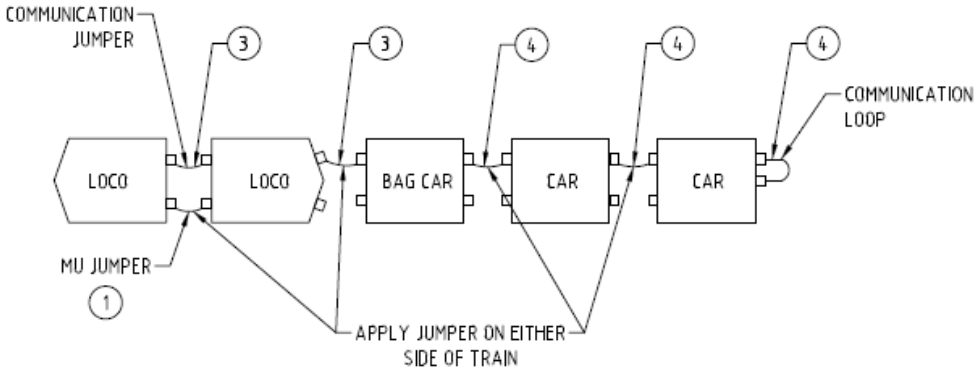
1.3 Identification by mechanical interlocking

Receptacle housings and mating jumper cable plugs for different services (MU, car communication, etc.) should be mechanically interlocked to prevent a jumper being inserted into a different service receptacle. This should be achieved by a combination of two techniques:

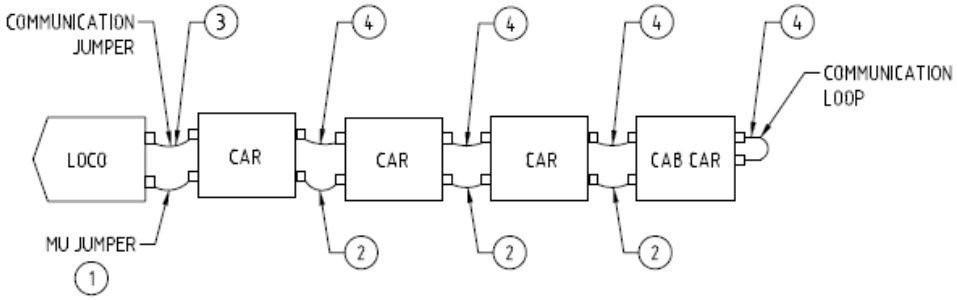
- **Keyways:** A master key on the metal jumper head and corresponding keyway in the metal receptacle housing to provide plug orientation in the receptacle.
- **Contact block rotation:** Rotating the contact block into one of three positions, relative to the housing, to provide unique keying of the mating. (The contact block itself is the same for all applications.)

FIGURE 1

Typical Consist 27-Point Jumper Cable Arrangement



INTERCITY CONSIST



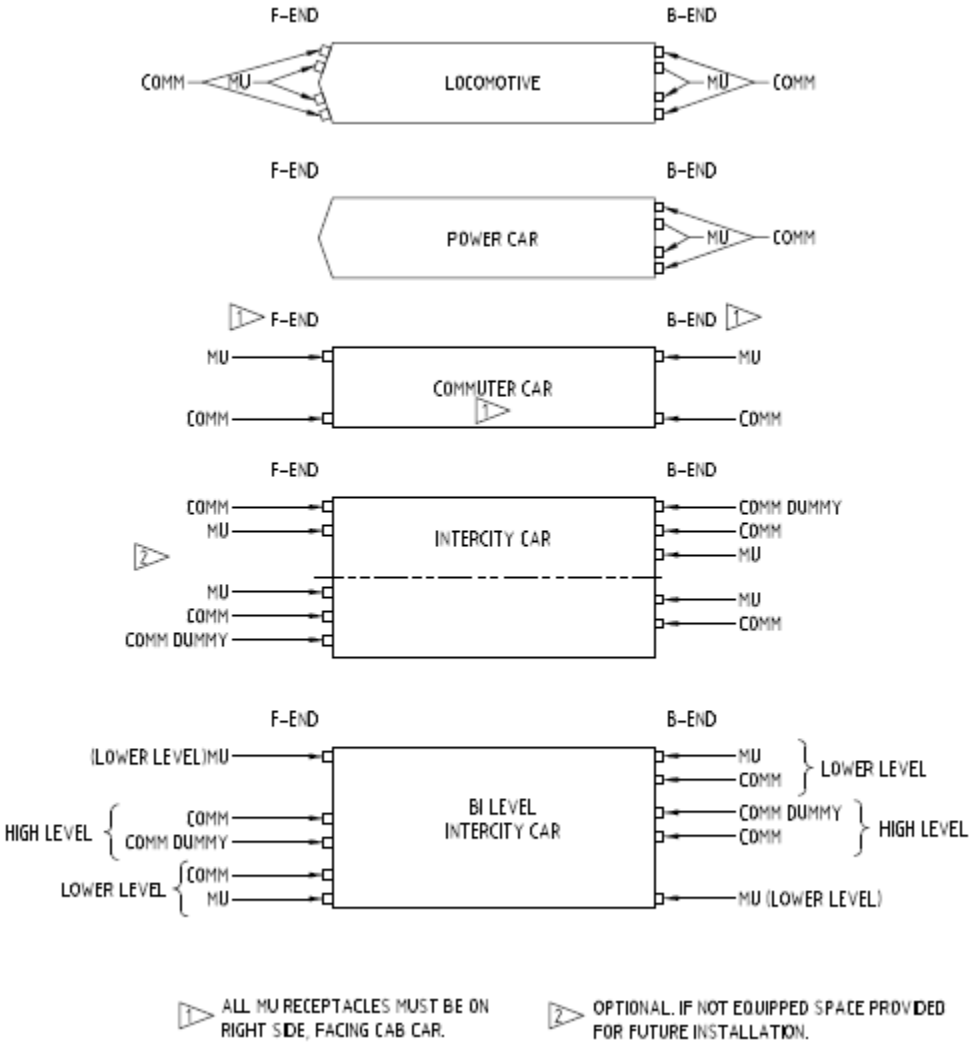
IF CAR IS EQUIPPED WITH COMMUNICATION AND MU RECEPTACLES ON BOTH SIDES, JUMPERS CAN BE APPLIED ON EITHER SIDE

