

An American National Standard

IEEE Standard Guide for the Application, Operation, and Maintenance of Automatic Circuit Reclosers

Sponsor

**IEEE Reclosers and Sectionalizers Subcommittee
NEMA Automatic Circuit Recloser Technical Committee**

Secretariat

**Edison Electric Institute
Institute of Electrical and Electronics Engineers
National Electrical Manufacturers Association**

Approved June 22, 1972
Reaffirmed December 15, 1977
Reaffirmed December 12, 1985
Reaffirmed June 18, 1992

IEEE Standards Board

Approved June 14, 1973
Reaffirmed October 10, 1979
Reaffirmed May 3, 1988

American National Standards Institute

Published by

**Institute of Electrical and Electronics Engineers
345 East 47th Street, New York, N. Y. 10017**

American National Standard

An American National Standard implies a consensus of those substantially concerned with its scope and provisions. An American National Standard is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of an American National Standard does not in any respect preclude anyone, whether he has approved the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard. American National Standards are subject to periodic review and users are cautioned to obtain the latest editions.

CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of publication. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute, 1430 Broadway, New York, N. Y. 10018.

©Copyright 1973 by

The Institute of Electrical and Electronics Engineers, Inc.

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.

Foreword

(This Foreword is not a part of American National Standard Guide for the Application, Operation, and Maintenance of Automatic Circuit Reclosers, C37.61-1973, IEEE Std 321-1973.)

This is a new standard developed to provide information on the selection, application, operation and maintenance of automatic circuit reclosers. It represents current practice on this product in the United States.

The preparation of this standard was the cooperative work of the IEEE Switchgear Committee (Reclosers and Sectionalizers Subcommittee), which prepared this standard, and the NEMA Switchgear Section (SG-13 Automatic Circuit Recloser Technical Committee), and the C37 Subcommittee on Automatic Circuit Reclosers and Line Sectionalizers, which reviewed and approved the document.

Upon recommendation of this latter subcommittee, the proposed American National Standard was voted on by Standards Committee C37 on Power Switchgear, and subsequently approved as an American National Standard.

Suggestions for improvement gained in the use of this standard will be welcome. They should be sent to the American National Standards Institute, Inc, 1430 Broadway, New York, N. Y. 10018.

The American National Standards Committee on Power Switchgear, C37, which reviewed and approved this standard, had the following personnel at the time of approval:

C. L. Wagner, *Chair*
C. M. Clevenger (*Executive Vice-Chairman, High-Voltage Switchgear Standards*)
W. R. Wilson (*Executive Vice-Chairman, IEC Activities*)
W. E. Laubach (*Executive Vice-Chairman, Low-Voltage Switchgear Standards*)
J. G. Werner, *Secretary*

Organization Represented

Association of Iron and Steel Engineers.....

Electric Light and Power Group.....

Institute of Electrical and Electronics Engineers.....

National Electrical Manufacturers Association.....

Tennessee Valley Authority

Name of Representative

T. S. Novak

J. E. Beehler

H. G. Frus

K. D. Hendrix

F. R. Solis

C. D. Stalnaker

R. W. Hudson (*Alt*)

R. H. Knight (*Alt*)

J. P. Markey (*Alt*)

R. E. Friedrich

J. B. Owens

H. O. Simmons, Jr

G. W. Walsh

H. F. White

H. H. Fahnoe (*Alt*)

J. A. Imhof (*Alt*)

M. J. Maier (*Alt*)

D. C. Musgrave (*Alt*)

A. P. Colaiaco

R. W. Dunham

C. E. Grycko

W. J. Smith

W. R. Wilson

J. G. Werner (*Alt*)

Owen S. C. Hammer

Organization Represented**Name of Representative**

U. S. Department of the Army.....	R. H. Bruck
U. S. Department of the Interior, Bureau of Reclamation.....	Edward N. Tomsic
U. S. Department of the Navy, Naval Facilities Engineering Command.....	D. M. Hannemann Leonard W. Johnson (Alt)

The personnel of the IEEE Reclosers and Sectionalizers Subcommittee who prepared this standard were as follows:

L. V. McCall, Chair

R. S. Arnold	G. W. Dolloff	J. P. Fitzgerald
A. L. Bohlinger	F. W. Edwards	E. R. Longman
W. L. Carey	R. A. Few	B. H. Schultz
L. B. Crann		F. C. Tuefel

