

# IEEE Guide for Installation, Maintenance, and Operation of Irrigation Equipment Located Near or Under Power Lines

IEEE Power and Energy Society

Sponsored by the  
Transmission and Distribution Committee

---

IEEE  
3 Park Avenue  
New York, NY 10016-5997  
USA

**IEEE Std 1542™-2018**  
(Revision of IEEE Std 1542-2007)

# **IEEE Guide for Installation, Maintenance, and Operation of Irrigation Equipment Located Near or Under Power Lines**

Sponsor

**Transmission and Distribution Committee  
of the  
IEEE Power and Energy Society**

Approved 5 December 2018

**IEEE-SA Standards Board**

**Abstract:** Industry practices and guidelines for installation, maintenance, and operation of irrigation equipment near or under power lines as they pertain to minimum distance to energized conductors and proper grounding to help minimize nuisance shocks are presented in this guide. A variety of conditions in general terms is covered in this guide. Specific recommendations are made for the type of irrigation systems and power line parameters most commonly found.

**Keywords:** farm irrigation systems, IEEE 1542™, irrigation, irrigation systems, sprinklers

---

The Institute of Electrical and Electronics Engineers, Inc.  
3 Park Avenue, New York, NY 10016-5997, USA

Copyright © 2019 by The Institute of Electrical and Electronics Engineers, Inc.  
All rights reserved. Published 11 January 2019. Printed in the United States of America.

IEEE is a registered trademark in the U.S. Patent & Trademark Office, owned by The Institute of Electrical and Electronics Engineers, Incorporated.

PDF: ISBN 978-1-5044-5383-7 STD23462  
Print: ISBN 978-1-5044-5384-4 STDPD23462

*IEEE prohibits discrimination, harassment, and bullying.*

For more information, visit <http://www.ieee.org/web/aboutus/whatis/policies/p9-26.html>.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

## Important Notices and Disclaimers Concerning IEEE Standards Documents

IEEE documents are made available for use subject to important notices and legal disclaimers. These notices and disclaimers, or a reference to this page, appear in all standards and may be found under the heading “Important Notices and Disclaimers Concerning IEEE Standards Documents.” They can also be obtained on request from IEEE or viewed at <http://standards.ieee.org/ipr/disclaimers.html>.

### Notice and Disclaimer of Liability Concerning the Use of IEEE Standards Documents

IEEE Standards documents (standards, recommended practices, and guides), both full-use and trial-use, are developed within IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (“IEEE-SA”) Standards Board. IEEE (“the Institute”) develops its standards through a consensus development process, approved by the American National Standards Institute (“ANSI”), which brings together volunteers representing varied viewpoints and interests to achieve the final product. IEEE Standards are documents developed through scientific, academic, and industry-based technical working groups. Volunteers in IEEE working groups are not necessarily members of the Institute and participate without compensation from IEEE. While IEEE administers the process and establishes rules to promote fairness in the consensus development process, IEEE does not independently evaluate, test, or verify the accuracy of any of the information or the soundness of any judgments contained in its standards.

IEEE Standards do not guarantee or ensure safety, security, health, or environmental protection, or ensure against interference with or from other devices or networks. Implementers and users of IEEE Standards documents are responsible for determining and complying with all appropriate safety, security, environmental, health, and interference protection practices and all applicable laws and regulations.

IEEE does not warrant or represent the accuracy or content of the material contained in its standards, and expressly disclaims all warranties (express, implied and statutory) not included in this or any other document relating to the standard, including, but not limited to, the warranties of: merchantability; fitness for a particular purpose; non-infringement; and quality, accuracy, effectiveness, currency, or completeness of material. In addition, IEEE disclaims any and all conditions relating to: results; and workmanlike effort. IEEE standards documents are supplied “AS IS” and “WITH ALL FAULTS.”

Use of an IEEE standard is wholly voluntary. The existence of an IEEE standard does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the IEEE standard. Furthermore, the viewpoint expressed at the time a standard is approved and issued is subject to change from time to time about through developments in the state of the art and comments received from users of the standard.