PUSH-PULL CONSIST

LEGEND:

1. MU JUMPER-LOCO-LOCO-CAR
2. MU JUMPER-CAR-CAR
3. COMM JUMPER-LOCO-LOCO-CAR
4. COMM JUMPER-CAR-CAR

FIGURE 2
27-Point Receptacle Positions



NOTE: Power car may be double-ended. MU can be any of the car types.

1.4 Identification by color code

As an identification aid (refer to **Figure 1** and **Figure 2** above), receptacles and associated jumpers should be color-coded and receptacle covers labeled as given in **Table 1** (unless otherwise required by the railroad).

TABLE 1
Color Code

Function	Color[1]	Label
MU Control	Black	"MU"
Communication[2]	Blue	"Comm"
Communication[3]	Yellow	"Comm"
Communication Dummy	White	"Dummy"
MU Dummy (if required)	Yellow	"Dummy"

1. Colors in accordance with OSHA regulations.
2. "Intercity" protocol (see APTA RP-E-017-99, Table 12).
3. "Commuter" protocol (see APTA RP-E-017-99, Table 13).

1.5 Current rating

Contact rating of the mated jumper and receptacle contacts should be 30 A continuous over the entire operating range of the assemblies.

1.6 Contact mating force

Plug/receptacle contact mating force should be 54 lbf ±10 lbf (240 N ±45 N). Individual contacts should fall between 0.5 and 3.25 lbf (2.2 and 14.5 N).

1.7 Jumper head retention in the receptacle

The head of the jumper cable should be retained in the receptacle by the engagement of a boss on the inside surface of the cover into a corresponding cavity in the jumper head. The jumper cable should be sacrificial relative to the receptacle. Design of this interface should be such that neither the receptacle nor the jumper cable is damaged by pulling the locked jumper out of the receptacle, such as by an unauthorized uncoupling.

1.8 Watertightness and weatherproofness

The mating of cable assemblies should provide a weatherproof connection is when exposed to the conditions described in APTA PR-E-RP-017-99, Rev. 2, "27-Point Control and Communication Trainlines for Locomotives, Locomotive-Hauled Equipment and DMUs," Sections 1.4. With a jumper fully seated in a receptacle, a watertight seal should be provided between the mated parts.

1.9 Environment

The receptacles and jumper cables should be designed and manufactured to operate reliably and without degradation under the following environmental conditions or with any additional requirements as specified by the authority. Of particular concern are shock, vibration and ambient temperature range.

The following are examples of conditions that may occur:

- exposure to weather typically experienced throughout the United States.
- direct sunlight
- temperature range from −40 °F to +140 °F (-40 °C to +60 °C).
- 5% to 100% relative humidity, including condensing
- blown and flying sand, dust, ballast, water, ice and other debris at up to 125 mph (200 km/h)
- combined vertical and horizontal movement incidental to motion between vehicles
- diesel fuel, car washing solvents and other fluids commonly experienced in the railroad environment

- being dropped onto the ground or other parts of the vehicle occasionally, as might occur when applying or removing jumpers from a vehicle

