INTERNATIONAL STANDARD

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First edition
2005-11

IEEE C37.60™

High voltage switchgear and controlgear –

Part 111:
Overhead, pad-mounted, dry vault, and submersible automatic circuit reclosers and fault interrupters for alternating current systems up to 38 kV

Withdrawn
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International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch

The Institute of Electrical and Electronics Engineers, Inc, 3 Park Avenue, New York, NY 10016-5997, USA
Telephone: +1 732 562 3800 Telefax: +1 732 562 1571 E-mail: stds-info@ieee.org Web: www.standards.ieee.org

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HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

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The text of this standard is based on the following documents:

IEEE Std	FDIS	Report on voting
C37.60 (2003)	17A/737/FDIS	17A/746/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives.

The committee has decided that the contents of this publication will remain unchanged until 2008.

The list of all the parts of IEC 62271 series, under the general title *High-voltage switchgear and controlgear,* can be found on the IEC website.

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IEEE Standard for Overhead, Pad-Mounted, Dry Vault, and Submersible Automatic Circuit Reclosers and Fault Interrupters for Alternating Current Systems Up to 38 kV

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Switchgear Committee
of the
IEEE Power Engineering Society

Approved 20 March 2003

IEEE-SA Standards Board

Abstract: Required definitions, ratings, procedures for performing design tests, production tests, and construction requirements for overhead, pad-mounted, dry vault, and submersible automatic circuit reclosers and fault interrupters for alternating systems up to 38 kV are specified.
Keywords: dry vault, fault interrupter, overhead, pad-mounted, recloser, submersible, standard operating duty, switchgear

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IEEE Introduction

This standard has been revised from IEEE Std C37.60-1981, incorporating significant improvements that reflect the present state of the art in recloser technology. These include changes and additions in the following areas:

a) Expanded the standard to include gas-insulated reclosers.
b) Revised the title and scope to limit the standard to 38 kV; deleted ratings above 38 kV nominal.
c) Added voltage ratings commonly used outside of North America with related dielectric withstand capabilities taken from IEC 60694-2002.[a]
d) Added several new interrupting ratings in the 15.5 kV, 27 kV, and 38 kV ranges.
e) Revised limits of temperature and temperature rise to be consistent with circuit breaker standards.
f) Reorganized the switching tests into 6.3 following a format similar to IEEE Std 1247™-1998 and referenced IEEE Std 1247-1998 for switching test procedures.
g) Removed the requirement for transformer magnetizing tests; reference discussion in IEEE Std 1247-1998.
h) Clarified the intent of the switching tests as related required capabilities and prohibited the use of single-phase tests to qualify three-phase reclosers in the performance of the switching tests.
i) Removed the altitude correction factors. (Refer to the following paragraph and informative Annex E.)
j) Removed the X/R footnote and table of multiplication factors from old 5.6 to new informative Annex A with expanded information and data.
k) Added new informative Annex B.
l) Added transient recovery voltage (TRV) specifications and informative Annex C and Annex D.
m) Restricted the use of single-phase testing to verify three-phase performance.
n) Reduced radio influence voltage (RIV) limits.
o) Added Partial Discharge as a design and production test.
p) Reduced dc withstand voltage test time from 15 min. to 5 min.

Although this revised standard will be published before the work on IEEE PC37.100.1, Draft Standard Requirements for Power Switchgear [B13][b] is completed, it is the intention of the Recloser Working Group to issue supplements or revisions to adopt common requirements. There was considerable discussion in the Recloser Working Group regarding the addition of the partial discharge test requirements suggesting that this topic should be revisited at the next revision cycle to see if the data collected between now and then shall warrant any changes in the test procedure or test limits.

[a] Information on references can be found in Clause 2.
[b] The numbers in brackets correspond to the numbers of the bibliography in Annex F.

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1. Scope

This standard applies to all overhead, pad-mounted, dry vault, and submersible single- or multipole alternating current automatic circuit reclosers and fault interrupters for rated maximum voltages above 1000 V and up to 38 kV.

In order to simplify this standard where possible, the term *recloser*/*FI* (*reclosers*/*FIs*) has been substituted for *automatic circuit recloser* or *fault interrupter* or both.

NOTE—When reclosers are applied in a substation, special considerations may apply, see 6.5.1.5.3.

2. References

This standard shall be used in conjunction with the following publications. When the following publications are superseded by an approved revision, the revision shall apply.

ANSI C37.06-2000, American National Standard for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis—Preferred Ratings and Related Required Capabilities.[1]

ANSI C37.06.1-2000, American National Standard Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis—Designated "Definite Purpose for Fast Transient Recovery Voltage Rise Times."

[1]ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA (http://www.ansi.org).

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ANSI C37.85-2002, American National Standard for Switchgear—Alternating-Current High-Voltage Power Vacuum Interrupters—Safety Requirements for X-Radiation Limits.

