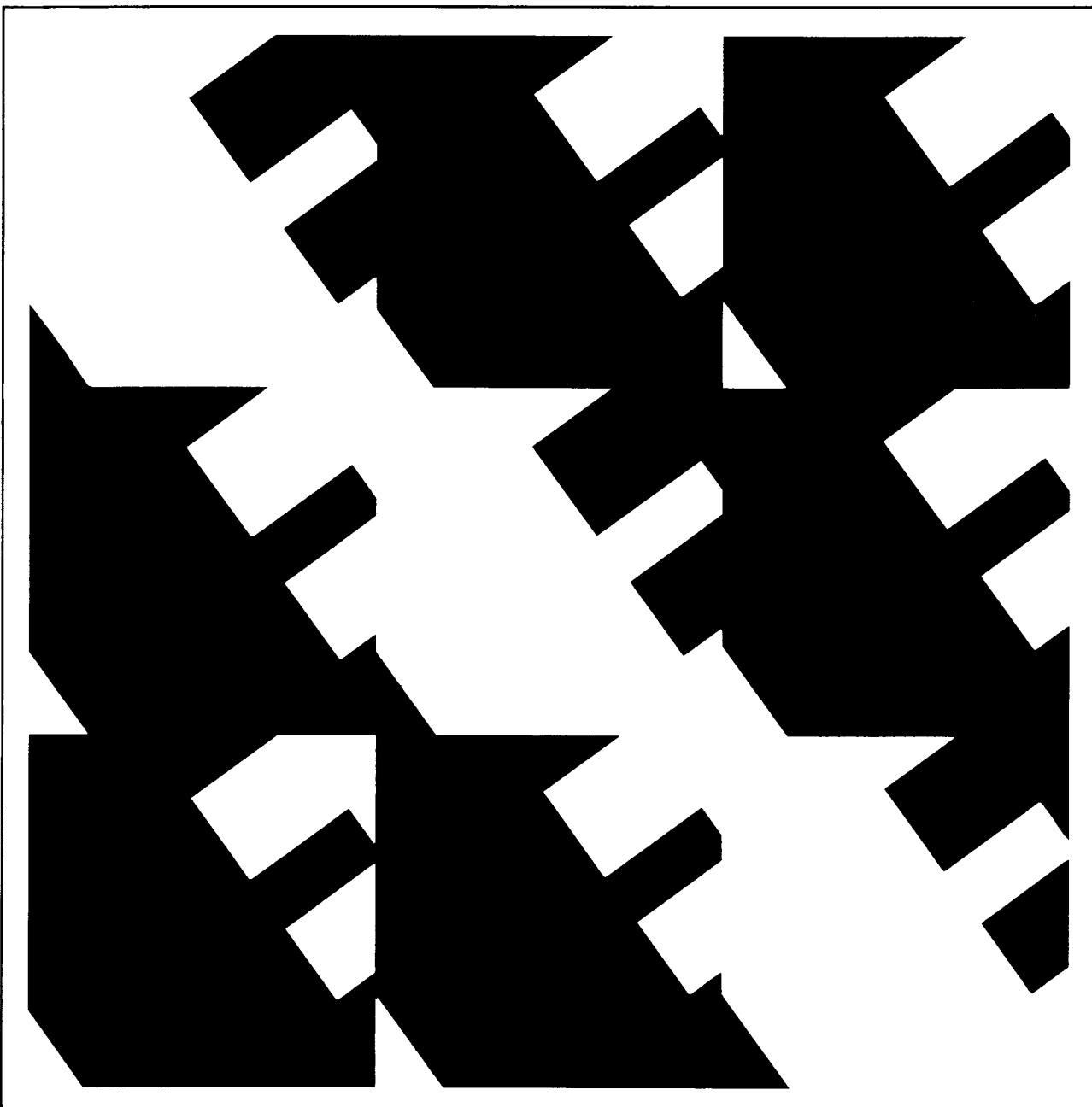


IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines

ANSI/IEEE Std 644-1987



Published by The Institute of Electrical and Electronics Engineers, Inc. 345 East 47th Street, New York, NY 10017, USA
March 16, 1987

