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PRESS Mechanical Working Group

End-of-Car Connections with Tightlock and Interlocking Knuckle-Type Couplers

Abstract: This recommended practice defines the position of air connection fittings and electrical connections with respect to tightlock couplers pulling face and shank.

Keywords: air connections, air hoses, brake hoses, communication trainlines, digital trainlines, ECP trainlines, HEP trainlines, MU trainlines

Summary: This recommended practice defines the location of air and electrical connections adjacent to coupler shank for short- and long-shank tightlock couplers used in passenger rail service. It defines the locations for locomotive-to-locomotive, locomotive-to-car and car-to-car connections for air brake fittings and hoses, ECP trainlines, head end power receptacles and cables, multiple unit (MU) receptacles and cables, communications receptacles and cables, and digital trainline receptacles and cables. In addition, it addresses interferences with safety appliances and between the connections. This document was titled “Air Connections for Passenger Cars Equipped with AAR Long Shank Tight Lock or Similar Long Shank Type Couplers” in its previous version.

Scope and purpose: This recommended practice is meant to serve as a tool for passenger locomotive and passenger car designers to heighten the awareness of static and dynamic spatial relationships between certain interface points that are critical. The configurations of end connections shown in this document are recommendations. Applications of end connections shall not conflict with or interfere with the required clearances, access and use of any safety appliance.

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Introduction

This introduction is not part of APTA PR-M-RP-001-97, Rev. 2, "End-of-Car Connections with Tightlock and Interlocking Knuckle-Type Couplers."

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.

This recommended practice was developed from documents formerly maintained by the Association of American Railroads (AAR), including AAR S-031, "Steam and Air Connections—Passenger Car," and AAR S-033, "Steam and Air Connections—Passenger Car." The following documents were used in updating this recommended practice from only addressing air connections into addressing intervehicle connections:

- 49 CFR Part 231, "Railroad Safety Appliance Standards"
- 49 CFR Part 238, "Passenger Equipment Safety Standards"
- *APTA PR-E-RP-016-99*, latest revision, *"480 Vac Head End Power System"*
- *APTA PR-E-RP-017-99*, latest revision, *"27-Point Control and Communication Trainlines for Locomotive and Locomotive-Hauled Equipment"*
- *APTA PR-E-RP-018-99*, latest revision, *"480 Vac Head End Power Jumper and Receptacle Hardware"*
- *APTA PR-E-RP-019-99*, latest revision, *"27-Point Jumper and Receptacle Hardware for Locomotive and Locomotive-Hauled Equipment"*
- *APTA PR-M-S-022-19*, latest revision, *"ECP Passenger Cable-Based Brake System Cable, Connectors & Junction Boxes—Performance Requirements"*
- PRIIA 305-919, "Digital Trainline Hardware"

Additionally, APTA has been requested by the Federal Railroad Administration to make reference to the integration of Safety Appliances in the design process (49 CFR Part 231, "Railroad Safety Appliance Standards" and 49 CFR Part 238, "Passenger Equipment Safety Standards"), as this is also a critical part of designing end-of-locomotive and end-of-car elements.

End-of-Car Connections with Tightlock and Interlocking Knuckle-Type Couplers

The term “shall” is used within this recommended practice. The “shall” term must be enforced for intercar compatibility including a rescue by a freight or another passenger locomotive.

1. Brake connections

1.1 Short-shank couplers

Conventional passenger car and passenger locomotive air brake intervehicle connections consist of two hoses associated with the coupler: brake pipe and main reservoir. This applies to the following situations: locomotive-to-locomotive, locomotive-to-car and car-to-car.

1.1.1 ECP carbody connector mounting envelope

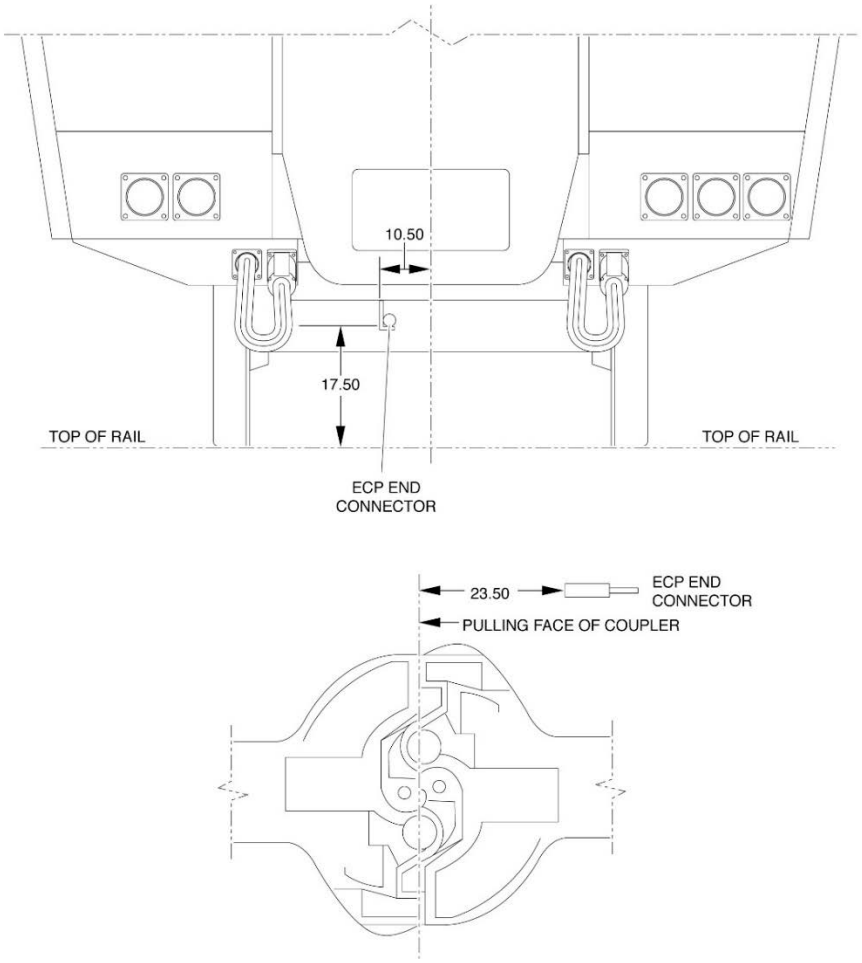
In all cases, 2 in. clearance shall be maintained around the angle cock handle through its full range of handle movement. The connector and the conduit or cable shall not interfere with cross-key removal.

As an alternate to the junction box, the carbody connector may be fitted to a conduit or other suitable rigid conduit fitting. The end of the conduit shall be solidly supported at the end of the car.

In all cases, the cable connection shall be as shown in **Figure 1**.

A suitable dummy coupling shall be provided for each electric connection as per Section 6.2 of this recommended practice.

FIGURE 1
ECP End Connector



NOTE: Dimensions are in inches. The ECP End Connector is the end of car receptacle / junction box (and not necessarily the cable connector).

1.2 Long-shank couplers

1.2.1 Air connections

The air brake end connections should be located as shown in **Figure 2** and **Figure 3**.

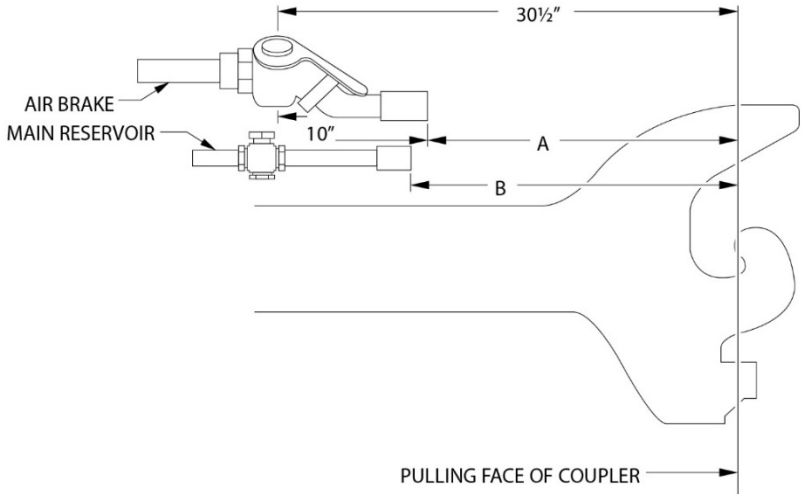
Angle cock and cutout cock shall be located no more than 12 in. behind the exterior plane of the end sheet to provide access to crew members while using end safety appliances. Adequate clearance to other under-car equipment shall be provided to allow access and operation.

NOTE: It is desirable to have the brake pipe and main reservoir end cocks located close to the side of the car to provide improved access for the train crew.

Main reservoir hose shall be 1⅛ in. (2.86 cm) inside diameter and 22 in. (56 cm) long. Refer to AAR Standard S-442-87, Hose Spec. M-601-88, or Alt. Std. M-601-A.

