

An American National Standard

IEEE Guide for the Grounding of Instrument Transformer Secondary Circuits and Cases

Sponsor

**Power System Relaying Committee
of the
IEEE Power Engineering Society**

Secretariat

**Institute of Electrical and Electronics Engineers
NoneNational Electrical Manufacturers Association**

Approved 22 September 1983
Reaffirmed 6 December 1990

IEEE Standards Board

Approved 23 January 1987
Reaffirmed 21 May 1991

American National Standards Institute

© Copyright 1988 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

IEEE Standards documents are adopted by the Institute of Electrical and Electronics Engineers without regard to whether their adoption may involve patents on articles, materials, or processes. Such adoption does not assume any liability to any patent owner, nor does it assume any obligation whatever to parties adopting the standards documents.

Foreword

(This Foreword is not a part of ANSI/IEEE C57.13.3-1983, IEEE Guide for the Grounding Instrument Transformer Secondary Circuits and Cases.)

The Guide for the Grounding of Instrument Transformer Secondary Circuits and Cases was originally published in March, 1951, as AIEE Application Guide No. 52. This original guide went out of print in 1976. The proposed new guide, ANSI/IEEE C57.13.3-1983, is intended to replace the original AIEE No. 52 and to update its content to include present practices. The primary emphasis of the new guide is personnel safety.

A number of diagrams have been included in the new guide to help illustrate recommended practices. The recommendations of the current National Electrical Code and the practices of various public utilities and manufacturers were taken into consideration. Hence, this guide recognizes the more commonly accepted practices and incorporates them into a general set of rules, with permissible exceptions.

This guide was prepared by the Grounding of Instrument Transformer Secondary Circuits and Cases Working Group of the Relaying Practices Subcommittee of the Power System Relaying Committee of the IEEE Power Engineering Society.

At the time it approved this guide, the C57 Committee had the following membership:

Roger Ensign, Chair
L.S. McCormick, Vice Chair
C. H. White, Secretary

Electric Light & Power	W. Cole (<i>Delegation Chair</i>) G. Gunnels P. Orehek D. Soffrin (<i>Alt</i>) J. Sullivan (<i>Alt</i>) A. Velazquez
Institute of Electrical and Electronics Engineers	J. Bonucchi O. Compton (<i>Delegation Chair</i>) J. Dutton R. Ensign F. Huber, Jr. (<i>Alt</i>) L. McCormick W. Neiswander H. Smith (<i>Alt</i>) B. Stanleigh H. Tucker
National Electrical Manufacturers Association	P. Cacalloro (<i>Alt</i>) P. Dewever (<i>Alt</i>) J. Douglas W. Kendall K. Linsley (<i>Delegation Chair</i>) G. Mayall W. McNutt J. Nay (<i>Alt</i>) T. Reback D. Strang (<i>Alt</i>) R. Uptegraff, Jr.

Testing Laboratory Group	W. O'Grady
	R. Seelbach
Tennessee Valley Authority	L. Smith
US Department of the Navy	H. Stickley
US Department of Energy	D. Torgerson
US Department of the Interior	F. Cook, Sr.
US D.A. REA.....	J. Arnold, Jr.
American National Standards Institute	C. Zegers

The members of the Grounding of Instrument Transformer Secondary Circuits and Cases Working Group responsible for developing this guide were:

B. L. Laird, Chair

C. W. Barnett	W. C. Kotheimer	J. W. Walton
J. L. Blackburn	J. R. Linders	J. A. Zulaski
	D. R. Volzka	

The members of the Relaying Practices Subcommittee who reviewed and approved this guide were:

A. T. Giuliente, Chair

L. E. Landoll, Vice Chair/Secretary

C. W. Barnett	R. W. Haas	L. Scharf
E. A. Baumgartner	S. H. Horowitz	B. D. Russell
J. Berdy	T. L. Kaschalk	J. R. Tudor
J. R. Boyle	D. K. Kaushal	J. R. Turley
D. M. Clark	W. A. Lewis	F. Von Roeschlaub
D. H. Colwell	J. Miller	C. L. Wagner
J. F. Criss	T. Neissink	J. E. Waldron
H. DiSante	S. L. Nilsson	M. A. Xavier
M. J. Fein	G. C. Parr	
C. W. Fromen	R. W. Pashley	