In publishing and making its standards available, IEEE is not suggesting or rendering professional or other services for, or on behalf of, any person or entity nor is IEEE undertaking to perform any duty owed by any other person or entity to another. Any person utilizing any IEEE Standards document, should rely upon his or her own independent judgment in the exercise of reasonable care in any given circumstances or, as appropriate, seek the advice of a competent professional in determining the appropriateness of a given IEEE standard.

IN NO EVENT SHALL IEEE BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO: PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE PUBLICATION, USE OF, OR RELIANCE UPON ANY STANDARD, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE AND REGARDLESS OF WHETHER SUCH DAMAGE WAS FORESEEABLE.

## Translations

The IEEE consensus development process involves the review of documents in English only. In the event that an IEEE standard is translated, only the English version published by IEEE should be considered the approved IEEE standard.

## Official statements

A statement, written or oral, that is not processed in accordance with the IEEE-SA Standards Board Operations Manual shall not be considered or inferred to be the official position of IEEE or any of its committees and shall not be considered to be, or be relied upon as, a formal position of IEEE. At lectures, symposia, seminars, and educational courses, an individual presenting information on IEEE standards shall make it clear that his or her views should be considered the personal views of that individual rather than the formal position of IEEE.

## Comments on standards

Comments for revision of IEEE Standards documents are welcome from any interested party, regardless of membership affiliation with IEEE. However, IEEE does not provide consulting information or advice pertaining to IEEE Standards documents. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments. Since IEEE standards represent a consensus of concerned interests, it is important that any responses to comments and questions also receive the concurrence of a balance of interests. For this reason, IEEE and the members of its societies and Standards Coordinating Committees are not able to provide an instant response to comments or questions except in those cases where the matter has previously been addressed. For the same reason, IEEE does not respond to interpretation requests. Any person who would like to participate in revisions to an IEEE standard is welcome to join the relevant IEEE working group.

Comments on standards should be submitted to the following address:

Secretary, IEEE-SA Standards Board  
445 Hoes Lane  
Piscataway, NJ 08854 USA

## Laws and regulations

Users of IEEE Standards documents should consult all applicable laws and regulations. Compliance with the provisions of any IEEE Standards document does not imply compliance to any applicable regulatory requirements. Implementers of the standard are responsible for observing or referring to the applicable regulatory requirements. IEEE does not, by the publication of its standards, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

## Copyrights

IEEE draft and approved standards are copyrighted by IEEE under US and international copyright laws. They are made available by IEEE and are adopted for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of engineering practices and methods. By making these documents available for use and adoption by public authorities and private users, IEEE does not waive any rights in copyright to the documents.

## Photocopies

Subject to payment of the appropriate fee, IEEE will grant users a limited, non-exclusive license to photocopy portions of any individual standard for company or organizational internal use or individual, non-commercial use only. To arrange for payment of licensing fees, please contact Copyright Clearance Center, Customer Service, 222 Rosewood Drive, Danvers, MA 01923 USA; +1 978 750 8400. Permission to photocopy portions of any individual standard for educational classroom use can also be obtained through the Copyright Clearance Center.

## Updating of IEEE Standards documents

Users of IEEE Standards documents should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of amendments, corrigenda, or errata. An official IEEE document at any point in time consists of the current edition of the document together with any amendments, corrigenda, or errata then in effect.

Every IEEE standard is subjected to review at least every 10 years. When a document is more than 10 years old and has not undergone a revision process, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art. Users are cautioned to check to determine that they have the latest edition of any IEEE standard.

In order to determine whether a given document is the current edition and whether it has been amended through the issuance of amendments, corrigenda, or errata, visit IEEE Xplore at <http://ieeexplore.ieee.org> or contact IEEE at the address listed previously. For more information about the IEEE SA or IEEE's standards development process, visit the IEEE-SA Website at <http://standards.ieee.org>.

## Errata

Errata, if any, for all IEEE standards can be accessed on the IEEE-SA Website at the following URL: <http://standards.ieee.org/findstds/errata/index.html>. Users are encouraged to check this URL for errata periodically.