FIGURE 2

Long-Shank Coupler Air Brake End Connections, Pulling Face of Coupler

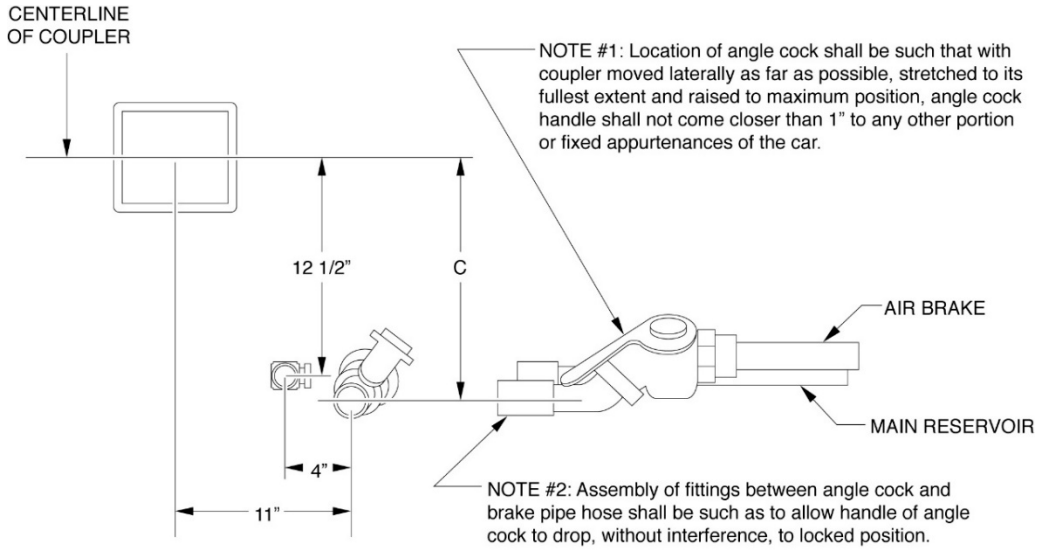


	A	B	C
MIN.	20½″	21½″	13¾
MAX.	21″	24″	14½″

NOTE: C dimension refers to **Figure 3** value.

FIGURE 3

Long-Shank Coupler Air Brake End Connections, Centerline of Coupler



GENERAL NOTES

A. All dimensions subject to a tolerance of plus or minus ⅛ in.
B. In situations where air brake and/or main reservoir cock are located remotely, the positions shown for the pipe nipple and air hose attachment point shall be the governing dimensions.
C. Venting ball cocks shall be used for lines operating at air pressures in excess of 110 psi nominal, to vent hose connection. Where a vent is provided, it shall be located such that it is not above the horizontal plane, taking into account the orientation of the ball cock.
D. Angle cock shall be oriented no more than 30 deg. from vertical.
E. Main reservoir cock shall be oriented no more than 30 deg. from vertical.
F. All trainline mountings to the hose rack shall be arranged to provide clearance with any other car structures throughout the range of swing and vertical coupler movement, as well as buff and draft as the rack follows the movement of the coupler to which it is mounted.
G. Straight brake pipe end cocks may be used with brake supplier-approved fittings.
H. This arrangement is not to be applied to Push-Back/Crash Energy Management (CEM) couplers.

1.2.2 ECP carbody connector mounting envelope

The ECP connection should be located as shown in **Figure 1**.

In all cases, 2 in. clearance shall be maintained around the angle cock handle through its full range of movement. The flexible connection, connector, and conduit or cable shall not interfere with cross-key removal.

As an alternate to the junction box, the carbody connector may be fitted to hose rack suspended from the coupler. The end of the conduit shall be solidly supported to the car structure at the point where the flexible jumper to the hose rack is anchored.

A suitable dummy coupling shall be provided for each electric connection (refer to Section 6.2).

2. Safety appliance and coupler considerations

2.1 General interference

The design of the ends of the vehicles should be integrated early on in the design to comprehensively and holistically meet the following requirements:

1. Location and clearance requirements of 49 CFR Part 231, "Railroad Safety Appliances," *APTA PR-CS-RP-019-11*, latest revision, *"Pushback Couplers in Passenger Rail Equipment,"* and *APTA PR-M-S-016-06*, latest revision, *"Safety Appliances for Rail Passenger Cars."*

2. Receptacle mounting locations shall provide sufficient clearance between, as well as among, receptacles and jumper cables of head end power (HEP), 27-point communication (COMM), multiple unit (MU), ECP and digital trainline (DTL) (if applicable) so they do not rub or foul each other, nor the uncoupling mechanism, buffer/diaphragm, air hoses or coupler. Jumpers shall not interfere with normal use of safety appliances (including uncoupling mechanism) or required clearances. This shall address both conditions of when jumpers are inserted into the receptacles, as well as when receptacles are empty or looped.

   Moreover, this should take into account all practical combinations of vehicles which may be intercoupled: car-to-car, car-to-locomotive (both locomotive ends) and locomotive-to-locomotive (on both ends). Variables include the worst-case combination of the following:

   - relative motion to adjacent vehicle: resulting from operation on worst-case track conditions (i.e., FRA Class 1), in changing curvature, lateral displacement passing through two facing point turnouts or crossovers (reverse curves), in buff and draft, vertical track curves (rises and dips) etc.
   - coupler motion laterally and vertically
   - diaphragm movement (both adjacent another car and when unrestrained)
   - whether jumper is inserted into receptacle or not

   There should be no interference that restricts the receptacle cover from fully opening to allow insertion or withdrawal of jumpers.

   Tests should be conducted with the new and existing rolling stock coupled to verify successful interfaces and freedom from interferences in actual track conditions.

3. Depending on car design, the handbrake mechanism will need to be included in this review if it is located within the respective areas.

2.2 Uncoupling lever with safety appliances

The arrangement of the uncoupling lever shall be coordinated with the location of the nearby safety appliances. These include the uncoupling levers and the end handholds. Refer to 49 CFR 231.12, 231.13 and 231.14, as well as *APTA PR-M-RP-002-98*, latest revision, *"Inspection & Maintenance of Type H-Tightlock Coupler Systems,"* and *APTA PR-M-S-016-06*, latest revision, *"Safety Appliances for Rail Passenger Cars"* for details.

2.3 Uncoupling levers with jumper cables

Clearance identified in AAR Standard S-132, "Type No. 6 Operating Mechanism" and other uncoupling lever designs shall be maintained, as applicable. Clearance surrounding the uncoupling lever, including jumper cables, shall be maintained to prevent interference with use.

3. Locomotive compatibility

3.1 Locomotive MU hoses

In addition to the hoses identified in Section 1, passenger locomotives need to be equipped with MU hoses to facilitate proper independent air brake operation of two or more passenger and/or passenger and freight locomotives. These three hoses should be located at all four corners of the locomotive, in accordance with **Figure 4**, **Figure 5**, and AAR Standard S-5529, "Multiple Unit Pneumatic Brake Equipment for Locomotives." Moving outward away from the locomotive coupler, they are:

- main reservoir equalizing,
- actuating, and
- independent application/release.