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

W. A. Elmore, Chair

D.R. Volzka, Vice Chair

C. H. Griffin, Secretary

R. F. Arehart	J. W. Chadwick, Jr.	R. W. Haas
J. J. Arneth	D. M. Clark	R. E. Hart
C. W. Barnett	G. A. Colgrove	M. D. Hill
E. A. Baumgartner	D. H. Colwell	R. W. Hirtler
J. Berdy	D. Dalasta	S. H. Horowitz
J. L. Blackburn	R. W. Dempsey	F. B. Hunt
J. B. Blose	H. DiSante	J. A. Imhof
J. J. Bonk	E. J. Emmerling	R. H. Jones
J. R. Boyle	R. J. Felton	T. L. Kaschalk
B. Bozoki	R. J. Fernandez	D. K. Kaushal
W. D. Breingan	C. M. Gadsden	J. L. Koepfinger
J. A. Bright	A. T. Giuliente	W. C. Kotheimer
H. J. Calhoun	S. E. Grier	R. J. Kuhr

B. L. Laird
L. E. Landoll
J. R. Latham
H. Lee
W. A. Lewis
J. R. Linders
W. R. Lund
G. J. Marieni
C. A. Matthews
F. N. Meissner
J. Miller
R. J. Moran
J. J. Murphy

T. J. Murray
G. R. Nail
T. Niessink
G. C. Parr
R. W. Pashley
C. J. Pencinger
A. G. Phadke
A. C. Pierce
J. W. Pope
G. D. Rockefeller
B. D. Russell
M. S. Sachdev
E. T. Sage

L. Scharf
J. E. Stephens
A. Sweetana
E. F. Troy
J. R. Turley
E. A. Udren
W. H. VanZee
C. L. Wagner
J. E. Waldron
L. N. Walker
J. W. Walton
J. A. Zulaski

When the IEEE Standards Board approved this standard on September 22, 1983, it had the following membership:

James H. Beall, *Chair*
Edward Chelotti, *Vice Chair*
Sava I. Sherr, *Secretary*

J. J. Archambault
John T. Boettger
J. V. Bonucchi
Rene Castenschiold
Edward J. Cohen
Len S. Corey†
Donald C. Fleckenstein
Jay Forster

Donald N. Heirman
Irvin N. Howell
Joseph L. Koepfinger*
Irving Kolodny
George Konomos
R. F. Lawrence
John E. May
Donald T. Michael*

John P. Riganati
Frank L. Rose
Robert W. Seelbach
Jay A. Stewart
Clifford O. Swanson
Robert E. Weiler
W. B. Wilkens
Charles J. Wylie

*Member emeritus

†Deceased

CLAUSE	PAGE
1. Introduction	1
1.1 General	1
1.2 Scope	1
1.3 References	2
2. Grounding of Instrument Transformer Secondary Circuits	2
2.1 Introduction	2
2.2 Ground Connection to Only One Point in the Secondary Circuit	2
2.3 Recommended Point of Grounding	3
2.4 Location and Making of Connection to Ground	3
2.5 Minimum Size of Conductor for Ground Connection or Neutral Bus	4
2.6 Ground Connection Isolation Test Facilities	4
3. Grounding of Instrument Transformer Cases and Cases of Connected Equipment	17
3.1 Metallic or Conductive Case Grounding	17
3.2 Internal Conductive Parts — Insulated Cases	17
3.3 Ungrounded Metallic or Conductive Cases	17
4. Exceptions to Grounding	17
5. Bibliography	18

IEEE Guide for the Grounding of Instrument Transformer Secondary Circuits and Cases

1. Introduction

1.1 General

The primary emphasis of this guide is personnel safety and proper performance of relays at powerline frequencies. The grounding and shielding of cables and other grounding considerations are not addressed. However, references dealing with these and related subjects are included in the Bibliography.

