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(Revision of IEEE Std C37.20.3-1987)

IEEE Standard for Metal-Enclosed Interrupter Switchgear

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

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Abstract: This standard covers metal-enclosed interrupter (MEI) switchgear assemblies containing, but not limited to, such devices as interrupter switches; selector switches; power fuses; control, instrumentation and metering devices; and protective equipment. It includes, but is not specifically limited to, equipment for the control and protection of apparatus used for distribution of electrical power.

Keywords: metal-enclosed interrupter (MEI) switchgear, metal enclosed power switchgear, switchgear, switchgear assembly

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Introduction

(This introduction is not part of IEEE Std C37.20.3-2001, IEEE Standard for Metal-Enclosed Interrupter Switchgear.)

This standard has been revised to reflect needed technical changes that have been suggested since the last revision was published. The three substantive changes in this revision are as follows:

- a) The asymmetrical factor for momentary rating has been changed from 1.6 to 1.55.
- b) The impulse test requirements have been changed from 3 by 3 to 3 by 9. As a result, nine additional tests shall be run in case of flashover in the first set of the required three instead of the old requirement of three additional tests.
- c) A time other than 2 s has been allowed for the short-time current when limited by the ability of the switch. As a result, a new rating, “rated short-time current duration,” has been created.

The above changes reflect a move to harmonize with International Electrotechnical Commission and to accept current industry practices.

This standard uses IEEE Std 4-1978, IEEE Standard Techniques for High-Voltage Testing,^a instead of IEEE Std 4-1995, the current revision of this document. This deviation from normal practice was done because the latter standard omits several correction factors and test procedures needed and used by the IEEE Switchgear Committee in standards for switchgear and breakers. The IEEE Switchgear Committee has requested coordination and revision of IEEE Std 4-1995 to address these test procedures and correction factors.

IEEE Std C37.20.3-2001 was prepared by the Power Switchgear Assemblies Technical Committee of the National Electrical Manufacturers Association (NEMA) and by the Switchgear Assemblies Subcommittee of the IEEE Switchgear Committee. NEMA is responsible for Clause 5 and Clause 7, and the Switchgear Assemblies Subcommittee is responsible for Clause 3, Clause 4, Clause 6, and Clause 8.

This standard includes only the requirements for metal-enclosed interrupter switchgear. These requirements were previously a part of IEEE Std C37.20-1969, IEEE Standard for Switchgear Assemblies Including Metal-Enclosed Bus (1974 consolidated edition). Other types of equipment previously included in IEEE Std C37.20-1969 have been incorporated in separate publications. IEEE Std C37.20-1969 has for many years covered all switchgear assemblies including metal-enclosed bus. Standards committees of IEEE Switchgear and NEMA Power Switchgear recommended that the document be further developed and, where appropriate, that the various sections be identified with their own standards. This approach also coordinates with the Conformance Test Procedure Standards.

This publication is one of a series covering switchgear assemblies as follows (see Figure A):

- IEEE Std C37.20.1-1993, IEEE Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear
- IEEE Std C37.20.2-1999, IEEE Standard for Metal-Clad Switchgear
- IEEE Std C37.20.3-2001, IEEE Standard for Metal-Enclosed Interrupter Switchgear
- IEEE Std C37.20.4-2001, IEEE Standard for Indoor AC Switches Rated Above 1 kV through 38 kV for Use in Metal-Enclosed Switchgear^b
- IEEE Std C37.20.6-1997, IEEE Standard for 4.76 to 38 kV Rated Grounding and Testing Devices Used in Enclosures
- IEEE Std C37.21-1985 (Reaff 1998), IEEE Standard for Control Switchboards
- IEEE Std C37.22-1997, American National Standard Preferred Ratings and Related Required Capabilities for Indoor AC Medium Voltage Switches Used in Metal-Enclosed Switchgear
- IEEE Std C37.23-1987 (Reaff 1991), IEEE Standard for Metal-Enclosed Bus and Calculating Losses in Isolated-Phase Bus

^aInformation on references can be found in Clause 2.

^bThis IEEE standards project was not approved by the IEEE-SA Standards Board at the time this publication went to press. For information about obtaining a draft, contact the IEEE.

