IEEE Std 141-1993
(Revision of IEEE Std 141-1986)

IEEE Recommended Practice for Electric Power Distribution for Industrial Plants

Sponsor

**Power Systems Engineering Committee
of the
Industrial and Commercial Power Systems Department
of the
IEEE Industry Applications Society**

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Abstract: A thorough analysis of basic electrical-systems considerations is presented. Guidance is provided in design, construction, and continuity of an overall system to achieve safety of life and preservation of property; reliability; simplicity of operation; voltage regulation in the utilization of equipment within the tolerance limits under all load conditions; care and maintenance; and flexibility to permit development and expansion. Recommendations are made regarding system planning; voltage considerations; surge voltage protection; system protective devices; fault calculations; grounding; power switching, transformation, and motor-control apparatus; instruments and meters; cable systems; busways; electrical energy conservation; and cost estimation.
Keywords: energy management, grounding, industrial power system, industrial power system economics, industrial power system planning, industrial power system protection, power cables, power distribution, power transformers, power system measurements, switches/switchgear, wiring

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Introduction

(This introduction is not part of IEEE Std 141-1993, IEEE Recommended Practice for Electric Power Distribution for Industrial Plants.)

Development of the IEEE Red Book has been an evolving process. With the publication of IEEE Std 141-1993, the Red Book has been in print for about fifty years. Work began on the seventh edition in 1987 with the participation of more than seventy electrical engineers from industrial plants, consulting firms, equipment manufacturers, and academe. It was sponsored and the final version approved by the Power Systems Design Subcommittee of the Power Systems Engineering Committee, Industrial and Commercial Power Systems Department, IEEE Industry Applications Society. The seventh edition was approved by the IEEE Standards Board in 1993 as an IEEE Recommended Practice. It provides pertinent information and recommended practices for the design, construction, operation, and maintenance of electric power systems in industrial plants.

The first publication was developed in 1945 by the Committee on Industrial Power Applications of the American Institute of Electrical Engineers (AIEE). It was entitled *Electric Power Distribution for Industrial Plants* and sold for $1.00 a copy. It became known by the nickname “Red Book” because of its red cover, and a precedent was established for the present IEEE Color Book series, which now encompasses ten books.

The second edition was published in 1956. The committee responsible for its preparation had become a subcommittee of the Industrial Power Systems Committee of the AIEE. This edition was identified as AIEE Number 952.

By 1964, the AIEE had become the Institute of Electrical and Electronics Engineers and the third edition was identified as IEEE No. 141. The fourth edition was produced in 1969, approved as an IEEE Recommended Practice, and identified as IEEE Std 141-1969. The fifth edition, published in 1976, was IEEE Std 141-1976, and the sixth edition, published in 1986, became an American National Standard as well as an IEEE Recommended Practice, and was identified as ANSI/IEEE Std 141-1986.

The authors of this 1993 edition wish to acknowledge their indebtedness to the several hundred engineers whose expertise and work culminated in the six previous editions. The present stature of the Red Book would not have been achieved without their efforts.

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IEEE Recommended Practice for Electric Power Distribution for Industrial Plants

Chapter 1
Overview

1.1 Scope and general information

This publication provides a recommended practice for the electrical design of industrial facilities. It is likely to be of greatest value to the power-oriented engineer with limited industrial plant experience. It can also be an aid to all engineers responsible for the electrical design of industrial facilities. However, it is not intended as a replacement for the many excellent engineering texts and handbooks commonly in use, nor is it detailed enough to be a design manual. It should be considered a guide and general reference on electrical design for industrial plants and buildings.

Tables, charts, and other information that have been extracted from codes, standards, and other technical literature are included in this publication. Their inclusion is for illustrative purposes; where technical accuracy is important, the latest version of the referenced document should be consulted to assure use of complete, up-to-date, and accurate information.

It is important to establish, at the outset, the terms describing voltage classifications. Table 1-1, adapted from IEEE Std 100-1992 [B5],[1] indicates these voltage levels. The National Electrical Code, described in 1.5.1, uses the term *over 600 volts* generally to refer to what is known as *high voltage*. Many IEEE Power Engineering Society (PES) standards use the term *high voltage* to refer to any voltage higher than 1000. All nominal voltages are expressed in terms of root-mean-square (rms). For a detailed explanation of voltage terms, see Chapter 3. ANSI C84.1-1977 [B1] lists voltage class designations applicable to industrial and commercial buildings where medium voltage extends from 1000 V to 69 kV nominal.

1.2 Industrial plants

The term *industrial plants,* as used in this chapter, refers to industrial plants, buildings, and complexes where manufacturing, industrial production, research, and development are performed. It does not include commercial buildings, such as institutional, governmental, public, health-related office buildings, nor apartment and residential buildings.

If commercial buildings are included in industrial complexes, then the use of IEEE Std 241-1990 (the Gray Book) would be appropriate for these specific buildings. If medical facilities

[1]The numbers in brackets preceded by the letter B correspond to those of the bibliography in 1.21.