FIGURE 4
Front End Sheet Locomotive Air Brake Connections

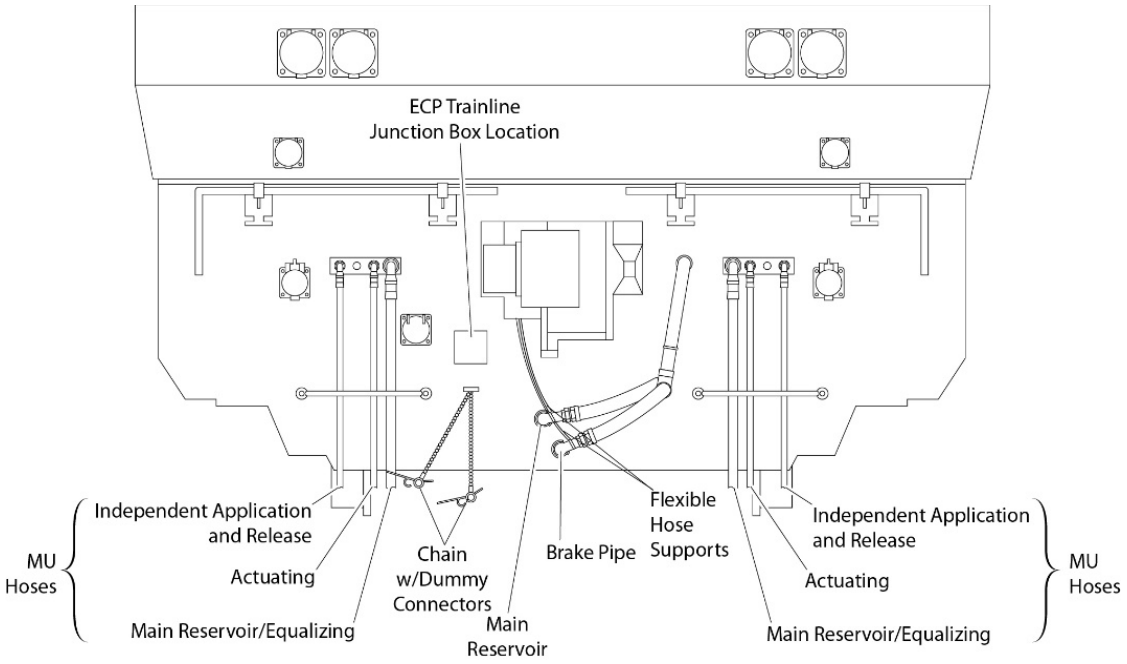
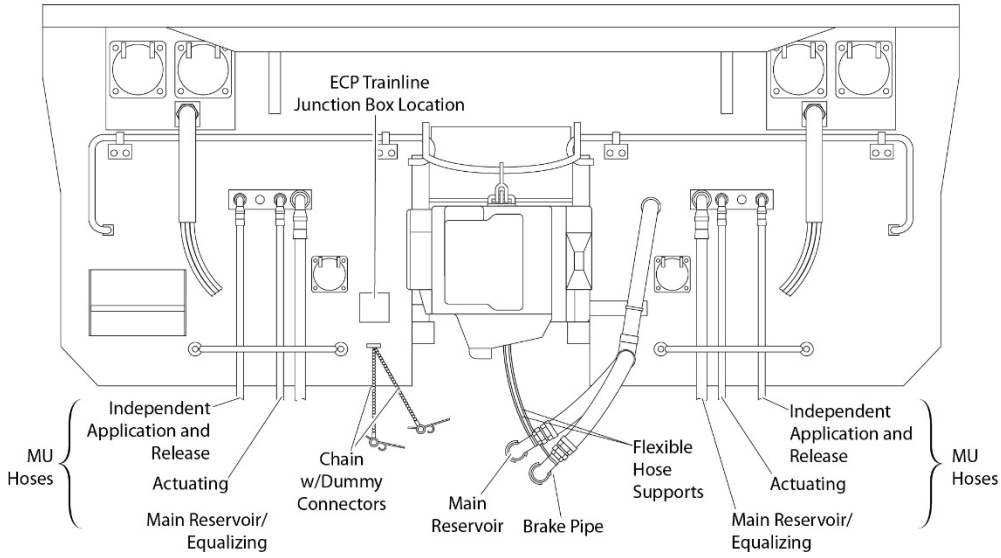


FIGURE 5
Rear End Sheet Locomotive Air Brake Connections



3.2 Locomotive-locomotive-car

Compatibility of both ends of the locomotive shall be considered during design to address all the various coupling combinations possible between two locomotives: F-R, F-F and R-R. Likewise, a locomotive can be coupled to the passenger cars facing either way: F-end to the cars or R-end to the cars. This shall also address the fact that opposite ends of a passenger car may not be the same, such as with a cab car. Compatibility includes coupling; air brake hoses; HEP, 27-point MU and COMM, and DTL (if equipped) jumpers and buffer/diaphragm. Not only is the geometry of all these intervehicle connections different among the combinations of vehicle orientations, but the dynamic motion across the interface differs considerably among them. Locomotives and cars are generally designed independently of each other without serious regard to the location of the various jumper cables crossing the interface between them until late in the design, at which point it is hard to change the design if it is not favorable. This can result in awkward and unreliable jumper interfaces between the locomotive and car.

3.2.1 Pilot

The locomotive or cab car pilot, sometimes referred to as the “snow plow,” is installed on the leading end(s) of a locomotive and the cab end of a cab car. Its profile shall adhere to the clearance requirements of the host railroad(s) as well as any others which the unit might experience, in addition to meeting the 49 CFR 229.123 requirement for railhead clearance.

In addition to deflecting obstacles from the track to protect the locomotive, the pilot can be helpful in offering some protection for the HEP receptacles/jumper cables on the F-end. This may be accomplished by the addition of small doors that are normally closed, flush with the pilot, but can be opened when the receptacles are in use. If this provision is incorporated, then the inside edges of the opening should be well-rounded so as to not expose sharp edges to the cables passing through it. The hole size and location should minimize the contact of jumpers during normal movement so as to minimize rubbing on the edges of the opening during any dynamic relative motion between vehicles.

When evaluating clearance to another locomotive or car, the following variables shall be considered: operation on worst-case track conditions (i.e., FRA Class 1), curving left or right, vertical curves, changes in

curvature, buff and draft, lateral offsets resulting from two facing point turnouts or crossovers (reverse curves), etc.

NOTE: Most of these are additive (worst-case curving occurring during maximum buff, for example).

3.2.1.1 Locomotive-to-locomotive

Pilots shall never interfere with the operation of corresponding cables, hoses and receptacles of a coupled locomotive. Clearance evaluation shall consider all possible locomotives with which the equipment might be coupled, even if infrequently, including freight road locomotives of the host railroad. The review shall also include locomotives coupled F-end to R-end, "elephant style."

3.2.1.2 Locomotive-to-car

When a locomotive is coupled with its F-end against the cars, the pilot shall not interfere with the operation of cables, hoses and receptacles on the car to which it is coupled. The analysis shall take into account that the locomotive may be coupled to various types of cars, and that the car ends may not be the same, such as with a cab car.

3.2.1.3 Car-to-car

Cab cars may be coupled F-end to F-end. Accordingly, the pilots of the two cars shall not interfere with the operation of cables, hoses, and receptacles on the car to which it is coupled. The analysis shall take into account that there may be more than one type of cab car.

4. Buffers and diaphragms

Diaphragms are used to enclose the intercar pathway between adjacent passenger cars. The bottom portion, including the walk plate, is referred to as the buffer. A wide variety of diaphragm types are used among passenger car fleets.

Passenger cars can have either of two intercar doorway floor heights:

End Type	Height Above Top of Rail	Application
Low-level end	50–53 in.	All single-level cars, multilevel cars, gallery cars, low end of high-level transition cars
High-level end	104½ in.	High-level intercity

The mating face of the passenger car buffer and diaphragm extends approximately 2 in. beyond the pulling face of the coupler when not against another diaphragm. When coupled to another car, the mating face is approximately even with the coupler pulling face.

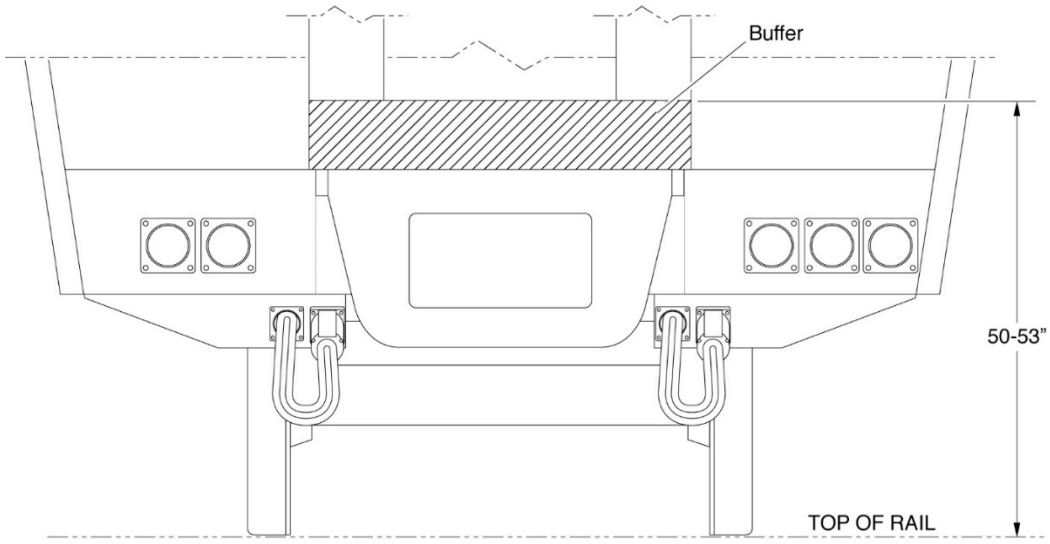
There is substantial movement between the buffers of two coupled cars in both the vertical and lateral directions. These actions shall be considered in the design of end-of-car trainline connections.

NOTE: There is substantial relative movement between the buffers of two coupled cars as the cars move along the railroad—some vertical, but considerably lateral. Maximum displacement occurs around stations and especially in yards, where operation is on worst-case track conditions (i.e., FRA Class 1), where there are many sharp radius turnouts, two facing point turnouts and crossovers (reverse curves). As the train snakes through these demanding track geometries, there can be up to 17 in. of lateral movement. Likewise, track vertical curves during dips cause the tops of the adjacent diaphragms to become closer to each other, especially on high-level cars.

