

# IEEE Recommended Practice for Reporting Field Failure Data for Power Circuit Breakers

Sponsor  
**Switchgear Committee**  
of the  
**IEEE Power Engineering Society**

Reaffirmed 11 September 2002  
Approved 20 June 1996  
**IEEE Standards Board**

**Abstract:** A format is presented that provides a concise and meaningful method for recording pertinent information on power circuit breaker field failures. It is recommended that this format be utilized in record keeping and directing corrective action to improve field reliability of power circuit breakers.

**Keywords:** power circuit breakers

---

The Institute of Electrical and Electronics Engineers, Inc.

345 East 47th Street, New York, NY 10017-2394, USA

Copyright © 1996 by the Institute of Electrical and Electronics Engineers, Inc.

All rights reserved. Published 1996. Printed in the United States of America.

ISBN 1-55937-766-6

*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 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 that 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 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 societies and Standards Coordinating 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  
445 Hoes Lane  
P.O. Box 1331  
Piscataway, NJ 08855-1331  
USA

<p>Note: 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 with respect to the existence or validity of any patent rights in connection therewith. The IEEE shall not be responsible for identifying all patents for which a license may be required by an IEEE standard or for conducting inquiries into the legal validity or scope of those patents that are brought to its attention.</p>
---

Authorization to photocopy portions of any individual standard for internal or personal use is granted by the Institute of Electrical and Electronics Engineers, Inc., provided that the appropriate fee is paid to Copyright Clearance Center. To arrange for payment of licensing fee, please contact Copyright Clearance Center, Customer Service, 222 Rosewood Drive, Danvers, MA 01923 USA; (508) 750-8400. Permission to photocopy portions of any individual standard for educational classroom use can also be obtained through the Copyright Clearance Center.

## Introduction

(This introduction is not part of IEEE Std 1325-1996, IEEE Recommended Practice for Reporting Field Failure Data for Power Circuit Breakers.)

The reliability of installed equipment depends upon many factors, some of which are related to the installation, application, maintenance, and environment, while others are associated with the design, manufacture, and shipment of the equipment. Availability of improved information for meaningful feedback to the manufacturer or others is essential to assure mutual understanding of any field failures encountered and the best practical corrective action.

The High-Voltage Circuit Breaker Subcommittee of the IEEE Switchgear Committee recognized this need and established the Quality and Reliability Working Group. One of the results of this group's activities was the development of the Failure Reporting Form for power circuit breakers. This has been in trial use for several years, and it is now appropriate to elevate its status to a recommended practice.

The Quality and Reliability Working Group of the High-Voltage Circuit Breaker Subcommittee of the IEEE Switchgear Committee that prepared and approved this standard had the following membership:

### **D. Sharma, *Chair***

R. W. Alexander	K. I. Gray	R. A. Sarkinen
D. M. Benenson	C. L. Hand	M. Smith
W. J. Bergman	K. D. Hendrix	R. K. Smith
J. H. Brunke	C. Isaac	H. E. Spindle
S. Delisi	R. Jackson	A. D. Storms
R. L. Dotson	G. N. Lester	J. Tannery
P. W. Dwyer	J. M. Sailors	J. H. Ugo

The following persons were on the High-Voltage Circuit Breaker Subcommittee that had oversight and approval of this document:

### **P. W. Dwyer, *Chair***

R. W. Alexander	S. Kuznetsov	H. C. Ross
A. Bosma	G. N. Lester	E. M. Ruoss
J. H. Brunke	R. W. Long	G. St. Jean
C. J. Dvorak	A. K. McCabe	R. A. Sarkinen
M. J. Eckelkamp	G. F. Montillet	D. Sharma
R. D. Garzon	D. E. Parr	H. M. Smith
K. I. Gray	B. Patel	T. J. Tobin
H. L. Hess	D. F. Peelo	E. F. Veverka
D. S. Johnson	G. O. Perkins	C. L. Wagner
P. L. Kolarik	A. B. Rishworth	

The following persons were on the balloting committee:

R. J. Alton	Raymond L. Capra	Kenneth Hendrix
J. G. Angelis	Alexander Dixon	H. L. Hess
Richard H. Arndt	J. J. Dravis	W. E. Hoenigmann
Steve Atkinson	C. J. Dvorak	Jerry M. Jerabek
L. Ronald Beard	Peter W. Dwyer	P. L. Kolarik
Harvey L. Bowles	Ruben D. Garzon	David G. Kumbera
Matthew Brown	Louis W. Gaussa	Stephen R. Lambert
John H. Brunke	Keith I. Gray	Ward E. Laubach