## Patents

Attention is called to the possibility that implementation of this standard may require use of subject matter covered by patent rights. By publication of this standard, no position is taken by the IEEE with respect to the existence or validity of any patent rights in connection therewith. If a patent holder or patent applicant has filed a statement of assurance via an Accepted Letter of Assurance, then the statement is listed on the IEEE-SA Website at <http://standards.ieee.org/about/sasb/patcom/patents.html>. Letters of Assurance may indicate whether the Submitter is willing or unwilling to grant licenses under patent rights without compensation or under reasonable rates, with reasonable terms and conditions that are demonstrably free of any unfair discrimination to applicants desiring to obtain such licenses.

Essential Patent Claims may exist for which a Letter of Assurance has not been received. The IEEE is not responsible for identifying Essential Patent Claims for which a license may be required, for conducting inquiries into the legal validity or scope of Patents Claims, or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of this standard are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility. Further information may be obtained from the IEEE Standards Association.

## Participants

At the time this IEEE guide was completed, the Corona and Field Effects Working Group had the following membership:

**Danna Liebhaber, *Chair***  
**Robert Schaerer, *Vice Chair***

Mazana Armstrong  
Gordon Baker  
Tony Baker  
Justin Bell  
Stephen Bell  
Yair Berenstein  
Allen Bernstorf  
Bryan Beske  
David Boudreau  
John Chan  
Rich Collins  
Benjamin Cotts  
Cody Davis  
Nicholas DeSantis  
Michael Dolan  
Kevin Edmonds

Eric Engdahl  
Namal Fernando  
Bruce Freimark  
Nancy Fulk  
Michael Garrels  
Jennifer Havel  
Arjan Jagtiani  
Jahangir Khan  
Nestor Kolcio  
Sarah Kolehmainen  
Ray McCoy  
Chad McKinney  
Dennis Neitzel  
Juan Nuño  
Kunhal Parikh  
Marc Patterson

Teja Rao  
Jerry Reding  
Brian Reynolds  
Steve Roberts  
Andy Schwaim  
Jens Seifert  
Tim Shaw  
Gary Sibilant  
Ross Smith  
Paul Springer  
Gerald Stewer  
Dick Stro  
Kade Sutzentruber  
Timothy Van Remmen  
Mark Varner  
Mike Wartjes

The following members of the individual balloting committee voted on this guide. Balloters may have voted for approval, disapproval, or abstention.

Saleman Alibhay  
Thomas Barnes  
Bryan Beske  
Gustavo Brunello  
Demetrio Bucaneg Jr.  
William Bush  
Thomas Callsen  
William Chisholm  
Robert Christman  
Benjamin Cotts  
Charles DeNardo  
Gary Donner  
Namal Fernando

Michael Garrels  
George Gela  
Randall Groves  
Werner H. Helzlsouer  
Randy Hopkins  
John Kuchinsky  
Gung-Yiu Lam  
Danna Liebhaber  
Otto Lynch  
William McBride  
Dennis Neitzel  
Joe Nims  
Lorraine Padden

Bansi Patel  
S. Patel  
Marc Patterson  
Thomas Proios  
Jerry Reding  
Charles Rogers  
Bartien Sayogo  
Robert Schaerer  
Jerry Smith  
Gary Smullin  
John Vergis  
Daniel Ward  
Aaron Wilson

When the IEEE-SA Standards Board approved this guide on 5 December 2018, it had the following membership:

**Jean-Philippe Faure**, *Chair*  
**Gary Hoffman**, *Vice Chair*  
**John D. Kulick**, *Past Chair*  
**Konstantinos Karachalios**, *Secretary*

Ted Burse  
Guido R. Hiertz  
Christel Hunter  
Joseph L. Koepfinger\*  
Thomas Koshy  
Hung Ling  
Dong Liu

Xiaohui Liu  
Kevin Lu  
Daleep Mohla  
Andrew Myles  
Paul Nikolich  
Ronald C. Petersen  
Annette D. Reilly

Robby Robson  
Dorothy Stanley  
Mehmet Ulema  
Phil Wennblom  
Philip Winston  
Howard Wolfman  
Jingyi Zhou

\*Member Emeritus

## Introduction

This introduction is not part of IEEE Std 1542-2018, IEEE Guide for Installation, Maintenance, and Operation of Irrigation Equipment Located Near or Under Power Lines.