4.1 Low-level end doorways

Refer to **Figure 6**.

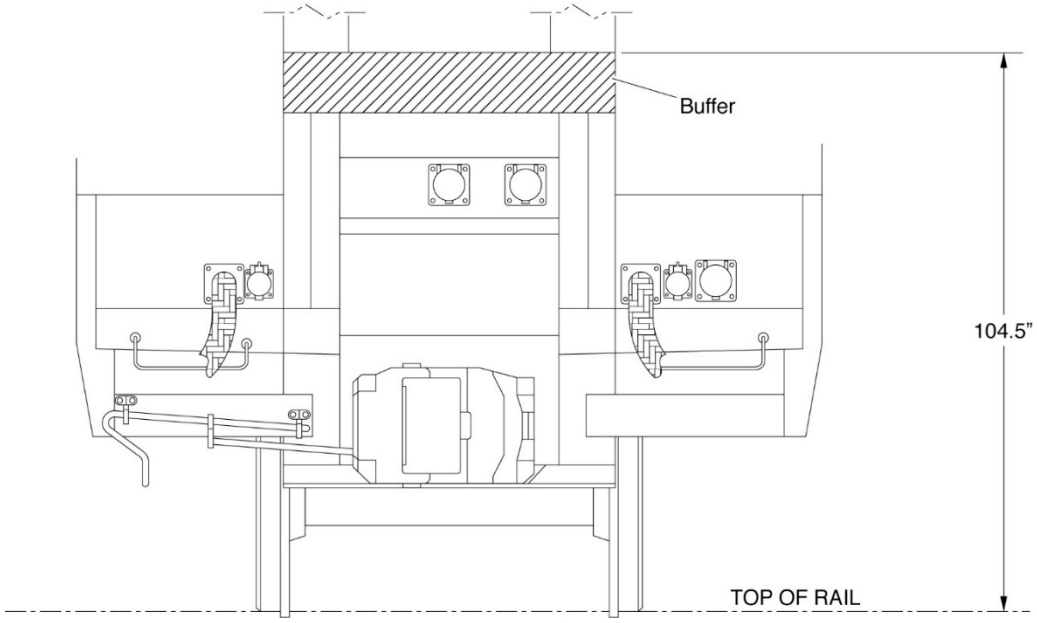
FIGURE 6
Low-Level End Doorway Buffer/Diaphragm Interfaces



4.2 High-level end doorways

Refer to **Figure 7**.

FIGURE 7
High-Level End Doorway Buffer/Diaphragm Interfaces



4.3 Locomotive

Locomotives are generally not equipped with diaphragms; however, the cars to which they couple are. A fixed buffer surface or some other alternative may be necessary on the locomotive end to allow the car diaphragm/buffer to move against the locomotive without damage and/or snagging of trainlines.

5. Power and communication trainlines

5.1 General considerations

5.1.1 General

The receptacle locations identified in this document were developed to allow interoperability between different fleets as well as to allow the use of the same standard-length HEP, MU and communication jumper cables universally, eliminating the need of developing unique jumper lengths for each new locomotive and/or car design.

Receptacle and jumper locations are quite sensitive to the mating arrangement locations. Due to the dynamic motion between cars during operation on worst-case track conditions (i.e., FRA Class 1), negotiating curves/changes in curvature and two facing point turnouts, crossovers, draft/buff, etc., the distance between adjacent car/locomotive mounting points varies considerably. Geometry resulting in mounting too far from the coupler pulling face will cause jumpers to pull out on the outside edge of cars taking curves; mounting too close will result in jumpers colliding with those on the adjacent car on the inside edge of cars taking curves. Considerable care is required in locating jumper and receptacle mounting to ensure that it does not interfere with safety appliances and especially the uncoupling mechanism. This, too, shall take into account jumper movement resulting from curving/curvature changes, draft, etc., as well as coupler movement.

Cable length should be in accordance with *APTA PR-E-RP-019-99,* latest revision, *"27-Point Jumper and Receptacle Hardware for Locomotives and Locomotive Hauled Equipment,"* and *APTA PR-E-RP-018-99,* latest revision, *"480 Vac Head End Power Jumper and Receptacle Hardware."*

5.1.2 Commuter

Operation of some commuter authorities is such that all cars always face the same orientation within the consist, e.g., A-end to B-end. Accordingly, this allows the possibility of installation of MU and communication jumper cables to be only on one side of the cars—e.g., MU on the right and communication on the left. This option prevents interfleet operation of the cars outside the original railroad fleet. All cars having only one-sided trainlines should be modified to allow for future installation of the 27-point receptacles on both sides on both ends.

5.1.3 Intercity/long distance

Operation of intercity/long distance cars is such that any car can be rotated end-to-end—e.g., A-end to A-end or A-end to B-end. Accordingly, this requires MU and communication trainline receptacles on both sides of all cars.

5.1.4 Mounting

The plate to which the receptacles and fixed jumper flanges are mounted should be reinforced to resist, without bending, forces produced from pulling the locked jumper out of the receptacle, such as by an unexpected uncoupling. A sacrificial element (e.g., jumper cable, breakaway mounting) should be used to avoid damaging the internal wiring of the vehicle.

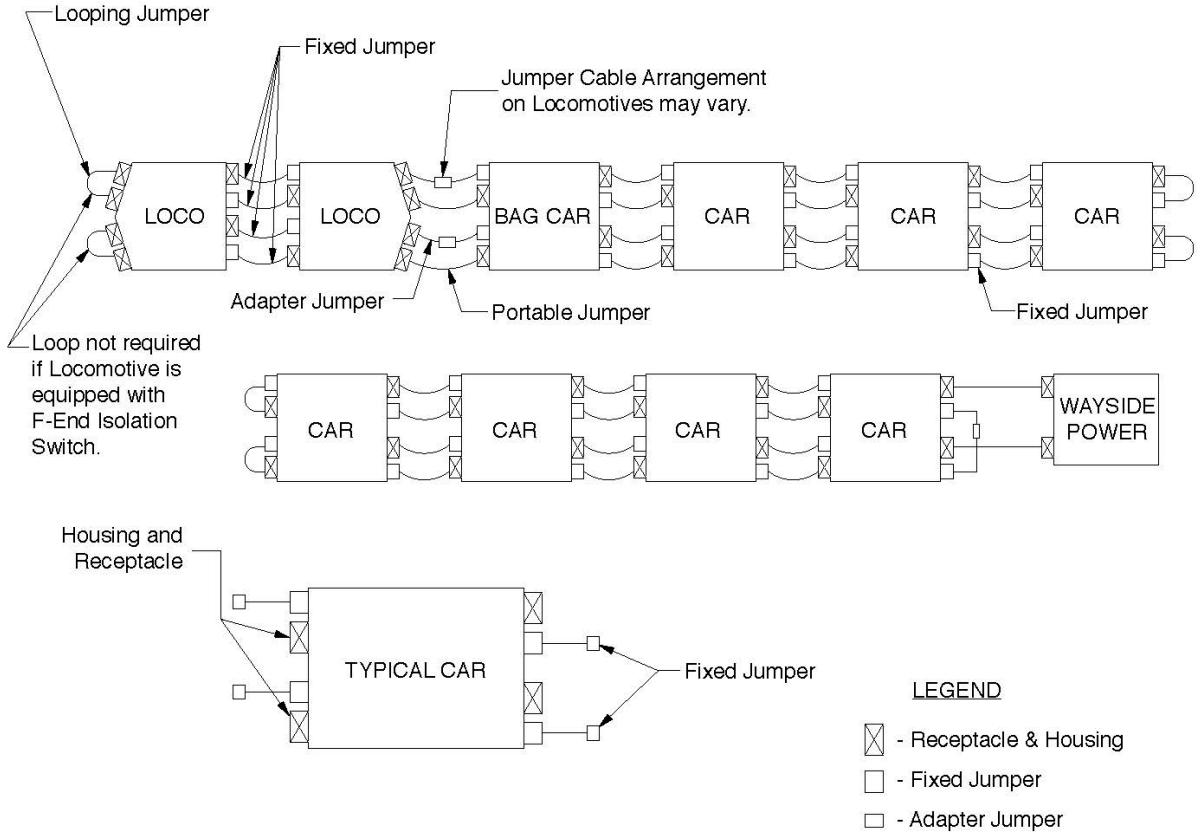
5.2 Head end power (HEP) trainlines (480 Vac)