2. Receptacles

2.1 Overall assembly

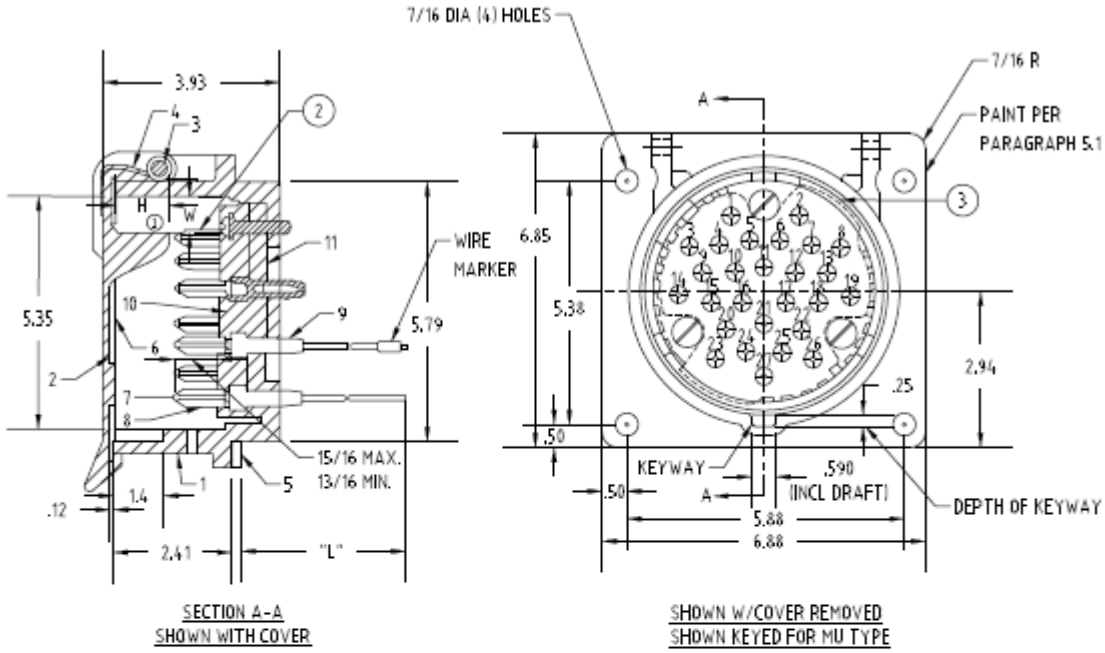
The flange-mounted receptacle assembly should consist of a metallic housing equipped with a contact block having 27 contacts, conforming to **Figure 3**, **Figure 4** and **Figure 5**. The spring-loaded hinged cover should provide a retention force to maintain the mated jumper cable in position in the receptacle.

Receptacles for different purposes should be mechanically interlocked to prevent cross-connecting jumper cables as per Section 1.3.

Pigtail wiring may be provided by the receptacle manufacturer or may be installed by the car/locomotive builder.

FIGURE 3

Basic 27-Point Receptacle



QTY	ITEM	DESCRIPTION
1	11	INSULATION REAR RIGID
1	10	INSULATION FRONT RIGID
27	9	GROMMET
27	8	MULTI CONTACT BAND
27	7	CONTACT PIN SILVER PLATED
1	6	COVER GASKET
1	5	FLANGE MOUNT GASKET
1	4	COVER SPRING, STAINLESS STEEL
1	3	COVER PIN, STAINLESS STEEL
1	2	RECEPTACLE COVER
1	1	RECEPTACLE HOUSING

NOTES:

1. DIM 'H' & 'W' ON COVER LUG MUST ADEQUATELY SECURE PLUG HEAD WHEN CONNECTORS ARE PROPERLY MATED.
2. SUFFICIENTLY SPRING LOADED DIAMETER TO HANDLE 30 AMPERES WHEN INSERTED IN .3125 $\pm^{.002}_{.000}$ I.D. FEMALE CONTACT, SILVER PLATED.
3. SLOT IN CASTING MUST ALLOW FOR REMOVAL OF REAR RIGID INSULATION (ITEM 11) THRU BACK OF HOUSING WITHOUT DISCONNECTING WIRING.
4. RECEPTACLE TO BE PAINTED IN ACCORDANCE WITH SECTION 4.1 WHITE LETTERS ON BLACK & BLUE BACKGROUND.
   BLACK LETTERS ON WHITE & YELLOW BACKGROUND.
5. ASSEMBLY TO BE PERMANENTLY LABELED WITH:
   MANUFACTURERS NAME, PART NO. & DATE OF MANUFACTURE.