John G. Leach  
 George N. Lester  
 Don Lott  
 E. L. Luehring  
 P. C. Mayo  
 Andrew K. McCabe  
 Lawrence V. McCall  
 Michael S. McGuire  
 William C. McKay  
 Harvey W. Mikulecky  
 Don C. Mills  
 Alec C. Monroe

Georges F. Montillet  
 F. J. Muench  
 James F. O'Donnell  
 Raymond P. O'Leary  
 A. F. Parks  
 David F. Peelo  
 G. O. Perkins  
 R. Kris Ranjan  
 J. C. Ransom  
 David N. Reynolds  
 H. C. Ross  
 Tim E. Royster

Guy St. Jean  
 L. H. Schmidt  
 E. W. Schmunk  
 C. A. Schwalbe  
 Devki N. Sharma  
 D. L. Swindler  
 John S. Tannery  
 S. H. Telander  
 Frederick C. Teufel  
 Thomas J. Tobin  
 Edward F. Veverka  
 Charles L. Wagner

When the IEEE Standards Board approved this standard on 20 June 1996, it had the following membership:

**Donald C. Loughry**, *Chair*  
**Richard J. Holleman**, *Vice Chair*  
**Andrew G. Salem**, *Secretary*

Gilles A. Baril  
 Clyde R. Camp  
 Joseph A. Cannatelli  
 Stephen L. Diamond  
 Harold E. Epstein  
 Donald C. Fleckenstein  
 Jay Forster\*  
 Donald N. Heirman  
 Ben C. Johnson

E. G. "Al" Kiener  
 Joseph L. Koepfinger\*  
 Stephen R. Lambert  
 Lawrence V. McCall  
 L. Brace McClung  
 Marco W. Migliaro  
 Mary Lou Padgett  
 John W. Pope  
 Jose R. Ramos

Arthur K. Reilly  
 Ronald H. Reimer  
 Gary S. Robinson  
 Ingo Rüsçh  
 John S. Ryan  
 Chee Kiow Tan  
 Leonard L. Tripp  
 Howard L. Wolfman

\*Member Emeritus

Also included are the following nonvoting IEEE Standards Board liaisons:

Satish K. Aggarwal

Alan H. Cookson

Chester C. Taylor

Kristin M. Dittmann  
*IEEE Standards Project Editor*

CLAUSE	PAGE
1. Overview .....	7
1.1 Scope .....	7
1.2 Purpose.....	7
2. References .....	7
3. Definitions.....	8
4. Recommended practice .....	8
4.1 Background .....	8
4.2 General .....	8
4.3 Description of form .....	8
5. Implementation .....	8
6. Failure report utilization.....	9
6.1 User .....	9
6.2 Manufacturer .....	9
7. Bibliography.....	10



# IEEE Recommended Practice for Reporting Field Failure Data for Power Circuit Breakers

## 1. Overview

Actual practices of power switchgear users in documenting field failures and failures of switchgear and other power delivery products vary widely. In order to restore failed elements to service, the emphasis often is to “clean up” a failure quickly, losing important data that is critical to corrective action. There is a real need for more depth in record keeping to improve reliability of power handling equipment. This recommended practice addresses this need.

### 1.1 Scope

A Failure Reporting Form, figures 1 and 2, has been developed by the IEEE Switchgear Committee to improve the reliability of circuit breakers through uniform reporting of field failures. The use of this approach is the recommended practice for all users of power circuit breakers.

### 1.2 Purpose

The use of the Failure Reporting Form, included in this document, is recommended to standardize reporting of field failures and to use these experiences to improve the reliability of power circuit breakers.

## 2. References

This recommended practice shall be used in conjunction with the following publications:

IEEE Std C37.100-1992, IEEE Standard Definitions for Power Switchgear (ANSI).<sup>1</sup>

---

<sup>1</sup>IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.

### 3. Definitions

For definitions applying to this standard, refer to IEEE Std C37.100-1992.

## 4. Recommended practice

### 4.1 Background

The form, figures 1 and 2, is derived from the experiences and with the approval of both manufacturers and users. Its main goals and requirements are to be simple to use, to define the field failure including its related environment, and to establish records and references for further analysis and action should the situation repeat itself or as other factors surface.

### 4.2 General

Details of the one-page reporting form have been carefully developed by users and manufacturers to arrive at an easy-to-use format that will contain enough information to understand the defined problem.

Although serious systems-related failures will require engineering input for figure 2, it is expected that the field maintenance person will complete the front side of the form, figure 1. The back side, figure 2, should be completed by the user's maintenance personnel with assistance, if required, from others.

The completed form, figures 1 and 2, should be sent to the person in the user's organization who monitors field performance of installed equipment. It should be used to analyze the reported failures and communicate incident-specific information to the manufacturer, as appropriate, when there is a repetitive or serious problem.