The guide is intended for designers, installers, and operators of the irrigation equipment, as well as electric power utilities whose lines are located near or above the irrigation systems. General information is provided on installation, maintenance, and operation of irrigation equipment as it relates to safety due to the presence of electric power lines. The following parameters are considered:

- a) Distance to energized conductors during installation
- b) Proper grounding to help minimize nuisance shocks
- c) Distance between irrigation nozzle and power line conductors during operation of the irrigation system

The recommended minimum conductor-to-nozzle distance is based on the maximum allowable body leakage current of 5 mA rms and field tests conducted by the Nebraska Public Power District and the USDA Agricultural Research Service, University of Nebraska.

Because of the great variety of conditions, practices, electrical system designs, types of irrigation systems, water conductivity, and ground resistance values, this guide covers these variables only in general terms. However, specific recommendations are made for the type of irrigation system and power line parameters that are most representative in the industry. The IEEE makes no representation or warranty as to the adequacy or accuracy of the information in this guide or as to economic or safety issues associated with the use of this guide. When determining whether or not, and/or how, to use the information in this guide, all factors shall be considered with regard to the specific situation(s).

This material is intended to provide a helpful reference for those seeking information on common industry practices so they may consider the experience of others in developing or modifying their own practices.

## Contents

1. Overview.....	10
1.1 Scope.....	10
1.2 Purpose.....	10
2. Normative references .....	11
3. Definitions.....	11
4. Application.....	11
5. Types of irrigation systems.....	12
5.1 General.....	12
5.2 Side roll .....	12
5.3 Boom.....	12
5.4 Hand move .....	12
5.5 Traveler .....	12
5.6 Center pivot.....	12
5.7 Corner pivot.....	13
5.8 Lateral move.....	13
6. Installation and maintenance.....	13
6.1 General.....	13
6.2 Distance to energized conductors.....	13
6.3 Protection from nuisance shocks .....	14
7. Operation of irrigation equipment.....	14
7.1 General.....	14
7.2 Distance from metal frame of irrigation equipment.....	14
7.3 Operating guidelines for Irrigation Systems .....	15
Annex A (informative) Discussion of historical studies on irrigation systems near transmission lines .....	20
Annex B (informative) Significance of parameters .....	24
Annex C (informative) Example of conductor-to-nozzle distance calculation .....	26
Annex D Bibliography .....	28

# IEEE Guide for Installation, Maintenance, and Operation of Irrigation Equipment Located Near or Under Power Lines

## 1. Overview

### 1.1 Scope

The guide is based on industry practices and presents guidelines for installation, maintenance, and operation of above ground irrigation equipment near or under power lines as they pertain to minimum distance to energized conductors and proper grounding to help minimize nuisance shocks. The guide covers a variety of conditions in general terms. Specific recommendations are made for the type of irrigation systems and power line parameters most commonly found. This guide does not cover transferred potentials and currents.

### 1.2 Purpose

The guide is intended for designers, installers, and operators of the irrigation equipment, as well as electric power utilities whose lines are located near or above the irrigation systems. General information is provided on installation, maintenance, and operation of irrigation equipment as it relates to safety due to the presence of electric power lines. The following parameters are considered:

- a) Distance to energized conductors during installation
- b) Proper grounding to help minimize nuisance shocks
- c) Distance between irrigation nozzle and power line conductors during operation of the irrigation system

The recommended minimum conductor-to-nozzle distance is based on the maximum allowable body leakage current of 5 mA rms and field tests conducted by the Nebraska Public Power District and the USDA Agricultural Research Service, University of Nebraska [B3]<sup>1</sup>.

Because of the great variety of conditions, practices, electrical system designs, types of irrigation systems, water conductivity, and ground-resistance values, this guide covers these variables only in general terms. However, specific recommendations are made for the type of irrigation system and power line parameters that are most representative in the industry. The IEEE makes no representation or warranty as to the adequacy or accuracy of the information in this guide or as to economy, or safety issues associated with the use of this guide. When determining whether or not, and/or how, to use the information in this guide, all factors shall be considered with regard to the specific situation(s).

<sup>1</sup>The numbers in brackets correspond to those of the bibliography in Annex D.