ANSI C57.12.28-1999, American National Standard for Pad-mounted Equipment—Enclosure Integrity.

ANSI C63.2-1996, American National Standard for Electromagnetic Noise and Field Strength Instrumentation, 10 kHz to 40 GHz—Specifications.

ASME BPVC-1998, Boilers and Pressure Vessels Code—Section VIII: Rules for Construction of Pressure Vessels—Division 1.[2]

IEC 60060-1-1989, High-Voltage Test Techniques—Part 1: General Definitions and Test Requirements.[3]

IEC 60270-2000, High-Voltage Test Techniques—Partial Discharge Measurements.

IEC 60502-1-2004, Power Cables with Extruded Insulation and Their Accessories for Rated Voltages from 1 kV ($U_m = 1,2$ kV) Up to 30 kV ($U_m = 36$ kV)—Part 1: Cables for Rated Voltages of 1 kV ($U_m = 1,2$ kV) and 3 kV ($U_m = 3,6$ kV).

IEC 60502-2-2005, Power Cables with Extruded Insulation and Their Accessories for Rated Voltages from 1 kV ($U_m = 1,2$ kV) Up to 30 kV ($U_m = 36$ kV)—Part 2: Cables for Rated Voltages from 6 kV ($U_m = 7,2$ kV) Up to 30 kV ($U_m = 36$ kV).

IEC 60694-2002, Common Specifications for High-Voltage Switchgear and Controlgear Standards.[6]

IEC 62271-100-2003, High-Voltage Switchgear and Controlgear—Part 100: High-Voltage Alternating-Current Circuit-Breakers.[7]

IEEE Std 4™-1995, IEEE Standard Techniques for High Voltage Testing.[4,5]

IEEE Std 4a™-2001, Amendment to IEEE Standard Techniques for High-Voltage Testing.

IEEE Std 386™-1995, IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V.

IEEE Std 1247™-1998, IEEE Standard for Interrupter Switches for Alternating Current Rated Above 1000 Volts.

IEEE Std 1291™-1993, IEEE Guide for Partial Discharge Measurement in Power Switchgear.

IEEE Std C37.04-1999, IEEE Standard Rating Structure for AC High-Voltage Circuit Breakers.

IEEE Std C37.09-1999, IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.

[2]ASME publications are available from the American Society of Mechanical Engineers, 3 Park Avenue, New York, NY 10016-5990, USA (http://www.asme.org).

[3]IEC publications are available from the Sales Department of the International Electrotechnical Commission, Case Postale 131, 3, rue de Varembé, CH-1211, Genève 20, Switzerland/Suisse (http://www.iec.ch/). IEC publications are also available in the United States from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA (http://www.ansi.org).

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[7]Edition 1.1 Consolidated edition.

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IEEE Std C37.41™-2000, IEEE Standard Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories.

IEEE Std C37.90.1™-2002, IEEE Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.

IEEE Std C37.100™-1992 (Reaff 2001), IEEE Standard Definitions for Power Switchgear.

NEMA 107-1987 (Reaff 1993), Methods of Measurement of Radio Influence Voltage (RIV) of High-Voltage Apparatus.[6]

3. Definitions

The definitions of terms contained in this standard, and to the related standards for recloser/FIs, shall be in accordance with IEEE Std C37.100-1992. These definitions are not intended to embrace all possible meanings of the terms. They are applicable only to the subject treated in this standard.

unit operation (of a recloser): An interrupting operation followed by a closing operation. The final interruption is also considered one unit operation.

NOTE—See Figure 1.

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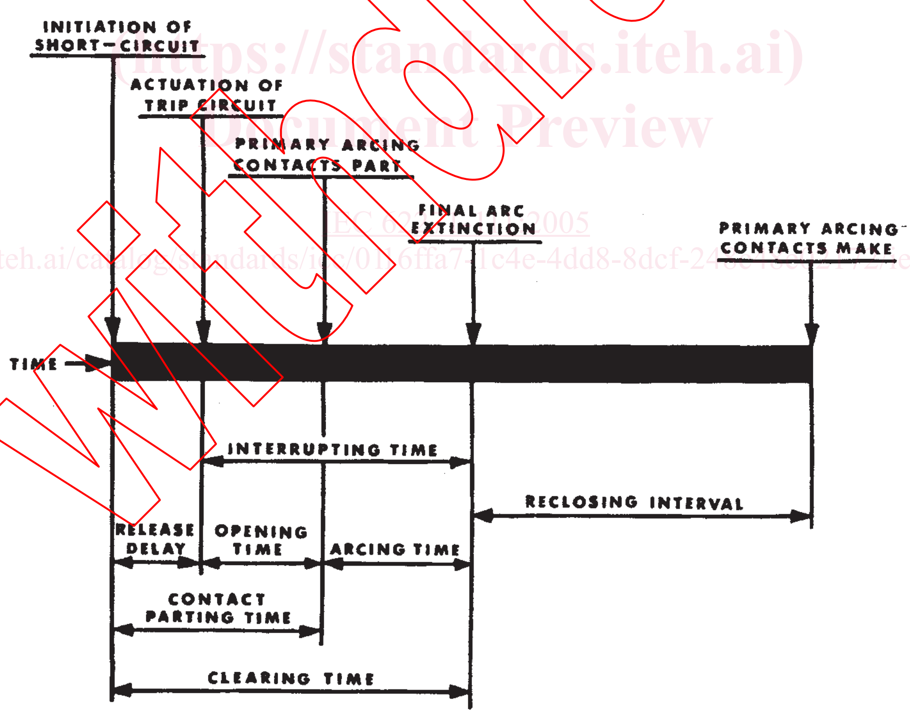