5.2.1 General

The HEP trainline is an electrical cable system that allows HEP to be transmitted over the entire length of the consist. The trainline may provide auxiliary power to the equipment in each vehicle or may simply pass through, providing a power path between opposite ends of that vehicle. Power to feed the trainline may be a locomotive, power car or ground (wayside) power. HEP is generally 480 Vac, three-phase, 60 Hz. When a consist, with or without locomotive, is parked in a yard or station for an extended period, it is often connected to wayside power. For a detailed description of the HEP system, refer to *APTA PR-E-RP-016-99*, latest revision, *"480 Vac Head End Power System."*

Four HEP jumper cables are used to achieve each locomotive-locomotive-car-car connection, with jumpers provided at all four corners of each vehicle. Refer to **Figure 8**. Fixed jumpers are the norm for cars and the B-end of diesel-electric locomotives. Employing fixed jumpers reduces the number of connections required to a minimum, improving reliability. (Using portable HEP jumpers instead results in twice the number of connections.) Refer to *APTA PR-E-RP-018-99*, latest revision, *"480 Vac Head End Power Jumper and Receptacle Hardware."*

FIGURE 8
Typical Consist HEP Jumper Cable Arrangement



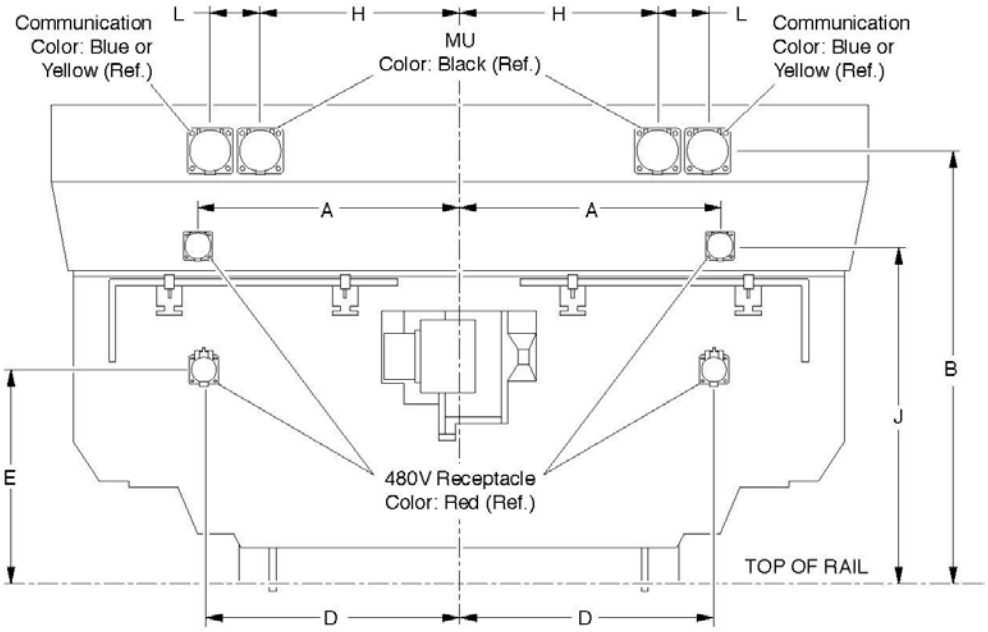
5.2.2 Locomotives

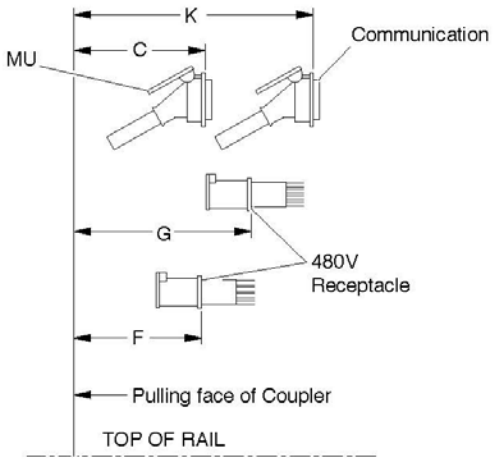
The F-ends of locomotives are generally equipped with four HEP receptacles; likewise, double-ended locomotives. Refer to **Figure 9**. Since the leading end of the locomotive is particularly exposed to impact damage, such as from snow or other debris, it is desirable to locate the receptacles to shield them as much as practical. Locomotives with tall pilots may be equipped with small doors in them to allow access to the receptacles when they are in use, but otherwise shield them from damage.

Design of both F- and B-ends of the locomotive should take into account that locomotives may operate with either F- or B-end against the cars, as well as with other locomotives either B-to-B or F-to-B end.

FIGURE 9

End-of-Vehicle Trainline Connector Typical Location, Locomotive F-End





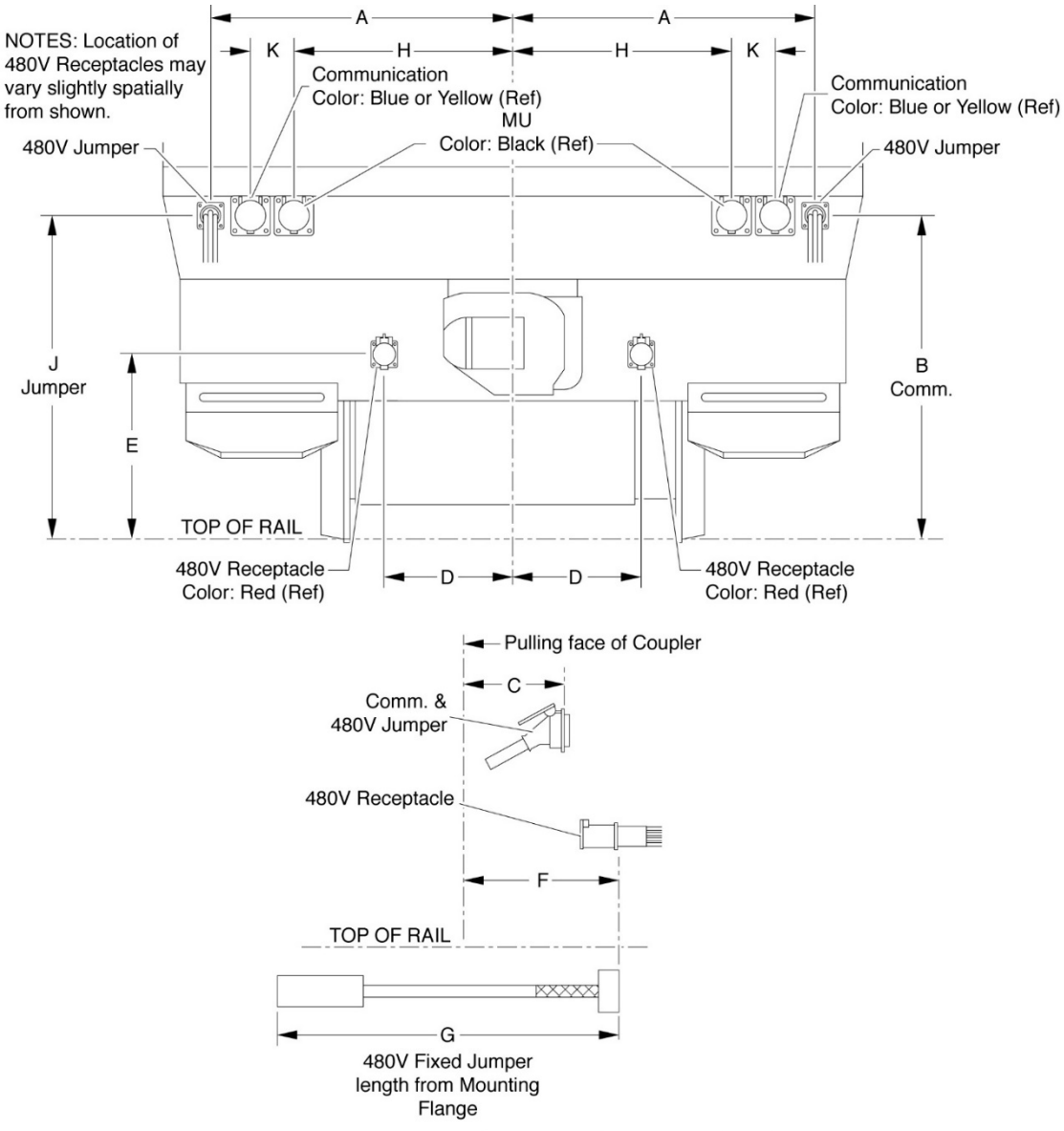
	A	B	C	D	E	F	G	H	J	K	L
Option 1	29.25	64.46	19.19	37.50	32.01	18.75	26.54	29.25	50.28	21.56	7.50
Option 2	39.00	53.00	25.50	38.63	33.25	33.25	21.75	19.12	40.75	25.50	7.12

NOTE: This can also represent the B-end of a dual cab locomotive. Dimensions are in inches.