SH10892

An American National Standard
**IEEE Standard Procedures for
Measurement of Power Frequency Electric
and Magnetic Fields from AC Power Lines**

Sponsor
**Corona and Field Effects Subcommittee
of the
Transmission and Distribution Committee
of the
IEEE Power Engineering Society**

Approved June 19, 1986
IEEE Standards Board

Approved November 17, 1986
American National Standards Institute

© Copyright 1987 by

**The Institute of Electrical and Electronics Engineers, Inc
345 East 47th Street, New York, NY 10017, USA**

*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.*

IEEE Standards documents are developed within the Technical Committees of the IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Board. Members of the committees serve voluntarily and without compensation. They are not necessarily members of the Institute. The standards developed within IEEE represent a consensus of the broad expertise on the subject within the Institute as well as those activities outside of IEEE which have expressed an interest in participating in the development of the standard.

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 brought about through developments in the state of the art and comments received from users of the standard. Every IEEE Standard is subjected to review at least once every five years for revision or reaffirmation. When a document is more than five years old, and has not been reaffirmed, 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.

Comments for revision of IEEE Standards are welcome from any interested party, regardless of membership affiliation with IEEE. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments.

Interpretations: Occasionally questions may arise regarding the meaning of portions of standards as they relate to specific applications. When the need for interpretations is brought to the attention of IEEE, the Institute will initiate action to prepare appropriate responses. Since IEEE Standards represent a consensus of all concerned interests, it is important to ensure that any interpretation has also received the concurrence of a balance of interests. For this reason IEEE and the members of its technical committees are not able to provide an instant response to interpretation requests except in those cases where the matter has previously received formal consideration.

Comments on standards and requests for interpretations should be addressed to:

Secretary, IEEE Standards Board
345 East 47th Street
New York, NY 10017
USA

Foreword

(This Foreword is not a part of ANSI/IEEE Std 644-1987, IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines.)

The working group is indebted to Martin Misakian for leading and coordinating the effort to update and expand IEEE Standard 644-1979, IEEE Recommended Practices for Measurement of Electric and Magnetic Fields from AC Power Lines, into the present document.

Dr. Misakian and his task force of Luciano Zaffanella, Rod Baishiki, and Bruce Whitney were responsible for preparing the original version of this document, which was presented as a working group report at the 1977 IEEE Power Engineering Society Summer Meeting in Mexico City. The working group members acknowledge the contribution of the many participants to the field trips at the Bonneville Power Administration (BPA) and at the Electric Power Research Institute (EPRI) Project Ultra-High Voltage (UHV), particularly Dr. Dan Bracken, formerly of BPA, Dr. Don Deno of Project UHV, members of the Energy Research and Development Administration (ERDA) sponsored *E-Field Project*¹ at the National Bureau of Standards (NBS), and the contribution of the participants to a special Field Strength Measurement Workshop organized by W. Johnson of EPRI. Contributions of working group members during the preparation of the original document and the present version are also gratefully acknowledged.

This standard was prepared by the AC Fields Working Group of the Corona and Field Effects Subcommittee of the Transmission and Distribution Committee of the IEEE Power Engineering Society. At the time it approved this standard, the working group had the following membership:

F. M. Dietrich, *Chairman*

R. Aker
R. Baishiki
T. D. Bracken
J. E. Bridges
J. H. Bunke
R. J. Caola
R. E. Carberry
R. Conti
S. Cristina
J. Dabkowski

D. Deno
C. C. Diamond
W. Eisinger
C. H. Gary
W. Inkis
K. C. Jaffa
L. E. Lingo
T. J. McDermott
M. Misakian
J. T. Morgan
G. B. Niles

R. G. Olsen
J. P. Reilly
S. Rodick
R. J. Rusch
Y. Sawada
J. M. Silva
J. R. Stewart
J. M. Van Name
B. J. Ware
P. S. Wong
R. Zavadil

The following persons were on the balloting committee that approved this document for submission to the IEEE Standards Board:

L. A. Belfore
V. L. Chartier
W. H. Cole
F. A. Denbrock
C. C. Diamond

G. V. Fantozzi
J. H. Mallory
S. P. Maruvada
D. T. Michael
D. L. Nickel

T. A. Pinkham
R. G. Rocamora
R. C. Seebald
L. L. Smith
D. D. Wilson

¹ See [B8] on p 21.