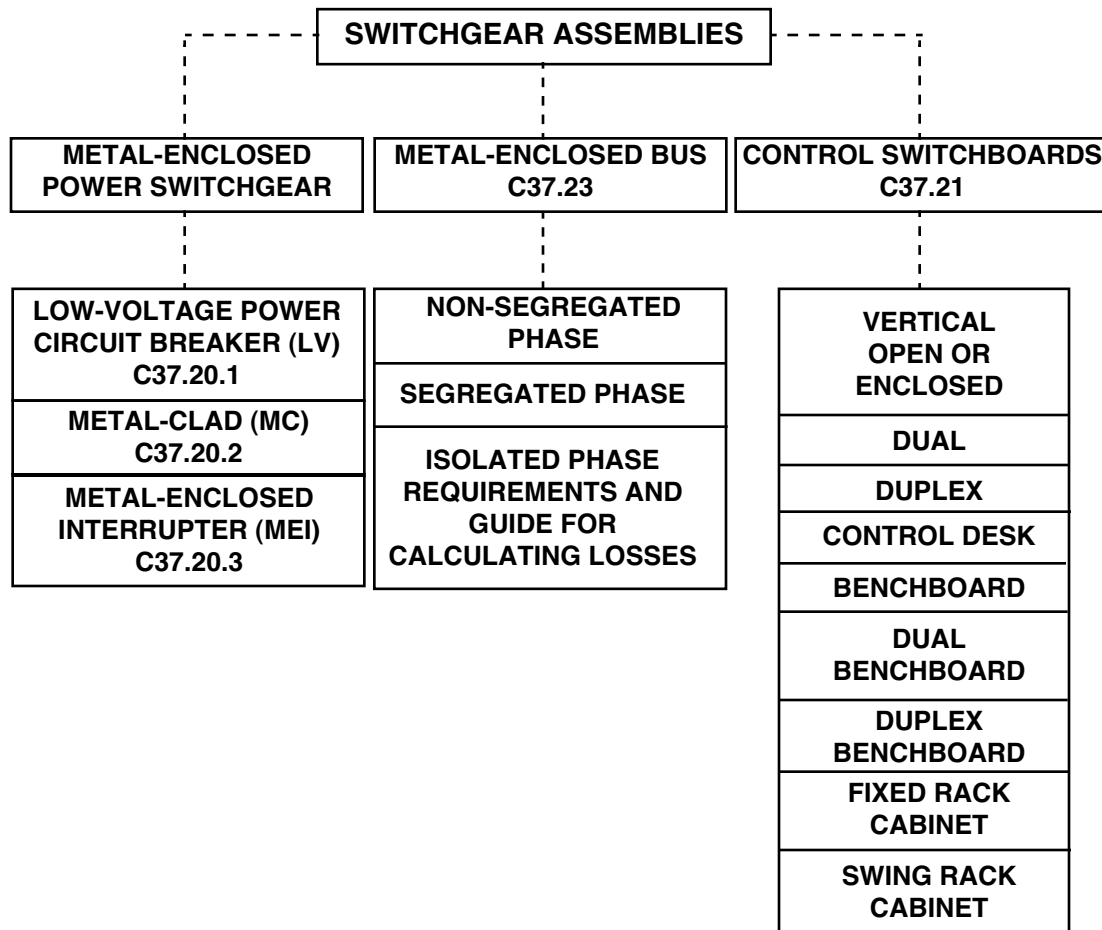


Figure A—Publications about switchgear assemblies

Through this joint effort over the many years, the switchgear assemblies standards have been extremely valuable to the industry. Further suggestions for improvement gained in the use of this standard are welcome.

The Switchgear Assemblies Working Group that prepared and approved this standard had the following personnel:

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IEEE Standard for Metal-Enclosed Interrupter Switchgear

1. Scope

This standard covers metal-enclosed interrupter (MEI) switchgear assemblies containing, but not limited to, such devices as interrupter switches; selector switches; power fuses; control, instrumentation and metering devices; and protective equipment. It includes, but is not specifically limited to, equipment for the control and protection of apparatus used for distribution of electrical power.

This standard is concerned with enclosed (rather than open), indoor and outdoor switchgear assemblies rated above 1000 V. It includes equipment that is part of primary and secondary unit substations. It does not include gas-insulated substation equipment nor switching devices mounted integrally within a transformer enclosure.

2. References

This standard shall be used in conjunction with the following publications.

Accredited Standards Committee C2-1997, National Electrical Safety Code® (NESC®)¹

ANSI C37.06-2000, American National Standard for Switchgear—AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis—Preferred Ratings and Related Required Capabilities².

ANSI C37.22-1997, American National Standard Preferred Ratings and Related Required Capabilities for Indoor AC Medium Voltage Switches Used in Metal-Enclosed Switchgear.

ANSI C37.47-1981 (R1988), American National Standard Specifications for Distribution Fuse Disconnecting Switches, Fuse Supports, and Current-Limiting Fuses.

¹The NESC is available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.

²ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA.

ANSI C37.57-1990, American National Standard for Switchgear—Metal-Enclosed Interrupter Switchgear Assemblies—Conformance Test Procedures.

ANSI C37.58-1990, American National Standard for Switchgear—Indoor AC Medium-Voltage Switches for Use in Metal-Enclosed Switchgear—Conformance Test Procedures.