The B-ends of locomotives are generally equipped with two fixed HEP jumpers and two receptacles. Refer to **Figure 10**. It is recommended that the location and extended length of the jumpers be carefully coordinated with the design of the cars with which they are intended to operate, so the locomotive jumpers can span to the car receptacles, directly avoiding the need for adapter jumpers, if possible. This also applies to the car jumpers reaching the locomotive. Adapter jumpers reduce system reliability and are awkward to connect and disconnect.

FIGURE 10

End of Vehicle Trainline Connector Standard Location, Locomotive B-End



	A	B	C	D	E	F	G	H	J	K
Option 1	43.00	53.83	35.13	35.08	33.04	31.63	*	29.25	50.50	7.50
Option 2	45.82	57.18	18.15	23.00	27.88	25.50	*	39.50	50.06	8.00

* Refer to APTA PR-E-RP-018 for Column "G."

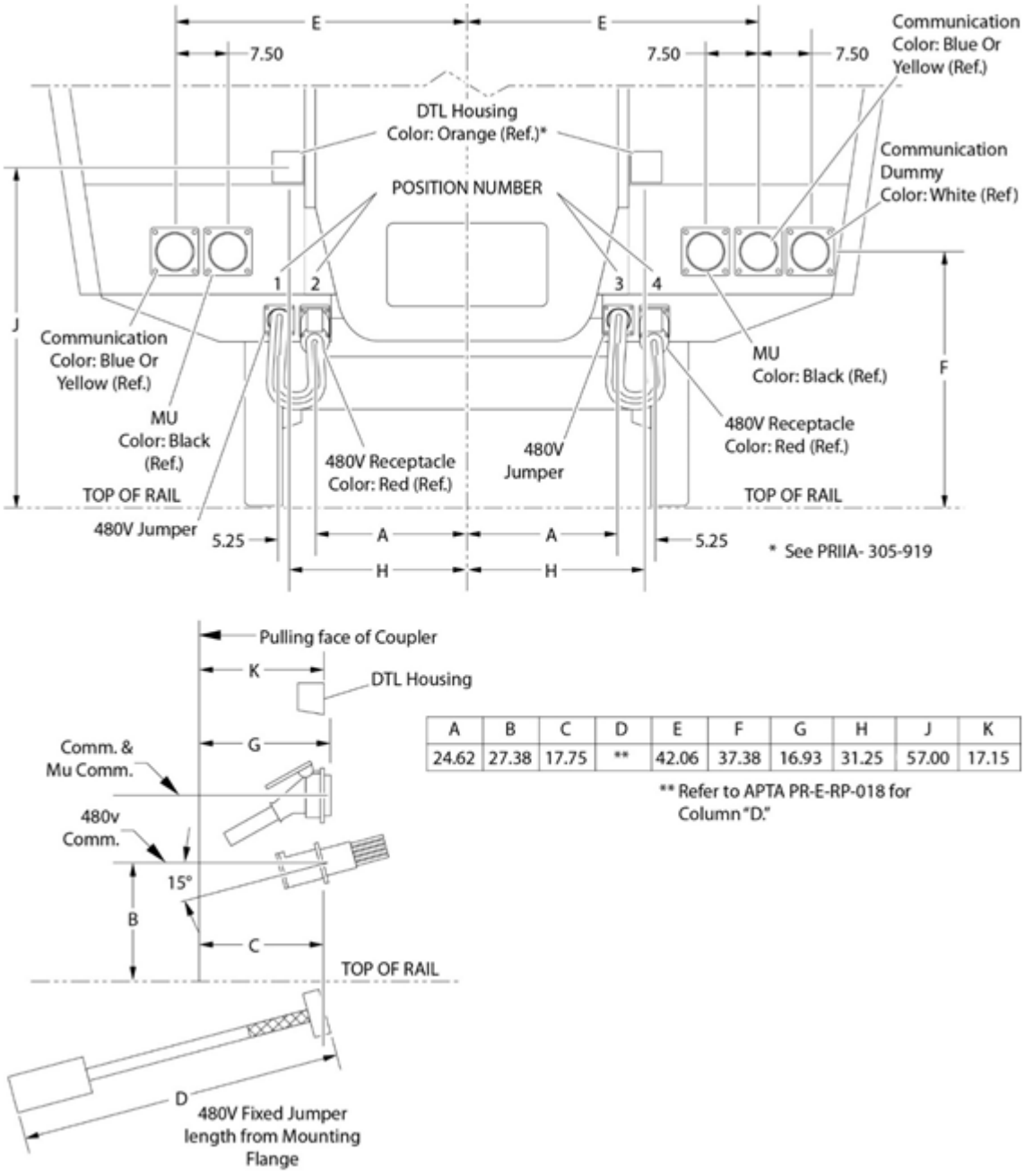
NOTE: Dimensions are in inches.

5.2.3 Low-level car ends

Cars are equipped with two HEP receptacles and two fixed jumper cables on each car end. Refer to **Figure 11**. Fixed jumpers are mounted in the #1 and #3 positions, facing the car end. Having the jumper mounted adjacent to the receptacle allows jumpers to be looped when not connected to another vehicle.

FIGURE 11

End of Vehicle Trainline Connector Standard Location, Low-Level Car End



A	B	C	D	E	F	G	H	J	K
24.62	27.38	17.75	**	42.06	37.38	16.93	31.25	57.00	17.15

** Refer to APTA PR-E-RP-018 for Column "D."

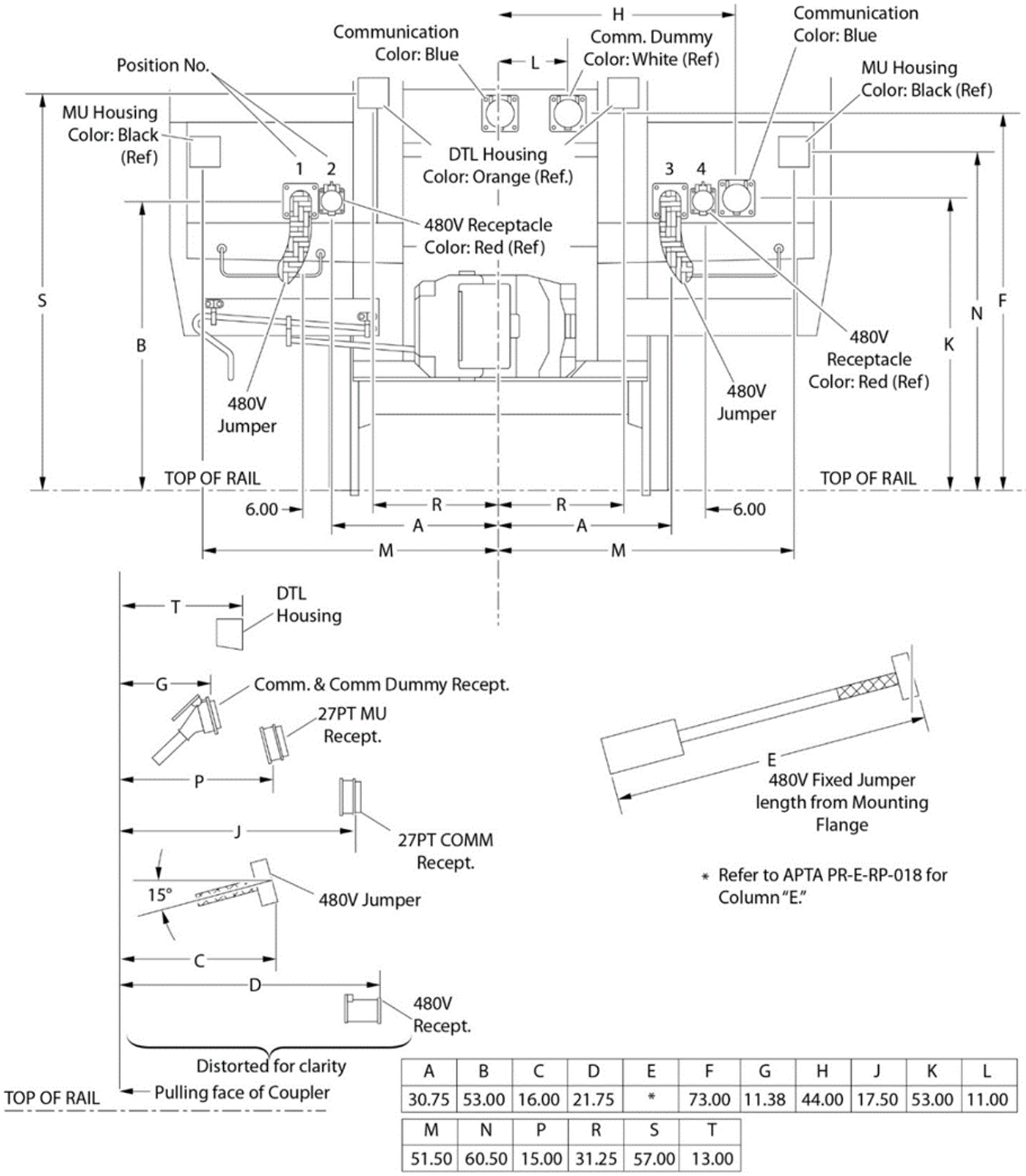
NOTE: Dimensions are in inches.