Historically, it has been common practice in the US to connect some part of the secondary circuit of voltage and current transformers to the station ground system. The present preferred practice is to locate this safety ground with suitable ground isolation test facilities at the first point of application (switchboard or relay panel) of the instrument transformer secondary circuit. The circuit ground isolation facilities will permit convenient testing of circuit insulation to ground.

Previous publications have made significant contributions to consistency in some areas of grounding practices. This guide will include those contributions that are generally practiced today, make revisions where present experience and practice indicate them to be desirable, and make recommendations in new areas of interest not previously addressed. Diagrams are included to illustrate the recommendations.

1.2 Scope

This guide contains general and specific recommendations for grounding current and voltage transformer secondary circuits and cases of connected equipment. The practices recommended apply to all transformers of this type, including capacitive voltage transformers and linear couplers, irrespective of primary voltage or whether the primary windings are connected to, or are in, power circuits or are connected in the secondary circuits of other transformers as auxiliary cts or vts. Although most diagrams included in this guide show relaying applications, the recommended practices apply equally to metering and other areas where instrument transformers are used.

Exceptions to grounding are permissible or sometimes required where advantages obtained by not grounding, in certain instances or in certain types of installations, are considered to outweigh the safety or other advantages obtained by grounding. Such exceptions should comply with the recommendations of ANSI C1-1987 [1]¹, even though utilities are presently exempt from the requirements of this code.

¹The number in square brackets corresponds to that of the reference listed in 1.3 of this standard; bracketed numbers preceded by B correspond to Section 5, Bibliography.

1.3 References

When this American National Standard is superseded by a revision, the revision shall apply.

[1] ANSI C1-1987, National Electrical Code.²

2. Grounding of Instrument Transformer Secondary Circuits

2.1 Introduction

Each secondary circuit should be a completely self-contained metallic circuit insulated from ground, except at one point in the circuit. At this physical location in the installation, the circuit should be solidly grounded through a conductor of adequate size. (See Section 4 for permissible exceptions and 2.5 for conductor size.)

For purposes of this guide, an instrument transformer secondary circuit consists of all instrument transformer secondary windings and all of the coils, contacts, and other components that are connected together in a metallic circuit to the instrument transformer secondary.

2.2 Ground Connection to Only One Point in the Secondary Circuit

The instrument transformer secondary circuit, irrespective of the number of instrument transformer secondary windings connected to or in that circuit, should be connected to the station ground at only one point. Usually, the common return circuit for two or more transformers in a set are made into a secondary common neutral. This neutral should then be connected to the station ground bus at only one point, so that the station ground bus itself will never serve to complete any part of the instrument transformer secondary circuit.

The reasons for making this ground connection only at a single point in each circuit are as follows:

- 1) To prevent differences of potential in the instrument transformer secondary circuit because of differences of potential between different points in the station ground grid. These differences are caused by the flow of fault current through the ground grid. Such differences of potential can result in the flow of current through the relay, instrument, and meter coils and cause possible incorrect performance of the relay and inaccuracies in the readings of the instruments and meters. High neutral conductor currents resulting from multiple ground connections to the neutral can cause thermal damage to the neutral conductor.
- 2) To facilitate the temporary removal and reestablishment of the ground connection, when desired, in order to make periodic tests for deterioration of insulation and accidental grounds in the instrument transformer secondary circuit.

For convenience, some users make a common neutral connection for the individual neutrals or wye points of two or more sets of transformers into a neutral bus and then connect this neutral bus to the station ground bus at only one point. It is not recommended that neutrals or wye points of two or more sets of transformers be connected into a common neutral bus because of the difficulty caused when it is desired to make insulation tests from one set of transformer secondary circuits to ground. Removing the one known or intentional ground to test the one secondary circuit will remove the necessary safety ground for the other secondary circuits that may still be energized. Recommended arrangements for circuit grounding are discussed in 2.6.

²This document is published by the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269. Copies are also available from the Sales Department, American National Standards Institute, 1430 Broadway, New York, NY 10018.