FIGURE 4

Basic Receptacle Contact Wiring

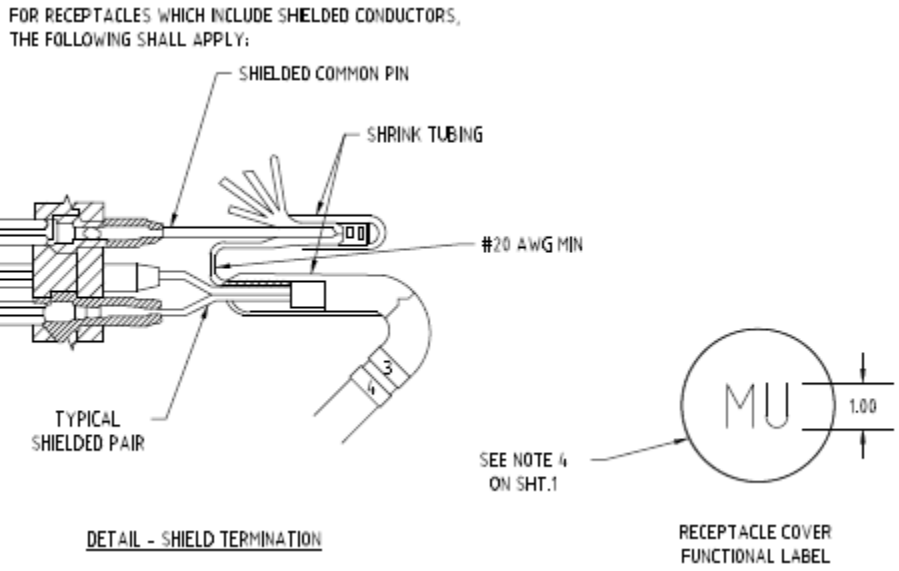
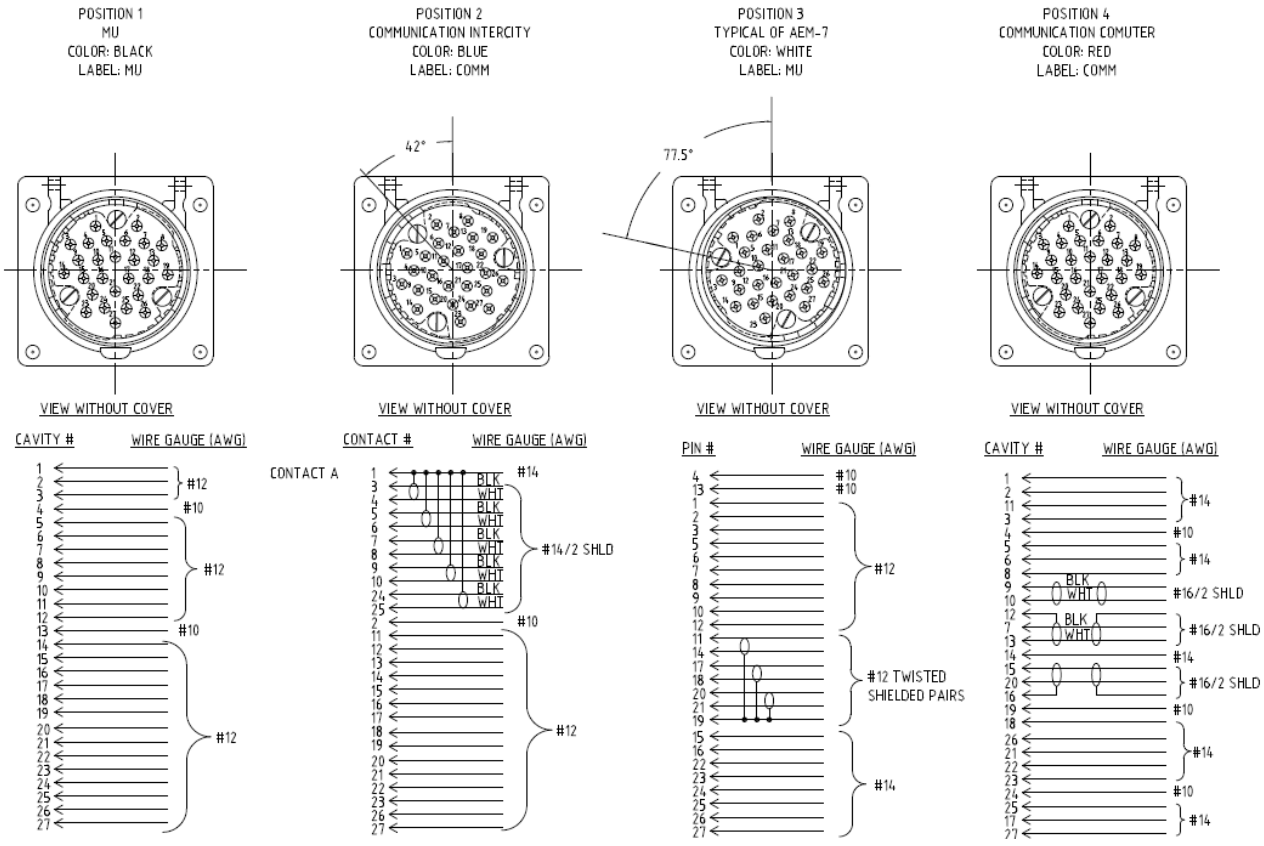


FIGURE 5

Types of 27-Point Receptacles



2.2 Housing

2.2.1 Housing and cover

The receptacle housing and its cover should be of an aluminum alloy or an equivalent corrosion-resistant material. The cover should open a minimum of 90° to allow easy insertion of the jumper plug.

2.2.2 Cover spring and hinge

The cover spring and hinge pin should be stainless steel or an equivalent corrosion-resistant material.

2.2.3 Cover gasket

A durable, long-life gasket, secured with compatible adhesive, should be provided on the inside face of the cover to provide a weatherproof seal when the cover is closed.

2.2.4 Flange seal

A durable, long-life seal, secured with compatible adhesive, should be provided on the mounting flange to provide a waterproof seal between the receptacle and the surface to which it is mounted.

2.2.5 Replacement considerations

A slot should be provided in the housing to make it possible to pass the rear insulator disk of the contact block, in a fully wired condition, through the housing without disconnecting any wiring. This is to allow a damaged housing to be replaced on a vehicle without having to disconnect any wiring.

2.2.6 Assembly color

The assembly should be painted and labeled in accordance with Section 1.4.