When the IEEE Standards Board approved this standard on June 19, 1986, it had the following membership:

John E. May, *Chairman*

James H. Beall
Fletcher J. Buckley
Paul G. Cummings
Donald C. Fleckenstein
Jay Forster
Daniel L. Goldberg
Kenneth D. Hendrix
Irvin N. Howell

Sava I. Sherr, *Secretary*

Jack Kinn
Joseph L. Koepfinger*
Edward Lohse
Lawrence V. McCall
Donald T. Michael*
Marco W. Migliaro
Stanley Owens
John P. Riganati
Frank L. Rose

Irving Kolodny, *Vice Chairman*

Robert E. Rountree
Martha Sloan
Oley Wanaselja
J. Richard Weger
William B. Wilkens
Helen M. Wood
Charles J. Wylie
Donald W. Zipse

*Member emeritus

Contents

SECTION	PAGE
1. Purpose	7
2. Definitions	7
3. References	8
4. Electric Field Strength Meters.....	8
4.1 General Characteristics of Electric Field Strength Meters.....	8
4.2 Theory and Operational Characteristics.....	10
4.3 Calibration of Electric Field Strength Meters	10
4.4 Immunity from Interference.....	14
4.5 Parameters Affecting Accuracy of Electric Field Strength Measurements	14
5. Electric Field Strength Measurement Procedures	15
5.1 Procedure for Measuring Electric Field Strength Near Power Lines.....	15
5.2 Lateral Profile (Figs 6 and 7).....	15
5.3 Longitudinal Profile (Fig 7).....	15
5.4 Precautions and Checks During <i>E</i> -Field Measurements.....	16
5.5 Measurement Uncertainty	17
6. Magnetic Field Meters	17
6.1 General Characteristics of Magnetic Field Meters.....	17
6.2 Theory and Operational Characteristics.....	17
6.3 Calibration of Magnetic Field Meters.....	18
6.4 Immunity from Interference.....	20
6.5 Parameters Affecting Accuracy of Magnetic Field Measurements.....	20
7. Magnetic Field Measurement Procedures	20
7.1 Procedure for Measuring Magnetic Field Near Power Lines	20
7.2 Lateral Profile	20
7.3 Longitudinal Profile.....	20
7.4 Precautions and Checks During <i>B</i> -Field Measurements.....	20
7.5 Measurement Uncertainty	21
8. Reporting Field Measurements	21
9. Bibliography.....	21
 FIGURES	
Fig 1 (a) Spherical <i>E</i> -Field Probe; (b) Geometries of Commercial US <i>E</i> -Field Meters.....	10
Fig 2 Normalized <i>E</i> -Field at Plate Surface and Midway Between Plates.....	11
Fig 3 Large Parallel Plates Used for Calibration of <i>E</i> -Field Meter	12
Fig 4 Current Injection Calibration Check	12
Fig 5 Known <i>E</i> -Field for Large Parallel Plates and Tolerance Levels	13
Fig 6 Example of Lateral Profile of Vertical <i>E</i> -Field Strength at Midspan	16
Fig 7 Typical Plan View with Heights of Permanent Nearby Objects	16
Fig 8 Conducting Loop in Quasistatic Uniform <i>B</i> -Field.....	18
Fig 9 Coordinate System for Current Loop Generating Magnetic Field B_z	18
Fig 10 Percentage Departure of B_z from $B_z(0, 0, 0)$ for Positions in the Plane of a Square Current Loop 1×1 m and 3 cm Above and Below the Plane (Parenthesis).....	19
Fig 11 Schematic of Circuit for Calibration of Magnetic Field Meter	20

TABLES

Table 1	Typical Background Data Sheet.....	9
Table 2	Normalized E -Field Values Midway Between Plates and at Plate Surfaces.....	11

APPENDIX

Units and Conversion Factors.....	23
A1. Units and Conversion Factors.....	23
A2. SI Units.....	23
A3. Useful Physical Constants.....	23
A4. References.....	23

APPENDIX TABLE

Table A1	Conversion from Customary to SI Units.....	23
----------	--	----