
CHAPTER 33

ELECTRICAL ENERGY UTILIZATION¹

TABLE OF CONTENTS

Part/Section	Description	Page
1	Factors to Consider in Making Electrification Economic Studies	33-1-1
1.1	General	33-1-2
1.2	Traffic	33-1-3
1.3	Capital Equipment Costs	33-1-4
1.4	Annual Operating Expenses	33-1-7
1.5	Maintenance-of-Way Changes	33-1-9
1.6	Other Costs, Liabilities and Benefits	33-1-9
2	Clearances	33-2-1
2.0	Changes From 1995 & 2005 Editions (2010)	33-2-2
2.1	Third-Rail Arrangements (2010)	33-2-3
2.2	Recommended Clearance Specifications to Provide for Overhead Electrification (2010)	33-2-6
2.3	Calculation of Vertical and Lateral Structure Openings (2010)	33-2-19
3	Recommended Voltages	33-3-1
3.1	Introduction	33-3-1
3.2	Definitions	33-3-2
3.3	Design Criteria (2017)	33-3-3
3.4	Recommended Voltages for New Construction (2008)	33-3-3
4	Railroad Electrification Systems	33-4-1
4.1	Catenary Definitions, Standards and Concepts	33-4-3
4.2	Catenary System Design Criteria	33-4-7
4.3	Electrification Feeding and Sectionalizing Arrangements	33-4-19
4.4	Contact Wire Ampacity	33-4-23
5	Railway Electrification Compatibility with Signal Systems	33-5-1
5.0	Changes from 1981, 1982 & 2012 Editions (2016)	33-5-2
5.1	Scope (2018)	33-5-2

¹ The material in this and other chapters in the AREMA *Manual for Railway Engineering* is published as recommended practice to railroads and others concerned with the engineering, design and construction of railroad fixed properties (except signal and communications), and allied services and facilities. For the purpose of this Manual, RECOMMENDED PRACTICE is defined as a material, device, design, plan, specification, principle or practice recommended to the railways for use as required, either exactly as presented or with such modifications as may be necessary or desirable to meet the needs of individual railways, but in either event, with a view to promoting efficiency and economy in the location, construction, operation or maintenance or railways. It is not intended to imply that other practices may not be equally acceptable.

TABLE OF CONTENTS (CONT)

Part/Section	Description	Page
5.2	Discussion (2016)	33-5-3
5.3	Requirements of the Signal and Electrification Systems (2016)	33-5-4
5.4	Electrical Effects (2016)	33-5-5
5.5	Use of Impedance Bonds in Railway Electrification (2016)	33-5-5
5.6	Impedance Bond Installation Requirements (2016)	33-5-7
6	Traction Power Supply Requirements for Railroad AC Electrification Systems	33-6-1
6.1	General	33-6-3
6.2	Electrification System Load	33-6-3
6.3	AC Electrification System Configuration	33-6-5
6.4	Electrification System Selection	33-6-14
6.5	System Studies	33-6-17
6.6	System Design	33-6-20
6.7	Utility Metering	33-6-27
6.8	Construction	33-6-28
7	Traction Electrification System Grounding & Bonding	33-7-1
7.0	Changes from the 1994 Issue of Chapter 33 Part 7 Rail Bonding	33-7-2
7.1	Introduction	33-7-2
7.2	AC Electric Traction System Considerations	33-7-4
7.3	DC Electric Traction System Considerations	33-7-6
7.4	Combined AC & DC Considerations	33-7-7
7.5	Facilities, Buildings, and Structures	33-7-8
7.6	Signal System Considerations	33-7-13
7.7	Lightning Protection	33-7-13
7.8	Determining Rail Bond Sizes	33-7-14
8	Electric Vehicle and Traction Power Distribution System Interaction	33-8-1
8.1	General	33-8-1
8.2	Vehicle Electrical Interaction with the Traction Power System	33-8-2
8.3	Mechanical Interaction of the Pantograph with the Overhead Contact System	33-8-3
9	Ancillary Power Systems	33-9-1
9.1	Wayside/Standby Power Systems	33-9-1
9.2	Snow Melting Equipment	33-9-4
10	Illumination	33-10-1
10.0	Changes from 2005 Edition (2018)	33-10-2
10.1	General (2018)	33-10-2
10.2	Outdoor Area Lighting in Railroad Yards and Terminals (2018)	33-10-2
10.3	Outdoor Area Lighting In Passenger Transit Yards and Terminals (2018)	33-10-8
10.5	Electric Lamp Characteristics (2018)	33-10-10
10.6	Evaluation Measurements and Tests (2018)	33-10-10

TABLE OF CONTENTS (CONT)

Part/Section	Description	Page
12	Traction Power Supply and Distribution Requirements for DC Rail Transportation Systems	33-12-1
12.1	Introduction	33-12-2
12.2	DC Traction Power System Characteristics	33-12-3
12.3	DC Traction Power Substations	33-12-5
12.4	DC Traction Power Distribution System	33-12-14
12.5	DC Traction Power System Planning and Design	33-12-20
12.6	References	33-12-22
13	Electrical Safety and Operational Considerations	33-13-1
13.1	Scope	33-13-1
13.2	Typical Terminology	33-13-2
13.3	General Instructions	33-13-3
Chapter 33	Glossary	33-G-1

INTRODUCTION

The Chapters of the AREMA Manual are divided into numbered Parts, each comprised of related documents (specifications, recommended practices, plans, etc.). Individual Parts are divided into Sections by centered headings set in capital letters and identified by a Section number. These Sections are subdivided into Articles designated by numbered side headings.

Page Numbers – In the page numbering of the Manual (33-2-1, for example) the first numeral designates the Chapter number, the second denotes the Part number in the Chapter, and the third numeral designates the page number in the Part. Thus, 33-2-1 means Chapter 33, Part 2, page 1.

In the Glossary and References, the Part number is replaced by either a “G” for Glossary or “R” for References.

Document Dates – The bold type date (Document Date) at the beginning of each document (Part) applies to the document as a whole and designates the year in which revisions were last made somewhere in the document, unless an attached footnote indicates that the document was adopted, reapproved, or rewritten in that year.

Article Dates – Each Article shows the date (in parenthesis) of the last time that Article was modified.

Revision Marks – All current year revisions (changes and additions) which have been incorporated into the document are identified by a vertical line along the outside margin of the page, directly beside the modified information.

Proceedings Footnote – The Proceedings footnote on the first page of each document gives references to all Association action with respect to the document.

Annual Updates – New manuals, as well as revision sets, will be printed and issued yearly.