2.3 Contact block

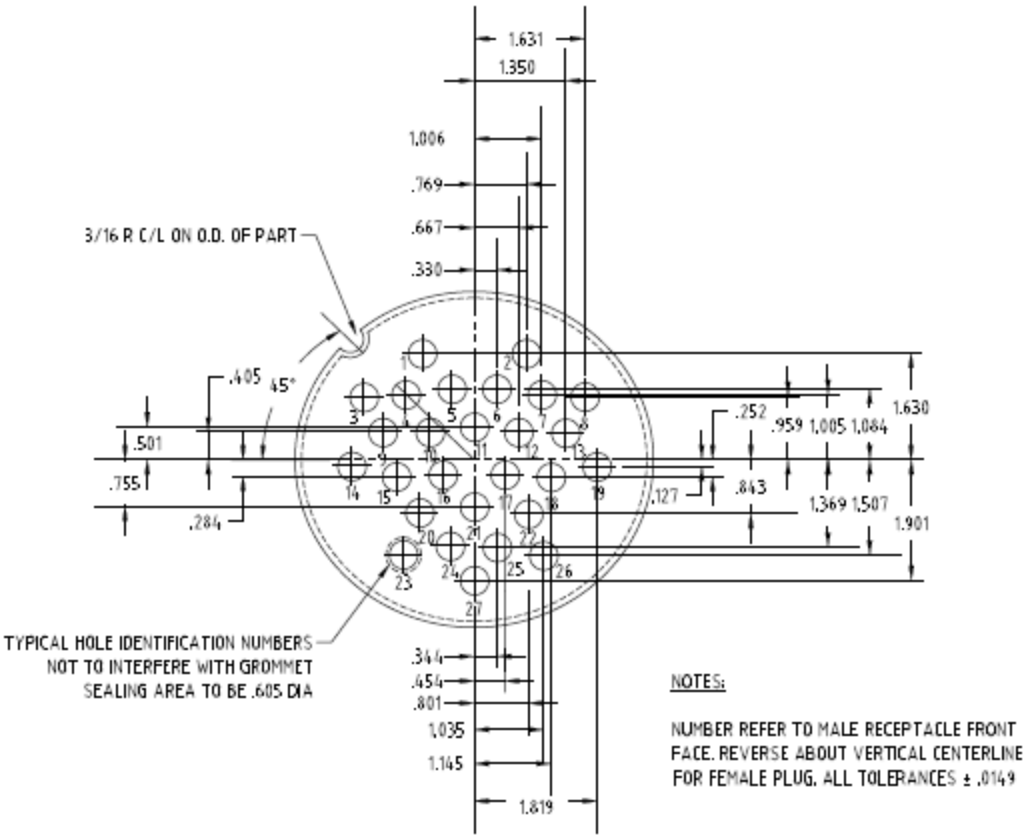
The contact block consists of a pair of insulator disks carrying the 27 contact pins, located in accordance with **Figure 6**. Each pin is crimped onto its respective wire and protected with a one-piece molded grommet. This should provide:

- a resilient mount for the contact;
- electrical insulation at the crimp; and
- mechanical support of the wire as it emerges from the contact.

Each contact cavity should be numbered per **Figure 6** with raised characters a minimum of 3⁄32 in. (2.4 mm) high on the exposed face of the front and the wire side of the back insulation disk.

The contact block assembly should be secured to the housing with screws and suitable locking hardware of stainless steel or approved equal corrosion-resistant material.

FIGURE 6
Receptacle Contact Block



2.4 Contact pins

Pin contacts should be fabricated from materials that meet or exceed the performance of copper alloy and should be silver-plated. The crimp barrel end of the contact should accept either #10, #12 or #14 AWG wire. Crimping should be done consistent with APTA PR-E-RP-002-98, “Installation of Wire and Cable on Passenger Rolling Stock.” Proper crimp tooling should be used to ensure low contact resistance and satisfactory resistance to wire pull-out. All crimps should show the capability to withstand a minimum of a 50 lbf (180 N) tensile pull. The male contact should be the flexible side of the male–female joint and should have adequate spring loading in a 0.3125 in. +0.002/−0.000 in. (7.934 mm +.051/−0.000 mm) socket to meet the contact rating. To ensure low contact resistance, the use of a multi-contact band or equivalent is recommended. This contact shroud should be of a spring type material that does not take a set or deform due to shock encountered in normal service, including occasional dropping.

2.5 Wire for receptacles

The wiring should consist of the number count and size specified by the appropriate wiring schematic (**Figure 5**). Each wire should be identified by a permanent marker located approximately 6 in. (150 mm) from the free end.

The wire should be 600 V, 110 °C, with tinned conductor, with cross-linked polyolefin insulation, per APTA PR-E-RP-009-98, "Ampacities for Wire and Cable Used on Passenger Rolling Stock with Flame, Smoke, and Toxicity Considerations," and as identified in **Table 2**.

