8. APTA PR-E-RP-009-98 Recommended Practice for Wire Used on Passenger Equipment

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Abstract: This recommended practice provides guidance on wire sizes, ampacities, derating and spacing for rail passenger equipment applications.

Keywords: wire, ampacity, derating

Participants

The American Public Transportation Association greatly appreciates the contributions of the following individual(s), who provided the primary effort in the drafting of the *Recommended Practice for Wire Used on Passenger Equipment*:

Brian Ley

At the time that this recommended practice was completed, the PRESS Electrical Committee included the following members:

Doug Warner, *Chair*

Gilbert L. Bailey
Brad Barkman
Ronald Bartels
Richard Benjamin
Dick Bruss
Daniel L. Davis
James Dietz
Dave Elliott
Hassan A. Fazli
Bert Gagne
Peter Hale
Carl C. Herrmann
Stephen Hilbert
LeRoy D. Jones
Brian Ley
Otto Masek
Rich Mazur
Chuck Olson
David Phelps
Craig Prudian
George Scerbo
Ike Tingos
Steve Zuiderveen

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1. Overview

1.1 Scope

The passenger rail industry phased this recommended practice into practice over the six-month period of July 1 to December 31, 1999. The recommended practice took effect January 1, 2000.

All wiring used on rolling stock should meet the requirements of the Association of American Railroads, Recommended Practice RP-585, 1994. AAR RP-585 and the information contained herein should be used when specifying wire for use on rolling stock. This document describes wire sizing parameters, including ampacities and derating values for temperature and spacing.

1.2 Purpose

This document covers recommended practices for specification and application of wiring for use on rolling stock.

2. Reference

Association of American Railroads, Recommended Practice RP-585, 1994

3. Definitions, abbreviation and acronyms

3.1 Definitions

For the purpose of this recommended practice, the following definitions apply.

3.1.1 ambient temperature: The environmental temperature surrounding the object under consideration. Where electrical heating wire is enclosed in thermal insulation, the ambient temperature is the temperature exterior to the thermal insulation.

3.1.2 ampacity: Current-carrying capacity, expressed in amperes, of an electrical conductor under stated thermal conditions**.**

3.1.3 AWG: The American Wire Gage, is used almost exclusively in the USA as a unit for sizing wire.

3.1.4 kcmil: Thousands of Circular Mills (kcmil supersedes the abbreviation MCM).

3.1.5 raceway: Any channel that is designed and used expressly for supporting wires, cables, or bus bars. Raceways consist primarily of, but are not restricted to, cable trays, conduits, and wireways.

3.1.6 wire: All insulated single-conductors, regardless of size.

4. Insulation temperature

Wire insulation systems used on rolling stock should be at a minimum rated for 230°F (110°C). Higher temperature insulation should be used as required by design applications.

5. Current carrying capacity for wire

Table 1, contains the ampacity values for standard sizes of wire used on rolling stock. The table includes a column for not more than three current carrying wires in a raceway and a second column for single insulated conductors, in free air. All values in table 1 are based on an ambient temperature of 104°F (40°C). For ambient temperatures other than 104°F (40°C), the given ampacities from either column of table 1must be adjusted using the proper multiplier from table 2.

Table 1

Ampacities of Copper Conductors (104°F (40°C)Ambient)

Size **AWG kcmil**	**Not More Than Three** **Conductors in a Raceway**	**Single Insulated** **Conductors, in free air**
AWG **kcmil**	**Copper Conductor Temp** **230°F (110° C) above ambient**	**Copper Conductor Temp** **230°F (110° C) above ambient**
18	13	17
16	17	23
14	29	39
12	36	51
10	46	67
8	64	85
6	81	120
4	109	160
3	129	180
2	143	214
1	168	247
1/0	193	286

Size AWG kcmil	Not More Than Three Conductors in a Raceway	Single Insulated Conductors, in free air
2/0	229	329
3/0	263	380
4/0	301	446
250	345	493
262	---	524
300	391	552
313	---	590
350	436	611
373	---	657
400	468	663
444	---	734
500	531	767
535	---	828
600	588	860
646	---	931
700	645	953
750	673	1000
777	---	1047
800	699	1039
1000	785	1197

Table 1

Temperature Correction Factors
(104°F (40°C) Ambient)

Ambient Temp. °C	Multiplier
41-50	.93
51-60	.85
61-70	.76
71-80	.65
81-90	.53
91-100	.38

Table 2

The following is a sample calculation for one 2/0 wire, routed in free air, with an ambient temperature of 149°F (65°C):

Adjusted Ampacity = 329Amps x 0.76 = 250Amps.

6. Adjustment factors

Where the number of current carrying wires in a raceway exceeds three, the allowable ampacities shall be reduced as shown below in table 3. These multipliers should be applied to the values from the, "Not More Than Three Conductors in a Raceway."

Note: The following correction factors do not apply to conductors in nipples having a length not exceeding 24 inches (61 cm).

Correction Factors for More than Three Current-Carrying
Conductors in a Raceway with Load Diversity

Number of Current Carrying Wires	Multiplier
4 through 6	0.80
7 through 9	0.70
10 through 24*	0.70
25 through 42*	0.60
43 and above*	0.50

Table 3

* These factors include the effects of a load diversity of 50 percent.

The following is a sample calculation for eight AWG #12, current carrying wires, in a conduit, with an ambient temperature of 104°F (40°C):

Adjusted Ampacity = 36Amps x 0.70 = 25.2 Amps

The ampacities for wire in air, or wire in conduit in air, are based on a single insulated wire or conduit. Where the spacing between wire or conduit surfaces is not greater than the diameter of the largest adjacent wire or conduit, the current ratings should be reduced in accordance with values given below in table 4 for wires and 5 for conduits.

GROUP CORRECTION FACTORS

Number of Wires in Air

Horizontally	1	2	3	4	5	6
Vertically						
1	1.00	0.93	0.87	0.84	0.83	0.82
2	0.89	0.83	0.79	0.76	0.75	0.74
3	0.80	0.76	0.72	0.70	0.69	0.68

Table 4

GROUP CORRECTION FACTORS

Number of Conduits in Air

Horizontally	1	2	3	4	5	6
Vertically						
1	1.00	0.94	0.91	0.88	0.87	0.86
2	0.92	0.87	0.84	0.81	0.80	0.79
3	0.85	0.81	0.78	0.76	0.75	0.74

Table 5

The following is a sample calculation for six 2/0 wires in air, with a cleating arrangement of 3 horizontal and 2 vertical, and less than 1d (d = the diameter of the largest adjacent wire or conduit) between wire surfaces, with an ambient of 104°F (40°C):

Adjusted Ampacity = 329Amps x 0.79 = 260 Amps

7. Multiple deratings

In situations where wire must be derated for more than one factor, such as high ambient temperature and a large number of wires in a conduit, these ratings must be combined.

Annex A

(informative)

Bibliography

[B1] Institute of Electrical and Electronics Engineers, IEEE Std.835, "Power Cable Ampacities."