### 4.3 Description of form

The front side, figure 1, is to be filled out for all failures and is an adequate report for minor malfunctions, nonconformances, or nonsystem related failures.

The back side, figure 2, is useful for further elaboration of major failures that are more complex, with consideration given to system interaction.

Both figures may be incorporated on a single sheet of paper and bound into pads for easy availability.

## 5. Implementation

Users should use this form, figures 1 and 2, as a record and feedback system to improve equipment reliability.

Every effort should be made to promptly obtain and sort reports so that failures are prioritized to identify those deserving the most immediate attention. The success of this activity depends on a cooperative effort between the user's maintenance and operations people and the original manufacturer, when their involvement is needed.

The front side, figure 1, should be filled out by maintenance personnel. A minimum of instruction or guidance is required.



The questions should be answered and other details recorded at the job site soon after the failure occurs. It is recommended that these data be recorded before any repair work is initiated so as not to lose valuable clues on the origin of the problem as the repair work is carried out.

System Interaction, the back side, figure 2, is more complex and may require engineering analysis to provide the data.

## 6. Failure report utilization

### 6.1 User

The user can utilize the failure reports

- a) To establish or supplement existing systems to keep specific, uniform, and informative records of field failures.
- b) To provide data reports that can be sorted by manufacturer, model of equipment, age of equipment, similarity of application, etc. Data could be computerized for sorting and analysis.
- c) To provide data that can be used to analyze failures, and find trends or problems that should be reported to the manufacturer.
- d) To provide data that can be used to study specific failures involving application conditions and maintenance practices.
- e) To communicate to the manufacturer problems that require technical analysis and recommendation.

### 6.2 Manufacturer

The manufacturer can use the summary of failure reports to assist in

- a) Studying field equipment failures to recognize trends based on the total breaker population.
- b) Investigating those failures and suggesting corrective action. The action may result in changes in design, quality, application, shipping installation, or maintenance practices.
- c) Preparing and publishing suggestions for increasing reliability and reducing unplanned maintenance.

It is very important that each user carefully review all failure reports and send reports to the manufacturer that show serious or repetitive failures. By sending only selected reports to the manufacturer, the volume of reports is kept at a minimum and allows time for analysis of all problems. Generally, the newer the equipment, the larger the percentage of failure reports that should be sent to the manufacturer. Failures of older equipment are much more difficult to analyze as long-term maintenance records may not be available.

The use of this form does not eliminate the need for qualified technical personnel, both user and manufacturer, to investigate any major equipment problem. The use of this reporting format to improve reliability is meant to supplement, but not to supersede, normal warranty or customer service policies. One of the major contributions of this format is to provide better data. It is recognized that there are currently other failure reporting systems being used, but it is recommended that the approach suggested by this report be considered as a possible replacement system, or supplement, to those systems. For those establishing a reporting system for the first time, it is recommended that this format be adopted.

It is also recommended that manufacturers include a copy of this form in their product instruction books to encourage their use by all users.

## 7. Bibliography

The most recent editions of the following texts are recommended as guides on form content and usage.

[B1] IEEE Committee Report, “Circuit Breaker Field Problem Reporting Guide.”

[B2] IEEE Paper 81 WM 1142-9, *IEEE Transactions on Power Apparatus and Systems*, vol. PAS-100, no. 5, pp. 2438–2441, May 1981. Approved by the IEEE Switchgear Committee of the IEEE Power Engineering Society for presentation at the IEEE PES Winter Meeting, Atlanta, Georgia, Feb. 1–6, 1981.

USER REPORT NO. \_\_\_\_\_

## FAILURE REPORTING FORM FOR POWER CIRCUIT BREAKERS

Check all appropriate blocks and provide information indicated. For *major* trouble provide additional information requested on the back of this page, supplementing with additional pages if necessary.

**EQUIPMENT:**

Equipment Nameplate Information

Mfr. \_\_\_\_\_ Type \_\_\_\_\_ Serial # \_\_\_\_\_

kV \_\_\_\_\_ Inter Amps/MVA \_\_\_\_\_ Continuous Amps \_\_\_\_\_ BIL \_\_\_\_\_

Station \_\_\_\_\_

User Ident. of Breaker \_\_\_\_\_

**Brkr Background** Shipped \_\_\_\_\_ Installed \_\_\_\_\_ Maintained \_\_\_\_\_ Modernized \_\_\_\_\_ Trouble Date \_\_\_\_\_  
(Mo/Yr) (Mo/Yr) (Mo/Yr) (Mo/Yr) (Mo/Yr) (Mo/Day/Yr)