The personnel of the NEMA Automatic Circuit Recloser Technical Committee who reviewed and approved this standard were as follows:

B. H. Schultz, Chair
H. Colin Smith, Secretary

R. H. Arndt	J. R. Jones (Alt)	K. G. Darrow (Alt)
R. E. Koch (Alt)	R. S. Arnold	Fred C. Tuefel
A. L. Bohlinger	R. A. Few	W. C. McKay
J. R. Laughlin	A. F. Parks	E. J. Field
	G. O. Perkins	

The personnel of the C37 Subcommittee on Automatic Circuit Reclosers and Line Sectionalizers who reviewed and approved this standard were as follows:

B. H. Schultz, Chair
H. Colin Smith, Secretary

R. H. Arndt	G. W. Dolloff	E. R. Longman
A. L. Bohlinger	F. W. Edwards	M. L. Paulson
L. B. Crann	R. A. Few	F. C. Teufel
	J. P. Fitzgerald	

When this standard was approved on June 22, 1972, the IEEE Standards Committee had the following membership:

J. Forster , Chair
B. O. Weinschel , Vice Chair
S. I. Sherr , Secretary

S. J. Angello	G. E. Hertig	S. W. Rosenthal
Saul Aronow	J. L. Koepfinger	Gustave Shapiro
Jack Avins	Harvey Lance	R. M. Showers
B. B. Barrow	B. J. Leon	P. H. Smith
F. K. Becker	D. T. Michael	F. G. Timmel
Richard Brereton	J. D. M. Phelps	L. van Rooij
W. H. Cook	R. H. Rose, II	R. V. Wachter
Louis Costrell		W. T. Wintringham

CLAUSE	PAGE
1. Scope	7
2. Purpose	7
3. General	7
4. Application	8
4.1 Recloser Characteristics	8
4.2 Information Needed for Recloser Application	8
4.3 Selecting the Recloser	9
5. Operation	16
5.1 Installation	16
5.2 Reclosing After Lockout	16
5.3 Cold-Load Pickup	17
6. Maintenance	17
6.1 Frequency of Maintenance	17
6.2 Procedures	18
7. References	19
8. Revision of American National Standards Referred to in This Document	19
Annex A (informative) Recloser Characteristics	20
Annex B (informative) Procedure To Determine Maintenance Basis on Number of Operations of Oil-Filled Reclosers	24
Annex C (informative) Basis of Derivation of Duty Factors and Standard Operating Duties	26

An American National Standard

IEEE Standard Guide for the Application, Operation, and Maintenance of Automatic Circuit Reclosers

1. Scope

This application guide provides information on the selection, application, operation, and maintenance of single or multi-pole alternating-current automatic circuit reclosers. The guide is for use in conjunction with American National Standard Requirements for Automatic Circuit Reclosers for AC Systems, C37.60-1968, and Supplement C37.60a-1971. The definitions in American National Standard C37.60-1968 apply to this guide.

2. Purpose

This application guide was developed to identify the principle characteristics of reclosers, indicate the system information needed, and give step-by-step procedures used to select reclosers for specific applications.

3. General

Due to the wide variety of operating conditions, many different application and maintenance procedures are employed by users. This guide does not attempt to present all of these and is necessarily limited in scope. Where there are several acceptable procedures, as in the selection of recloser operating sequences, commonly used alternatives are described, with a discussion of their relative advantages. It assumes that the user of this guide will have some experience with fault current calculation procedures and with the application of fuse or relay-controlled circuit breakers to electric power systems. For the user lacking this experience, a list of selected references is included in Section 7.. Sample problems illustrate the procedure followed in selecting single-phase and three-phase reclosers, and in providing coordination with other protective devices in the circuit. Additional information on recloser ratings and the selection of recloser operating sequences is provided in Appendix A.

Section 5, Operation, recommends that operating checks be made on reclosers at the time of installation, and after operation, and discusses the problems associated with reenergizing a circuit which is protected by a recloser.

Section 6, Maintenance, covers the recommended frequency of maintenance, and maintenance procedures. A procedure to determine maintenance according to the number of recloser operations is described in Appendix B.