5.2.4 High-level car ends

Cars are equipped with two HEP receptacles and two fixed jumper cables on each car end. Refer to **Figure 12**. Fixed jumpers are mounted in the #1 and #3 positions, facing the car end. Having the jumper mounted adjacent to the receptacle allows jumpers to be looped when not connected to another vehicle.

FIGURE 12

End of Vehicle Trainline Connector Standard Location, High-Level Car End



A	B	C	D	E	F	G	H	J	K	L
30.75	53.00	16.00	21.75	*	73.00	11.38	44.00	17.50	53.00	11.00

M	N	P	R	S	T
51.50	60.50	15.00	31.25	57.00	13.00

NOTE: Dimensions are in inches.

5.3 Twenty-seven-point (27-point) MU and car control/communication trainlines

5.3.1 General

The 27-point MU trainline is an electrical trainline whose primary function is to convey traction and dynamic brake commands and indications. This trainline is used to provide those signals between:

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

For cars other than cab cars, the MU trainline typically passes through the car without any connection to the car.

The 27-point car control/communication trainline, referred to in this document as “communication trainline,” is an electrical trainline whose primary function is to convey car control and communication signals throughout the train. Typical signals include:

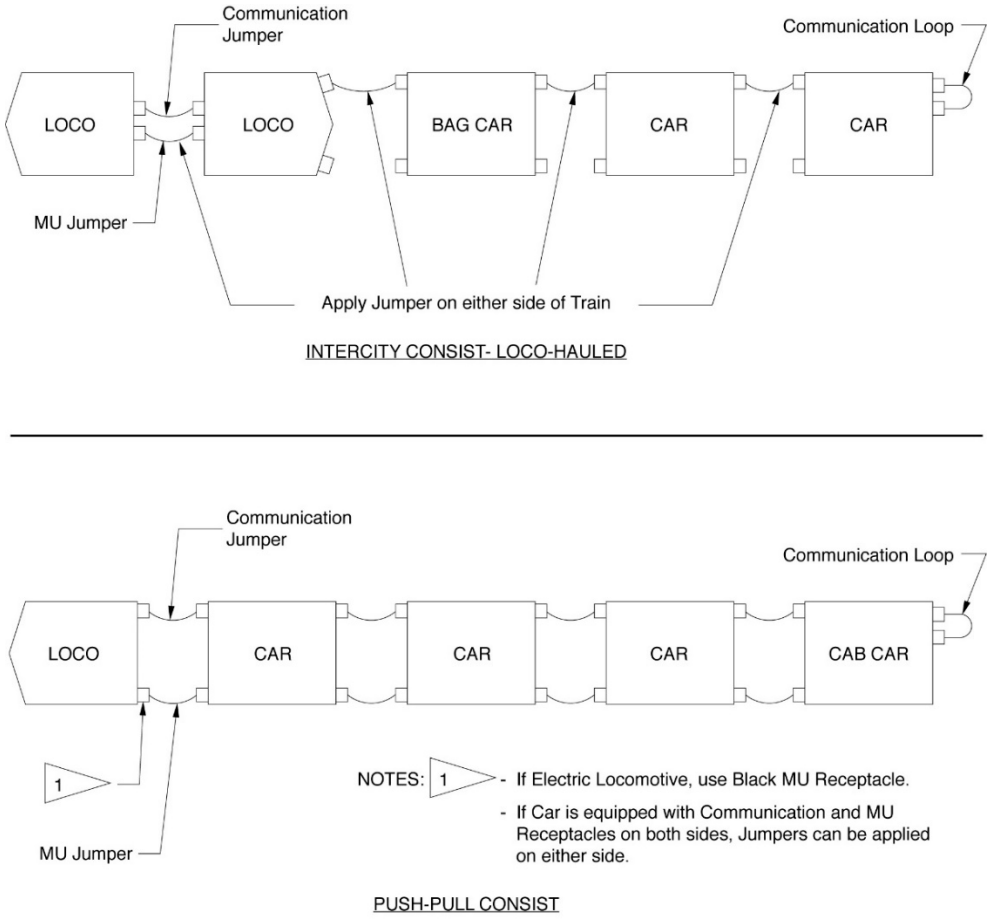
- door controls and indications;
- public address; and
- brake applied/released indications.

This trainline carries this information throughout the entire length of the consist, including locomotive(s).

A single MU jumper cable is used to achieve each locomotive-locomotive-car-car connection. For a locomotive-hauled train without a cab car or a second locomotive at the opposite end, no MU cables are required between cars. To operate more than one coupled locomotive, a MU jumper is required between each. Refer to **Figure 13**.

New cars should be built to allow for future installation of the MU 27-point receptacles on both sides on both ends.

FIGURE 13
Typical Consist 27-Point Cable Arrangement



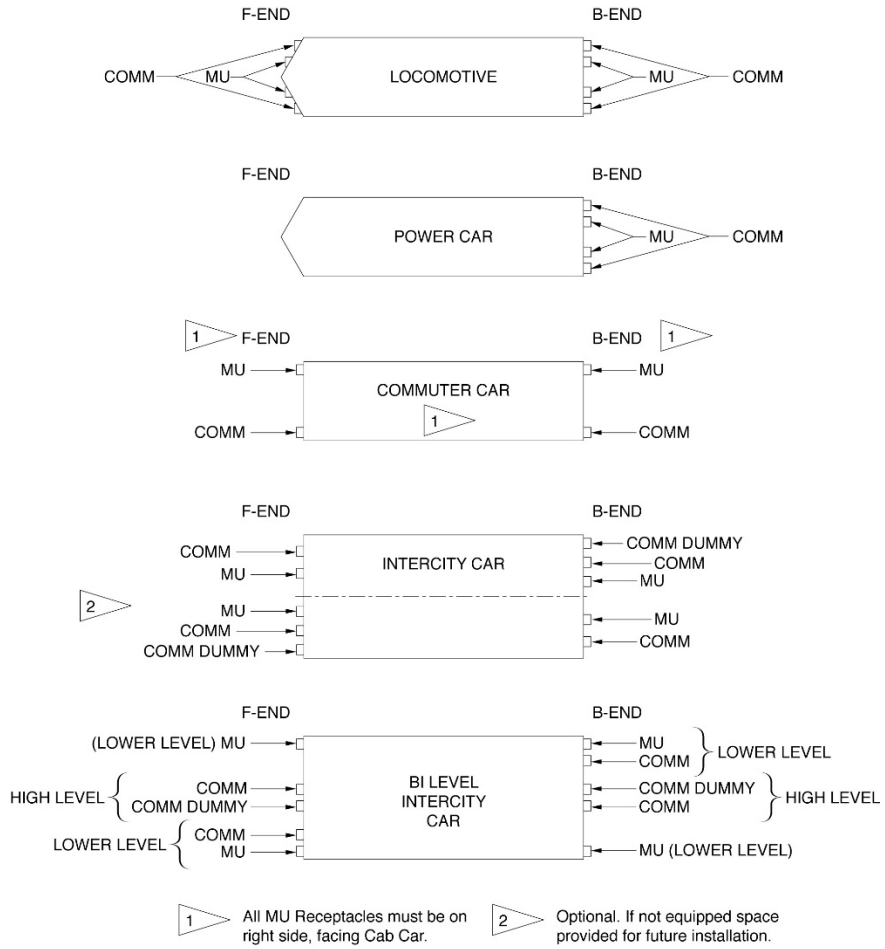
Likewise, a single communication jumper cable is used to achieve each locomotive-locomotive-car-car connection. Locomotives operating without passenger cars do not require a communication jumper between them.

For a detailed description of the MU and car control/communication trainlines, refer to *APTA PR-E-RP-017-99*, latest revision, *"27-Point Control and Communication Trainlines for Locomotives and Locomotive-Hauled Equipment."*

Locomotives should be equipped with both MU and communication 27-point receptacles on all four corners, as are most single-level cars. High-level end cars generally use communication receptacles mounted on the lateral centerline. This allows the vehicles to be operable with cars and locomotives coupled facing in any combination of directions.

Refer to **Figure 14** and *APTA PR-E-RP-019-99*, latest revision, *"27-Point Jumper and Receptacle Hardware."*

FIGURE 14
27-Point Receptacle Positions



NOTE: For DTL Receptacle locations, refer to **Figures 11** and **12**.

5.3.2 Locomotive

Locomotives are generally equipped with both MU and communication receptacles at each of the four corners. Refer to **Figure 9** and **Figure 10**. It is strongly recommended that the location and extended length of the jumpers be carefully coordinated with the design of the cars with which it is intended to operate, so the locomotive jumpers can span to the car receptacles directly.

