

The background of the cover is a photograph of a high-speed train, likely a Shinkansen, traveling on a track. The train is white with a blue stripe and is moving towards the viewer. Above the train, there is a complex network of overhead power lines and support structures. The sky is a pale, hazy blue.

Kiessling, Puschmann, Schmieder, Schneider

# Contact Lines for Electric Railways

Planning, Design,  
Implementation, Maintenance

**SIEMENS**

Second Edition

Kiessling / Puschmann / Schmieder / Schneider  
Contact Lines for Electric Railways

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Planning  
Design  
Implementation  
Maintenance

by Friedrich Kiessling, Rainer Puschmann,  
Axel Schmieder, Egid Schneider

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# Foreword

The publication of “Fahrleitungen elektrischer Bahnen” in English gives the international railway engineering community access to a work which, since its first edition in 1997, has achieved the status of a standard reference in German-speaking regions.

A contact line is an essential component of all electric railway traction energy supply systems. It is the interface between fixed installations and moving energy consumers, i. e. vehicles. The contact line designs must be adapted to the respective technical and operational requirements of the different railway electrification systems, the diversity of which has broadened considerably especially with the development of high-speed railway traffic. A thorough analysis of these requirements and corresponding satisfactory design measures are prerequisites for reliable and economical operation of contact lines and of railways in general.

The structure and contents of this book reflect this systematic approach:

- It contains a detailed description of all existing alternating-current and direct-current systems, the basic requirements that these impose on contact lines and the essential characteristics of the two basic designs: overhead contact lines and contact rails. The interaction of current collectors and contact lines and the issue of interference with railway-owned and third-party installations are dealt with in special chapters.
- The mechanical and the electrical parameters of contact lines, structural design solutions, project planning, construction and operation, including maintenance, are also discussed in detail.

In addition, the lists of available relevant international, European and national standards, as well as the regulations of railway operators and railway associations included in the appendix of the book are very useful. In this context, I would like to draw the readers' attention to the evolving technical and operational harmonisation of European railway companies spurred on by the EC directives on interoperability. In this process, “Technical Standards for Interoperability” which establish binding rules on the essential parameters, have been drawn up inter alia for the energy supply sector, where contact lines are dealt with specifically. The parameters, which are to be standardised in this way, have to be chosen carefully, taking technical and economic factors into consideration. I am very pleased to report that the compendium of knowledge provided by this book, “Contact Lines of Electric Railways”, was a great assistance in fulfilling this task. I would like to congratulate and thank the authors and publisher for their initiative by offering this important work to their professional colleagues all over the world.

Paris, October 2001

*Werner Breitling*  
Deputy Chief Executive, UIC, Paris



# Preface to the first English edition

The first edition of “Fahrleitungen elektrischer Bahnen” (Contact Lines for Electric Railways) was published in German in 1997 by B.G. Teubner-Verlag Stuttgart. The first edition was out of print quickly, so a second, revised edition was published in 1999. The co-authors of this book, Professor Dr. sc Anatoli Ignatjewitsch Gukow and Dr. sc. Peter Schmidt, died unexpectedly in 1999 and 2000, respectively. Both had essential roles in the production of the German edition.

There were no comparable works available and the book enjoyed wide distribution and attracted great interest, even in non-German-speaking countries instigating the need for translations in other languages.

Prior to the first English edition, substantial parts of the book were revised and adapted to include international overhead contact line designs. The revisions were based on international standards as published by IEC and EN.

Advice and comments from readers were also incorporated. More attention was paid to 50 Hz railways and local public transportation systems. New calculation methods, up-to-date examples of completed electrification projects and recently developed overhead contact line components have also been included.

The aims of the book are explained in the preface to the first edition, which also appears in this edition. The world-wide spread of high-speed railway systems, the need to ensure inter operability and the expansion of local public traffic systems are intensifying the demands made on electric railways, the qualifications of staff involved and supporting documentation. So, this edition especially aims to describe the theoretical principles underlying overhead contact lines and to offer possible solutions for their application, whilst taking current international developments in this complex field into consideration. At the same time, the book is intended as a co-operative contribution with projects carried out in parts of the world where German is not spoken.

The authors would like to thank the Transportation Systems Electrification Department of Siemens AG and especially the heads of this department, Dr. Werner Kruckow and Peter Schraut, who supported the preparation of the English edition. Beat Furrer of Furrer & Frey AG, Bern, Switzerland sponsored the preparation of the manuscript. The authors also thank the publishing company for its excellent technical facilities. Thanks are extended to Gernot Hirsinger for preparing the translation as well as Bela Jozsa, Norm Grady, Terry Wilkinson, John Allan and Jan Liddicut from Melbourne/Australia, who edited the English version and ensured that the complicated subject matter was understandable to English speaking readers. The authors thank Dr. Wilhelm Baldauf of Deutsche Bahn AG and Dr. Egid Schneider at Siemens AG, who supported them with contributions to certain sections of this revised edition, and Michael Schwarz for desk top editing.

The authors hope this book will promote co-operation amongst colleagues working in this field in as many countries as possible, and that it will contribute to their mutual technical understanding. They look forward to readers' comments and their advice on the content and design of the book.

Erlangen, September 2001      *Friedrich Kießling, Rainer Puschmann, Axel Schmieder*



# Preface to the second English edition

The first English edition of this book was based on the second German version printed in 1998 and published in 2001. This first English edition was well accepted by railway companies, manufactures, contractors, consultants and at universities and encouraged translations into Chinese in 2003 and Spanish in 2008. Meanwhile the English edition sold out so the publisher commissioned the authors to prepare a revised edition of the book to be published in 2009.

The authors of the first English edition invited Egid Schneider from Siemens AG to participate as co-author. He accepted the offer and revised the chapters dealing with electrical aspects of contact line systems. Like the first English edition, this book addresses the requirements of an international audience so the individual chapters of the first edition were revised and enlarged. The design of contact lines has been affected by the European Directives on Interoperability and the related Technical Specifications. These documents initiated the preparation and issuing of several new European Standards which have also been considered in this new edition.

Since 2001, new high-speed rail networks have been introduced in a number of countries and others enlarged. In Europe high-speed operation commenced in Austria, the Netherlands and Switzerland. The networks in France, Germany, Italy and Spain were extended. In China, high-speed lines designed for commercial speeds of 350 km/h were commissioned. In Switzerland, a new tunnel, through the Alps, designed for high speed operation was finished and put into service. For these applications, contact lines were designed anew and or adapted from previous designs. Examples of new lines, new materials and components that were introduced to the market are dealt with in the text. To present a comprehensive book on the subject matter the authors needed and received assistance and support from professional partners. In this context the authors would like to thank

- Jörg Schneppendahl and Roland Edel, Siemens AG, Erlangen, Railway Electrification, Johannes Emmelheinz and Daniel Leckel, Siemens AG, Erlangen, Railway Maintenance for sponsoring the revision and publication of the book,
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- those readers who commented on errors and proposed amendments,
- Michael Schwarz and Jörg Unglaub, Erlangen, who took care of the desk top editing.

The authors hope that the revised new edition meets the requirements of people world wide who are active in the contact line business world wide. The authors welcome comments on the contents and usefulness of this book.

Erlangen, March 2009

*Friedrich Kiessling, Rainer Puschmann, Axel Schmieder, Egid Schneider*

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