About 90 percent of all faults on overhead distribution lines are temporary faults caused by lightning, conductor slap, or by animal or tree contact. Early efforts to improve the reliability of service on distribution circuits led to the

development of the repeater fuse. With this arrangement, if a fuse were blown, a second and, if necessary, a third fuse, would automatically be inserted into the circuit. Since most faults were temporary in nature, service was usually restored automatically by the replacement fuse, and long service interruptions were avoided.

The success of the repeater fuse led to the development of the automatic circuit recloser, a self-controlled interrupting device which senses fault currents and proceeds through a predetermined sequence of opening and reclosing operations, followed by resetting, hold-closed or lockout. Early reclosers were single-phase, oil-filled, series-trip devices in which main circuit current above a specified value, flowing through a solenoid or operating coil, provided the energy required to open the main contacts.

The first reclosers had relatively low continuous and interrupting current ratings. With load growth, higher continuous and interrupting current ratings have been developed. Modern reclosers are manufactured in single-phase and in three-phase units with mechanical or electronic control. Interruption may be in oil or in a vacuum. Reclosers having higher current ratings may be shunt trip actuated, with operating energy for tripping and contact opening being obtained apart from the main circuit.

4. Application

4.1 Recloser Characteristics

A knowledge of recloser characteristics and standard ratings is a prerequisite to their proper application. The characteristics of importance in application are:

- 1) Voltage rating
- 2) Continuous current rating
- 3) Interrupting current rating
- 4) Minimum tripping current
- 5) Operating or time-current characteristic
- 6) Operating sequence
- 7) Reclosing interval
- 8) Reset time

A discussion of recloser characteristics is given in Appendix A. Manufacturers' catalogs provide information on available recloser models, their individual characteristics and optional accessory equipment. Standard ratings and requirements for reclosers are specified in American National Standard C37.60-1968 and Supplement C37.60a-1971.

4.2 Information Needed for Recloser Application

The minimal information given below is needed for recloser selection.

4.2.1

System data and circuit map showing:

- 1) System voltage
- 2) System grounding
- 3) System impulse insulation requirements
- 4) Tentative recloser location
- 5) Location of other sectionalizing devices
- 6) Maximum and minimum fault currents at each sectionalizing device location
- 7) X/R ratio at point of application

- 8) Minimum fault current¹ at end of each circuit or at end of recloser zone of protection
- 9) Location of major or critical loads and whether they are single- or three-phase

4.2.2

Manufacturers' data on available reclosers:

- 1) Time-current characteristic (TCC) curves
- 2) Operating sequence and control
- 3) Current and voltage ratings
- 4) Optional accessories

4.2.3

Data on other sectionalizing devices with which the recloser must coordinate:

- 1) Size or current rating
- 2) Time-current characteristic (TCC) curves

4.3 Selecting the Recloser

In selecting a recloser it is assumed that the operating sequence will be predetermined by system practice or by the characteristics of other sectionalizing devices with which the recloser must coordinate.

See Tables 2 and 3 of American National Standard Supplement C37.60a-1971. Note that reclosers are classified by "line numbers." This terminology will be used herein to identify or refer to various classes of reclosers.

The following steps are to be followed in selecting a recloser:

Step 1: From Table 2 of American National Standard Supplement C37.60a-1971, identify all recloser line numbers acceptable for the circuit voltage.

- 1) Line 1 reclosers may be used on circuits of 2.4—15 kV
- 2) Line 2—8, inclusive, reclosers may be used on circuits of 2.4—15.5 kV
- 3) Line 9—12, inclusive, reclosers may be used on circuits of 15.5—27 kV
- 4) Line 13 reclosers may be used on circuits of 27—38 kV
- 5) Line 14 reclosers may be used on circuits of 38—48.3 kV
- 6) Line 15 reclosers may be used on circuits of 48.3—72.5 kV

The remaining steps of this procedure assume the use of line reclosers that satisfy this voltage criteria.

Step 2: Determine maximum load current (allowing for some load growth) at the recloser location. From the recloser line numbers of Step 1, note from Table 3 of American National Standard Supplement C37.60a-1971 those that have continuous current rating equal to or greater than the maximum load current.

Step 3: Determine the maximum symmetrical fault current at the recloser location. (Allowing for future increase in fault current.)

¹See Sample Problems 1 and 2 for typical methods of determining minimum fault current, and Sample Problem 3 for an alternative method of determining the end of the zone of protection.