5.3.3 Low-level car ends

Cars are generally equipped with both MU and communication receptacles at each of the four corners. In addition, a communication dummy receptacle is provided adjacent to the communication receptacle on two corners. This allows the jumper to be looped to identify “end of train” to that trainline. Refer to **Figure 13**.

5.3.4 High-level car ends

Cars are equipped with a single communication receptacle, located on the lateral centerline of each end of the car, beneath the diaphragm buffer. A communication dummy receptacle is provided adjacent to the communication receptacle. A single communication receptacle is located low on the right side of the car,

facing the end. This allows the high end of the car to be connected to a single-level car, such as a baggage car, or locomotive. In addition, MU receptacles are located in all four corners at the lower level. Refer to **Figure 13**. High-level cars have the advantage of locating the jumper cables higher above top-of-rail, which provides better environmental protection than that of low-levels.

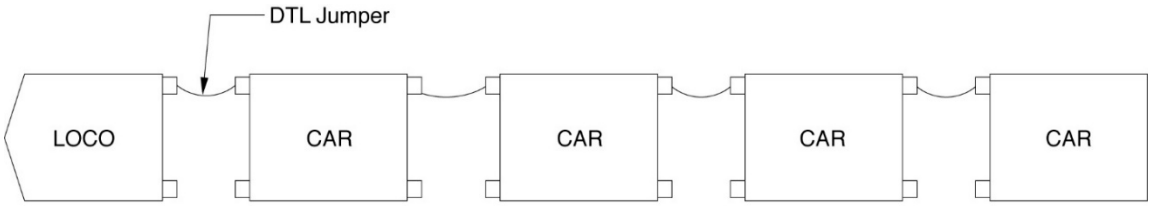
5.3.5 High-level cars with transition low-level end

Some high-level cars are built as transition cars, which are mechanically and electrically configured on one end to be low-level, while on the other end high-level. The low end of the car is configured according to Section 5.3.3, while the high end of the car is in accordance with Section 5.3.4.

5.4 Digital trainlines

Some passenger equipment has been equipped with digital trainlines. Receptacles are mounted on the car ends on both sides, with a single portable jumper interconnecting vehicles. Refer to PRIIA Specification 305-919, "DTL Hardware Requirements," for details on the mounting and equipment. See **Figure 15**.

FIGURE 15
Typical Consist DTL Configuration



Jumpers can be applied on either side.

6. Cables and receptacles

6.1 General

The HEP and 27-point MU and communication trainline receptacles and jumper cables have been defined so as to be universal among all passenger rolling stock, as have been the electrical functions. Refer to the following APTA recommended practices:

- *APTA PR-E-RP-018-99*, latest revision, *"480 Vac Head End Power Jumper and Receptacle Hardware"*
- *APTA PR-E-RP-019-99*, latest revision, *"27-Point Jumper and Receptacle Hardware for Locomotive and Locomotive-Hauled Equipment"*

6.2 Dummy couplings

The BP and MR hoses should be equipped with dummy couplings to allow these two hoses to be sealed off from the environment. They are to be attached to the coupler body or hose carrier using chains so when the dummy couplings are engaged with the hose gladhands, the hoses are prevented from dragging and are above minimum top-of-rail clearance.

The ECP cables should be equipped with dummy couplings to allow these cables to be sealed off from the environment. They are to be attached to the coupler body or hose carrier using chains so when the dummy couplings are engaged with the ECP intercar connecter, the cables are prevented from dragging and are above minimum top-of-rail clearance.

6.3 Hose supports

The BP and MR hoses are to be suspended at the gladhand end by flexible hose supports to ensure that they do not drag when uncoupled, per AAR Standard S-4006.

Likewise, the ECP intercar connectors are to be suspended at the connector end by flexible supports to ensure that they do not drag when uncoupled, per AAR Standard S-4006.

7. Testing

Static analysis and dynamic testing shall be performed for the track geometry. The track geometry should include intercar connections for similar cars or other car types, car to locomotive connections, coupler swing and truck to carbody rotation as approved by the authority having jurisdiction.

Related APTA standards

APTA PR-CS-RP-019-11, "Pushback Couplers in Passenger Rail Equipment"
APTA PR-E-RP-016-99, "480 Vac Head End Power System"
APTA PR-E-RP-017-99, "27-Point Control and Communication Trainlines for Locomotive and Locomotive-Hauled Equipment"
APTA PR-E-RP-018-99, "480 Vac Head End Power Jumper and Receptacle Hardware"
APTA PR-E-RP-019-99, "27-Point Jumper and Receptacle Hardware for Locomotive and Locomotive-Hauled Equipment"
APTA PR-M-RP-002-98, "Inspection & Maintenance of Type H-Tightlock Coupler Systems"
APTA PR-M-S-016-06, "Safety Appliances for Rail Passenger Cars"
APTA PR-M-S-022-19, "ECP Passenger Cable-Based Brake System Cable, Connectors & Junction Boxes—Performance Requirements"

References

American Association of Railroads (latest revisions):
- Specification M-601, Specification for Hose, Wrapped, Air-Brake, "End Hose"
- Standard S-132, Type No. 6 Operating Mechanism
- Standard S-441, Standard for Airbrake and Signal Hose-Mounting of Coupling and Nipple
- Standard S-4006, Hose Supports—Performance Testing
- Standard S-5529, Multiple Unit Pneumatic Brake Equipment for Locomotives

Code of Federal Regulations:
- Title 49 CFR, Part 231, Railroad Safety Appliance Standards
  - Section 12, Passenger-train cars with wide vestibules.
  - Section 13, Passenger-train cars with open-end platforms.
  - Section 14, Passenger-train cars without end platforms.
- Title 49 CFR, Part 238, Passenger Equipment Safety Standards

PRIIA
- Specification 305-919, "DTL Hardware Requirements"

Definitions

elephant style: A consist of Locomotives or cab control cars that are entrained such that the cab or F-End of one vehicle is coupled to the rear or non-cab end of the other.

facing point turnout: A turnout configuration where two switches are located with their points facing each other and spaced such that a single car is entering one switch before completely exiting the other.

interlocking knuckle type coupler: A knuckle coupler with features that interlock in a manner that prevents the relative motion vertically between two coupled interlocking couplers.

long-shank coupler: A coupler having a length of 59-1/2 inches or greater measured from the pulling face to the center line of the shank pin.

pushback coupler (PBC): A coupler that meets all requirements and functions of traditional couplers during operation and service, but additionally includes a retractable feature that activates at a given load and absorbs energy during pushback. It is neither a conventional long-shank or short-shank tightlock knuckle coupler.

short-shank coupler: A coupler having a length of 32-3/16 inches or less measured from the pulling face to the center line of the shank pin.

Abbreviations and acronyms

AAR	American Association of Railroads
BP	brake pipe
COMM	27-point communication trainline
DTL	digital trainline
ECP	electronically controlled pneumatic
HEP	head end power
MR	main reservoir
MU	multiple unit
NATSA	North American Transportation Services Association
PRIIA	Passenger Rail Investment and Improvement Act
psi	pounds per square inch
Vac	volts alternating current

Summary of document changes

- This document was retitled to its current title from "End-of-Car Connections with Tightlock and Interlocking Knuckle-Type Couplers" as part of Rev. 2. For all previous publications of this document prior to Rev. 2, unless otherwise indicated, this document was titled "Air Connections for Passenger Cars Equipped with AAR Long Shank Tight Lock or Similar Long Shank Type Couplers."
- Added PBC coupler exception to long-shank coupler recommendations.
- Added everything except Air Connections for Passenger Cars Equipped with AAR Long Shank Tight Lock or Similar Long Shank Type Couplers

Document history

Document Version	Working Group Vote	Public Comment/ Technical Oversight	Rail CEO Approval	Policy & Planning Approval	Publish Date
First published	March 3, 1997	—	—	—	March 11, 1999
First revision	—	—	—	—	Feb. 13, 2004
Second revision	Sept. 28, 2020	Oct. 31, 2020	Dec. 4, 2020	Dec. 31, 2020	Jan 15, 2021

The passenger rail industry phased this recommended practice into practice over the six-month period from July 1 to Dec. 31, 1999. It took effect Jan. 1, 2000. This document replaced AAR Standard S-031, "Steam and Air Connections for Passenger Cars," and AAR Standard S-033, "Steam and Air Connections—Passenger Car," with a standard to be maintained by the American Public Transportation Association.

Content for AAR S-031 originated at multiple points in 1903, 1911, 1912, 1931 and 1961. Ownership was transferred to APTA in 1997.

AAR S-033 was originally adopted by AAR as RP in 1946. It was revised and advanced to standard in 1953. Ownership was transferred to APTA in 1997.