Operational counter reading \_\_\_\_\_

**Location:** ☐ Indoor ☐ Outdoor **Enclosure:** ☐ Non-metal clad ☐ Metal-clad ☐ GIS

**Interrupter:** ☐ Air Blast ☐ Air magnetic ☐ Oil ☐ SF ☐ Vacuum Other \_\_\_\_\_

**ENVIRONMENT:**

**General:** ☐ Industrial ☐ Urban ☐ Suburban ☐ Rural ☐ Sea coast ☐ Above 3300 ft ☐ High contamination  
Other \_\_\_\_\_

**Weather conditions:** ☐ Dry ☐ Rain ☐ Lightning in area ☐ Snow ☐ Fog ☐ Freezing rain ☐ Frost ☐ Condensation

Temp. Trend — ☐ Rising ☐ Falling ☐ Steady ☐ Extreme cold ☐ Temperature \_\_\_\_\_ °C

Wind — ☐ Calm ☐ Light ☐ Strong—steady ☐ Strong—gusty

**External mechanical stresses involved:** ☐ Normal ☐ Earthquake ☐ Wind ☐ Abnormal terminal loading  
Other \_\_\_\_\_ **Nominal system voltage** \_\_\_\_\_

**TROUBLE:**

**When discovered:** ☐ Installation ☐ In Service ☐ Maintenance ☐ Test Other \_\_\_\_\_

**Breaker mode at time of trouble:** ☐ De-energized ☐ Closed ☐ Open ☐ Tripping ☐ Closing ☐ Reclosing  
☐ Fault interruption ☐ Load switching ☐ Line switching

**Breaker response at time of trouble:** ☐ Not called upon to operate ☐ Performed as intended  
☐ Unsatisfactory operation ☐ Failed to operate

**Subsystem in trouble:** ☐ External insulation to gmd. ☐ Internal insulation to gmd. ☐ Insulating medium

☐ Isolating contact ☐ Bushing ☐ Interrupter ☐ Seals—Gaskets ☐ Air system ☐ SF<sub>6</sub> system ☐ C.T.

☐ Resistor sw or aux. int. ☐ Voltage grading dev. ☐ Line terminals ☐ Compressor ☐ Heater ☐ Electrical Controls

☐ Wiring ☐ Operating mechanism ☐ Mechanical linkage ☐ Other \_\_\_\_\_

**State specifically what failed (with instr. book ref.):** \_\_\_\_\_

**Has it occurred before on this type of brkr?** ☐ No ☐ Yes How many times \_\_\_\_\_

**State how problem was corrected:** \_\_\_\_\_

**POSSIBLE CAUSE:** ☐ Design/Manufacture ☐ Shipping ☐ Storage ☐ Installation ☐ Instructions ☐ Maintenance  
☐ Wear/Aging ☐ Animal/Birds ☐ Other ☐ Not Obvious

**Comments and Suggestions:** \_\_\_\_\_

**EFFECT:**

**Breaker Down Time:** ☐ No interruption ☐ 30 min or less ☐ 1 hr ☐ 2 hr ☐ 6 hr ☐ 12 hr ☐ 24 hr Other \_\_\_\_\_

**Repair Time:** ☐ Less than 30 min ☐ 1 hr ☐ 2 hr ☐ 6 hr ☐ 1 day ☐ 2 days ☐ 3 days ☐ 1 week ☐ Other \_\_\_\_\_

**Breaker Outage Status:** ☐ Immediate forced outage ☐ Outage within 20 min ☐ Required subsequent outage  
☐ Repair deferred until regular maintenance ☐ No outage for repair

User person completing report \_\_\_\_\_ Date \_\_\_\_\_

User approval name \_\_\_\_\_ Date \_\_\_\_\_

User contact name \_\_\_\_\_ Telephone Number \_\_\_\_\_

User company \_\_\_\_\_

(This form may be copied)

### Figure 1— Failure Reporting Form for power circuit breakers

<b>ADDITIONAL INFORMATION REQUIRED FOR ANALYSIS OF MAJOR OR SYSTEM RELATED FAILURE (USE ADDITIONAL PAGES AS NECESSARY)</b>	
(1)	Single line station diagram showing involved breakers.
(2)	Operation and timing sequence (including all alarms) of this and related breakers from the last time that conditions were definitely normal.
(3)	Line conditions before, during, and after failure.
(4)	Oscillograms—attach with explanation and interpretation.
(5)	Attach a description of the exact position of all mechanical components from the control solenoid through all interrupter contacts as applicable (photograph each detail <i>before</i> mechanisms; supply copies of photos with report.)
(6)	Describe arc damage and location of arc products relative to valve seals. (Photograph each in detail <i>before</i> any clean up or post-failure mechanism movement; supply copies of photos with report.)
(This form may be copied)	

**Figure 2— Additional information required for analysis of major or system related failures**