ANSI Z535.4-1998, American National Standard for Product Safety Sign and Label.

ASTM B117-97, Standard Practice for Operating Salt Spray (Fog) Apparatus.³

ASTM D229-96, Standard Test Methods for Rigid Sheet and Plate Materials Used in Electrical Insulation.

ASTM D714-87 (2000), Standard Test Method for Evaluating Degree of Blistering of Paints.

ASTM D1535-97, Standard Practice of Specifying Color by the Munsell System.

ASTM D1654-92 (2000), Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.

ASTM D2303-97, Standard Test Methods for Liquid-Contaminant, Inclined-Plane Tracking and Erosion of Insulating Materials.

ASTM G21-96, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

IEEE Std 1-1986 (Reaff 1992), IEEE Standard General Principles for Temperature Limits in the Rating of Electric Equipment and for the Evaluation of Electrical Insulation.⁴

IEEE Std 4-1978, IEEE Standard Techniques for High-Voltage Testing.

NOTE—The 1978 Standard is used instead of the current standard because of the need for several correction factors that were omitted in the revised document.

IEEE Std 141-1993, IEEE Recommended Practice for Electric Power Distribution for Industrial Plants (IEEE Red Book).

IEEE Std 142-1991, IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems (IEEE Green Book).

IEEE Std 241-1990, IEEE Recommended Practice for Electric Power Systems in Commercial Buildings (IEEE Gray Book).

IEEE Std 242-1986 (Reaff 1991), IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book).

IEEE Std 344-1987 (Reaff 1993), IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations.

IEEE Std 446-1995 (Reaff 2000), IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications (IEEE Orange Book).

³ASTM publications are available from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA.

⁴IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA (<http://standards.ieee.org/>).

IEEE Std C37.04-1999, IEEE Standard Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.

IEEE Std C37.2-1996, IEEE Standard Electrical Power System Device Function Numbers and Contact Designations.⁵

IEEE PC37.20.4/D5a, IEEE Draft Standard for Indoor AC Switches Rated Above 1 kV Through 38 kV for Use in Metal-Enclosed Switchgear.⁶

IEEE Std C37.24-1986 (Reaff 1998), IEEE Guide for Evaluating the Effect of Solar Radiation on Outdoor Metal-Enclosed Switchgear.

IEEE Std C37.90.1-1989 (Reaff 1994), IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems.

IEEE Std C37.90.2-1995, IEEE Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.

IEEE Std C37.100-1992, IEEE Standard Definitions for Power Switchgear.

IEEE Std C57.13-1993, IEEE Standard Requirements for Instrument Transformers.

NEMA CC1-1993, Electric Power Connectors for Substations.⁷

NEMA WC5-1992, Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (ICEA S-61-402).

NEMA WC7-1998, Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (ICEA S-66-524).

NEMA LI1-1998, Industrial Laminating Thermosetting Products.

NFPA 70-1999, National Electrical Code® (NEC®).⁸

UL 486A-1997, Wire Connectors and Soldering Lugs for Use With Copper Conductors.⁹

3. Definitions

The definitions of terms contained in this standard, or in other standards referred to in this standard are not intended to embrace all legitimate meanings of the terms. They are applicable only to the subject treated in this standard.

⁵This publication is available from the Director, US Navy Publications and Printing Service, Eastern Division, 700 Robbins Ave., Philadelphia, PA 19111, USA.

⁶This IEEE standards project was not approved by the IEEE-SA Standards Board at the time this publication went to press. For information about obtaining a draft, contact the IEEE.

⁷NEMA publications are available from the National Electrical Manufacturers Association, 1300 N. 17th St., Ste. 1847, Rosslyn, VA 22209, USA.

⁸The NEC is available from Publications Sales, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101, USA.

⁹UL publications are available from Underwriters Laboratories, Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096, USA.

If a term is not defined in this standard, the definition in IEEE Std C37.100-1992 applies. An asterisk (*) following a definition indicates that the definition in this standard is not contained in IEEE Std C37.100-1992 while a dagger (†) indicates the definition differs from that in IEEE Std C37.100-1992.

3.1 Qualifying terms—switchgear

3.1.1 switchgear: A general term covering switching and interrupting devices and their combination with associated control, instrumentation, metering, protective, and regulating devices and covering assemblies of these devices with associated interconnections, accessories, and supporting structures used primarily in connection with the generation, transmission, distribution, and conversion of electrical power.

3.1.2 switchgear assembly (see Figure A in the introduction): An assembled equipment (indoor or outdoor) including, but not limited to, one or more of switching, interrupting, control, instrumentation, metering, protective, and regulating devices, together with their supporting structures, enclosures, conductors, electric interconnections, and accessories.