Figure 1—Unit operation

[6]NEMA publications are available from Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112-5704, USA (http://global.ihs.com/).

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4. Service conditions

4.1 Usual service conditions

Reclosers/FIs conforming to this standard shall be suitable for operation at their standard ratings provided that:

a) The temperature of the air (ambient temperature) is not above 40 °C or below −30 °C.
b) The altitude does not exceed 1000 m.
c) For submersible units, the water head does not exceed 3 m above the base of the enclosure during occasional submersion. Exposure to chemical or electrochemical reactions may be encountered in a subgrade environment. The subgrade environment may contain chemicals that contribute to mild corrosive reactions.

4.2 Unusual service conditions

Unusual service conditions shall include, but are not limited to, service conditions that exceed those defined in 4.1 or extremes in:

a) Actual service duty cycle
b) System conditions
c) Site conditions
d) Shock and/or vibration
e) Damaging fumes or vapors
f) Excessive or abrasive dust
g) Explosive mixtures of dust or gases
h) Salt air or extreme humidity

Unusual service conditions shall be brought to the attention of those responsible for the manufacture of the equipment to define or prevent loss of performance or service life, if any, from specified values. Applicable standards such as those for altitude correction shall be used when available.

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4.2.1 Abnormal ambient temperatures

Reclosers/FIs may be applied at higher or lower ambient temperatures than specified, but performance may be affected and special consideration shall be given to these applications.

4.2.2 Altitudes above 1000 m

Reclosers/FIs may be applied at altitudes higher than 1000 m; however, the rated lightning impulse withstand voltage, rated maximum voltage and rated continuous current shall be multiplied individually by the correction factor (see following note) to obtain values at which the application may be made. The rated symmetrical interrupting current, related required capabilities, and interrupting times are not affected by altitude.

NOTE—Altitude correction factors are being studied by the Switchgear Committee and will be adopted by issuance of a supplement or revision to this standard when they are approved. In the meantime, users should consult the manufacturer for appropriate derating when the equipment is applied above 1000 m. Refer also to Annex E.

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5. Rating

5.1 Rating information

The ratings shall include the following:

a) Rated maximum voltage
b) Rated power-frequency
c) Rated continuous current
d) Rated minimum tripping current (series-trip reclosers only)
e) Rated symmetrical interrupting current
f) Rated symmetrical making current
g) Rated lightning impulse withstand voltage
h) Rated control voltage

NOTE—Switching tests as specified in 6.3 are related required capabilities.

5.2 Rated maximum voltage

The preferred values of rated maximum voltage of reclosers/FIs are those shown in Column 2 of Table 1a) and Table 1b).

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Table 1a)—Preferred voltage ratings and related test requirements for reclosers (except those covered in Table 1b) (Note 1)

Line no. (Note 2)	Rated maximum voltage kV	Rated lightning impulse withstand peak voltage kV (Note 3)	Power-frequency insulation level withstand test kV (Warning Box and Note 3)	
			1 min. dry	10 s wet
Column 1	Column 2	Column 3	Column 4	Column 5
1	15	95	36	30
2	15.5	110	50	45
3	27	(Note 4)	60	50
4	38	150	70	60
11	12	75	28	23
12	17.5	95	38	32
13	24	125	50	45
14	36	170	70	60

WARNING
When performing tests involving open contacts in vacuum, adequate precautions such as shielding or distance should be used to protect test personnel against the possible occurrences of higher X-radiation due, for example, to incorrect contact spacing, or to the application of voltages in excess of those specified. For example, maintaining a distance of 2–3 m between the recloser/FI and all test personnel is a typical basic precaution to reduce the risk of excess X-radiation exposure. Further discussion of shielding, adequate distances and personnel exposure limits are found in ANSI Std C37.85-2002.

NOTES
1—The test values shown in Table 1a) are for design tests; refer to Clause 8 for field testing.
2—Lines 11–14 refer to distribution systems commonly found outside of North America; the test withstand levels were taken from IEC 60694-2002, Table 1a).
3—These are performance characteristics specified as test requirements in this standard.
4—For oil interrupting reclosers, 150 kV; for all others, 125 kV.

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