TABLE 2
Wire for Receptacles

Wire Gauge (AWG)	Stranding	Wire OD (in.)
#10	27/24	0.183
#12	19/25	0.146
#14	19/27	0.127
#14/2 shielded >85% coverage, with drain	19/27	0.378

3. Jumper cables

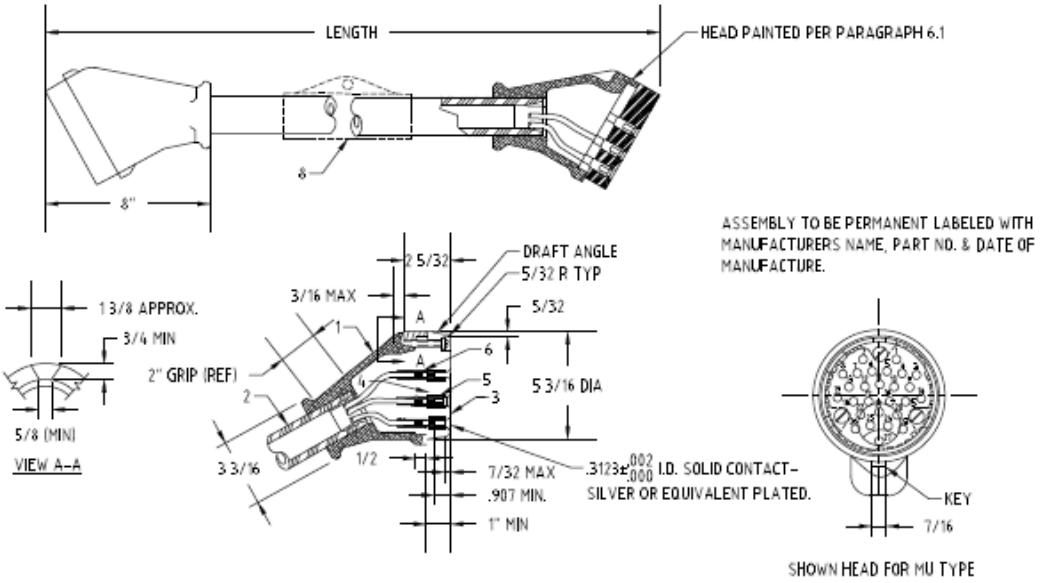
3.1 Jumper assemblies

The portable jumper cable assembly should consist of two 27-conductor plugs connected with a flexible rubber conduit, conforming to **Figure 7, Figure 8** and **Figure 9**. The jumper plug should accept the positive retention force of the spring-loaded hinged receptacle cover to maintain the mated jumper cable in position in the receptacle.

Jumper cables for different purposes should be mechanically interlocked to prevent cross-connecting jumper cables, as described in Section 1.3. During an unauthorized uncoupling of vehicles, the jumper cable should be sacrificial to prevent damage to the receptacle or its mounting, as described in Section 1.5.

The jumper cable assembly should be capable of being stretched as described in Section 3.5 without damage.

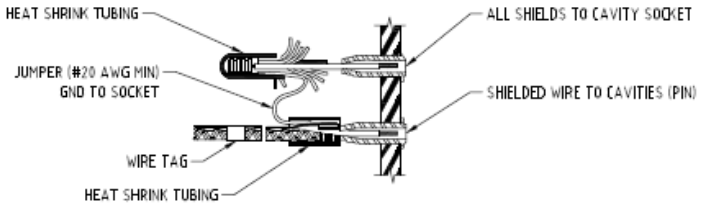
FIGURE 7
Basic 27-Point Jumper Cable



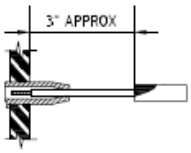
QTY	ITEM	DESCRIPTION
1	8	HANGER (RECOMMENDED ON JUMPERS 90" OR LONGER)
2	7	WEDGE
54	6	GROMMET
54	5	SOCKET CONTACT, SILVER PLATED
2	4	INSULATION, REAR
2	3	INSULATION, FRONT
1	2	1 1/4 I.D. HOSE REQ.
1	1	JUMPER MU HOUSING

FIGURE 8
Basic Jumper Cable Contact Wiring

FOR JUMPERS WHICH INCLUDE SHIELDED CONDUCTORS, THE FOLLOWING CONSTRUCTION SHALL APPLY:



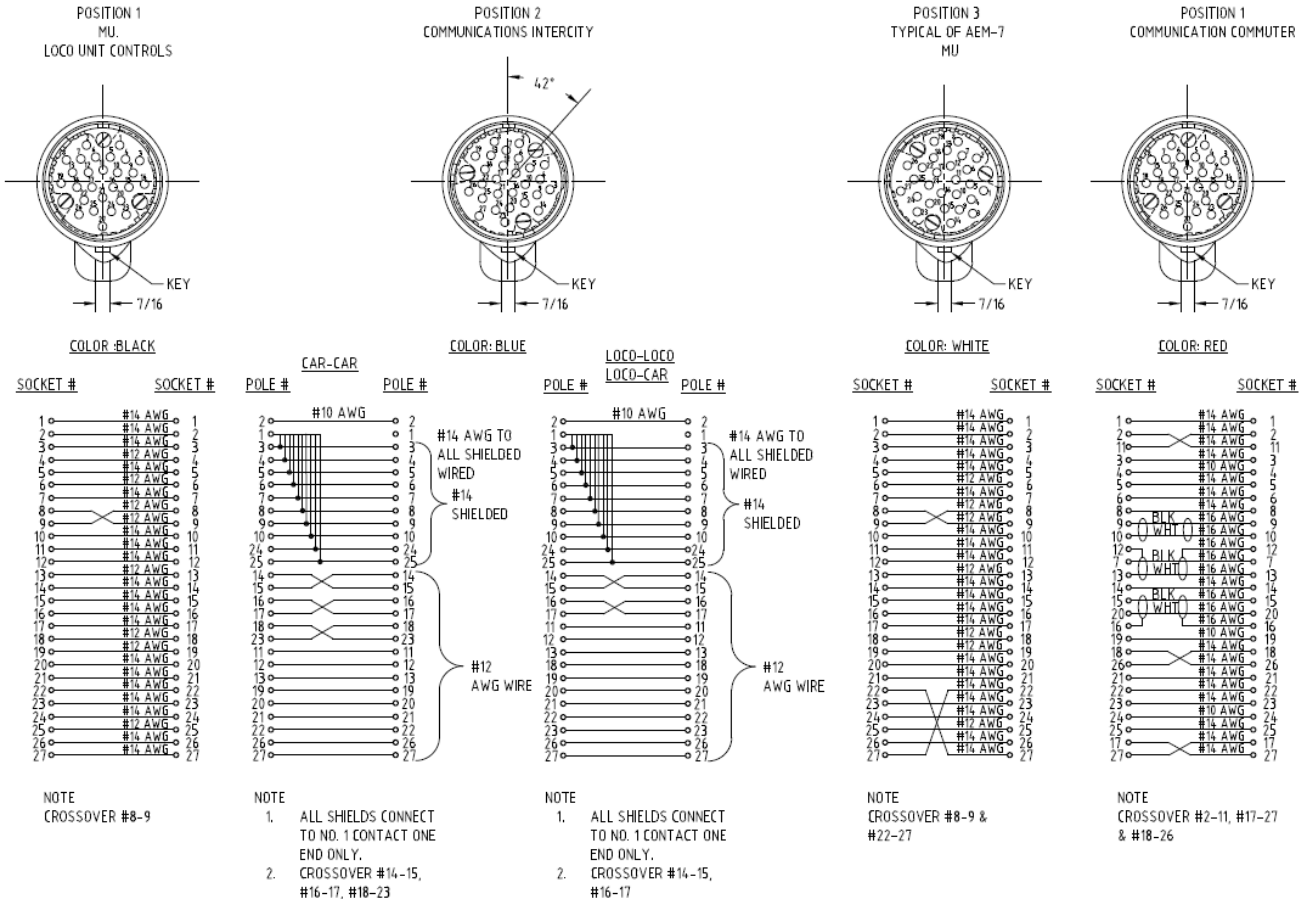
DETAIL B
ONE END ONLY



DETAIL C
ONE END ONLY

PROTECT ENDS OF SHIELDS WITH HEAT SHRINKABLE TUBING AS SHOWN

FIGURE 9
Jumper Cable Types



3.2 Head

The heads should be of an aluminum alloy or approved equal corrosion-resistant material. They should be securely attached to the rubber conduit (hose) mechanically, without adhesive, ensuring that the plugs cannot rotate on the conduit. The connection or joint at each end between plug head and rubber conduit should be watertight. The head assembly should be painted in OSHA colors in accordance with Section 1.4.

3.3 Contact block

The contact block consists of a pair of insulator disks carrying the 27 contact sockets, located in accordance with the spacing shown in **Figure 6**. (Note that the contact block of the jumper is the lateral mirror image of that of the receptacle.) Each contact should be crimped onto its respective wire and protected with a one-piece molded grommet. This should provide:

- a resilient mount for the contact;
- electrical insulation at the crimp; and
- mechanical support of the wire as it emerges from the contact.

The terminated contacts should be secured resiliently in the contact block to permit slight radial movement to allow for minor misalignment between plug and receptacle contacts. The front insulation disk should be molded from a durable, long-life, molded electrical-grade elastomer suitable for the specified environment. It

should have a high durometer rating, which will prevent the contacts from being pulled out of the assembly when plugs are withdrawn from the receptacle under adverse conditions. The rear insulation disk should be molded from a shock-resistant electrical-grade plastic material and should have a low moisture absorption property. The contact block is keyed to the head so it can be installed only in the correct orientation. The same contact block is used regardless of the head keying. Each contact cavity should be numbered per **Figure 4** with raised characters a minimum of 3⁄32 in. (2.4 mm) high on the exposed face of the front and the wire side of the back insulation disk. The joints between the contact block and the head and contacts to contact block should be waterproof. The contact block assembly should be secured to the head with corrosion-resistant screws and suitable locking hardware.

3.4 Contact sockets

Socket contacts should be fabricated from materials that meet or exceed the performance of copper alloy and be silver-plated. The crimp barrel end of the contact should accept either #10, #12 or #14 AWG wire. Crimping should be done consistent with APTA PR-E-RP-002-98, “Installation of Wire and Cable on Passenger Rolling Stock.” Proper crimp tooling should be used to ensure low contact resistance and satisfactory resistance to wire pull-out. All crimps must show the capability to withstand a minimum of a 50 lbf (180 N) tensile pull.

3.5 Wire for jumpers

The wiring should consist of the number count and size specified by the appropriate wiring schematic, **Figure 9**. Each wire should be identified by a permanent marker located approximately 6 in. (150 mm) from one end. There should be a minimum of 6 in. (150 mm) slack in the cut length of the wire bundle for removal of the insulation stack from the head and the replacement of a contact, if needed.

The slack should be evenly distributed throughout the length of the jumper to prevent excess strain and flexing on the contact termination, as well as to allow for hose stretch during adverse conditions. The wire should be 600 V, with tinned conductor, with highly flexible thermosetting insulation, and as identified in **Table 3**.

TABLE 3
Wire for Jumpers

Wire Gauge (AWG)	Stranding	Wire OD (in.)
#10	105/30	0.180
#12	65/30	0.158
#14	41/30	0.146
#14/2 shielded >85% coverage, with drain	105/34	0.175

3.6 Hose

The rubber conduit hose should be of braid reinforced construction, having a nominal inside diameter of 1¼ in. The braid lay should be such that stretching of up to 6 in. is possible, but that it should return to its nominal length within 30 minutes at 60 °F. (15 °C). The hose and its attachment to the heads should be capable of withstanding a minimum tensile pull of 600 lbf (266 N) without damage. The hose should resist damage from sunlight, weather, oil and fluid common to the railroad environment. The inner diameter of the conduit hose, when stretched 10% of the overall jumper length, should not be sufficiently reduced in size to cause the wires to be gripped. This is to prevent the wires from being pulled from the crimped contacts or being broken.

3.7 Hanger

Jumper cables of 90 in. (2.3 m) length or more should have a hanger arrangement to allow it to be supported mid-span. The hanger should be electrically non-conductive and include a metal insert for the attachment of the supporting hook or clevis.

4. Tests

4.1 Production tests

The manufacturer should conduct a complete set of production tests on all receptacles and jumper cables, as described in the following sections.

4.1.1 Insulation

Insulation resistance and dielectric tests should be conducted in accordance with the requirements of APTA PR-E-S-001-98, "Electrical Insulation Integrity," demonstrating the following:

- hipot should occur at 1500 Vac for jumpers:
  - hipot to plug housing
  - between shields and the conductors within the shield

4.1.2 Continuity

Continuity tests should be conducted in accordance with the requirements of APTA PR-E-S-001-98 to ensure the following:

- Continuity exists between all intended contacts of all receptacles/plugs.
- No wires are grounded to plug housing/receptacle body.
- No wires are shorted nor cross-connected to unintended circuits.

4.1.3 Mechanical

Tests should be conducted to verify the following:

- Mating (to ensure proper alignment and operation of each contact, as well as proper retention of the multi-contact band, etc.)
- Mating force measurement (periodic sample only, to verify that contacts meet requirements)

Related APTA standards

APTA PR-E-S-001-98, "Electrical Insulation Integrity"
APTA PR-E-RP-002-98, "Installation of Wire and Cable on Passenger Rolling Stock"
APTA PR-E-RP-009-98, "Ampacities for Wire and Cable Used on Passenger Rolling Stock with Flame, Smoke and Toxicity Considerations"
APTA PR-E-RP-017-99, "27-Point Control and Communication Trainlines for Locomotives and Locomotive-Hauled Equipment"

References

AAR S-512-1994, 27-Point Control Plug and Receptacle Standard

PRIIA specifications:
305-001: Specification for PRIIA Bi-Level Passenger Rail Car
305-003: Specification for PRIIA Single Level Passenger Rail Car
305-005: Specification for Diesel-Electric Passenger Locomotives
305-007: Specification for Trainset
305-009: Specification for Diesel Multiple Units (DMUs)
305-011: Specification for Dual Mode (DC 3rd Rail) Passenger Locomotives

Definitions

27-point jumper cable: A cable assembly having a 27-conductor plug on one or both ends, which is used to provide a flexible electrical connection between two cars and/or locomotives.

27-point receptacles: The receptacles mounted on the ends of rail vehicles into which the 27-point jumper cables mate.

jumper, fixed: A cable assembly having a 27-conductor plug on one end and the other end permanently fixed to the vehicle, which is used to provide a flexible electrical connection between two cars and/or locomotives.

looping: The process of connecting a jumper cable between two adjacent receptacles on the same vehicle. This is normally done on the exposed end of the last car of a train and establishes circuits identifying that point as the end of the train for various trainline circuits.

receptacle, dummy: A receptacle that is used to hold the free end of an unconnected jumper cable. The dummy may include contacts to establish end-of-train circuit functions for the trainline, or it may be a purely passive device with no contacts.

trainline: For the purposes of this recommended practice, an electrical cable system that allows electrical signals to be sent over the entire length of the train. Types include power, control, communication and data, often with more than one function contained within the same cable. The trainline may connect to equipment in each vehicle, or it may simply pass through, providing a signal path between vehicles on opposite ends of that vehicle.

trainline, car control/communication: A trainline (referred to within this document as "communication") whose function is primarily to convey car control and communication signals throughout the train. Typical signals include door controls and indications, public address, brake applied/released indications, etc.

trainline, multiple unit (MU): A trainline whose primary function is to convey traction and dynamic brake commands and indications. This trainline is used to provide those signals between the following:

- locomotives coupled together
- cab car and locomotive
- locomotives or power cars placed at opposite ends of the train
- MUs
- MUs, cab cars and/or locomotives

Abbreviations and acronyms

A amperes
AWG American Wire Gauge
COMM 27-point communication trainline
DMU diesel multiple unit
hipot high potential
lbf pound-force
MU multiple unit
N Newtons
OD outer diameter

Document history

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