3.1.3 metal-enclosed power switchgear: A switchgear assembly completely enclosed on all sides and top with sheet metal (except for ventilating openings and inspection windows) containing primary power circuit switching or interrupting devices, or both, with buses and connections and possibly including control and auxiliary devices. Access to the interior of the enclosure is provided by doors or removable covers.†

3.1.4 metal-enclosed interrupter (MEI) switchgear: Metal-enclosed power switchgear including the following equipment as required:

- a) Interrupter switches
- b) Power fuses (current-limiting or noncurrent-limiting)
- c) Bare bus and connections
- d) Instrument transformers
- e) Control wiring and accessory devices

The interrupter switches and power fuses may be stationary or removable (drawout). When removable, automatic shutters (that cover primary circuit elements when the removable element is in the disconnected, test, or removed position) and mechanical interlocks shall be provided for proper operating sequence.

3.2 Qualifying terms—IEEE 100

The following qualifying terms are defined in *The Authoritative Dictionary of IEEE Standards Terms*, Seventh Edition; and the user is referred to the definitions (relating to types of enclosures, ventilation methods, etc.) given in that dictionary:

3.2.1 accessible

3.2.2 enclosed

3.2.3 isolated

3.2.4 ventilated

3.3 Qualifying terms—IEEE Std C37.100-1992

The following qualifying terms are defined in IEEE Std C37.100-1992, and the user is referred to the definitions given in that dictionary:

3.3.1 enclosure

3.3.2 flame-resistant (retardant)**3.3.3 indoor****3.3.4 metal-enclosed****3.3.5 outdoor****3.3.6 resistant (suffix)****3.3.7 secondary****3.3.8 ventilated enclosure****3.4 Common or related terms**

The following common or related terms are defined in IEEE Std C37.100-1992, and the user is referred to the definitions given in that dictionary:

3.4.1 asymmetrical**3.4.2 auxiliary switch****3.4.3 bus****3.4.4 connected position****3.4.5 continuous current tests****3.4.6 disconnected position****3.4.7 drawout-mounted device****3.4.8 ground bus****3.4.9 main (primary switchgear connections)****3.4.10 normal frequency****3.4.11 primary disconnecting devices****3.4.12 removable element****3.4.13 secondary and control wiring****3.4.14 silver surfaced****3.4.15 stationary mounted device****3.4.16 symmetrical****3.4.17 terminal****3.4.18 terminal block****3.4.19 test position****3.5 Definitions of terms**

3.5.1 ambient air temperature: The temperature of the surrounding air that comes in contact with equipment.*

NOTE—Ambient air temperature, as applied to enclosed switchgear assemblies, is the average temperature of the surrounding air that comes in contact with the enclosure. See 6.2.2.3 for method of measurement.

3.5.2 design tests: Tests made by the manufacturer to determine the adequacy of the design of a particular type, style, or model of equipment or its component parts to meet its assigned ratings and to operate satisfactorily under normal service conditions or under special conditions if specified. Such tests may be used to demonstrate compliance with applicable standards of the industry.†

NOTES

1—Design tests are made on representative apparatus or prototypes to verify the validity of design analysis and calculation methods and to substantiate the ratings assigned to all other apparatus of basically the same design. These tests are not intended to be made on every design variation or to be used as part of normal production. The applicable portion of these design tests may also be used to evaluate modifications of a previous design and to ensure that performance has not been adversely affected. These data from previous similar designs may also be used for current designs, where appropriate. Once made, the tests need not be repeated unless the design is changed to modify performance.

2—Design tests are sometimes called type tests.

3.5.3 production tests: Tests made for quality control by the manufacturer on every device or representative samples, or on required parts or materials, to verify during production that the product meets the design specifications and applicable standards.†

NOTES

1—Certain quality assurance tests on identified critical parts of repetitive high-production devices may be tested on a planned statistical sampling basis.

2—Production tests are sometimes called routine tests.

3.5.4 conformance tests: Tests made to demonstrate compliance with the applicable standards. The test specimen is normally subjected to all planned production tests prior to initiation of the conformance test program.†

NOTE—The conformance tests may, or may not, be similar to certain design tests. Demonstration of margin (capabilities) beyond the standards is not required.

3.5.5 field tests (for switchgear): Tests made after the assembly has been installed at its place of utilization.†

3.5.6 switch compartment: The portion of the switchgear assembly that contains one switching device (such as an interrupter switch or power fuse interrupter switch combination) and the associated primary conductors.*

3.5.7 vertical section: The portion of the switchgear assembly between two successive vertical delineations. The vertical section may contain one or more switch compartments and associated primary conductors.*

4. Service conditions

Standards for the design and performance of MEI switchgear are based on usual service conditions as described in this clause. The selection of equipment for a particular application may be based on the construction and ratings as defined in this standard provided that the following usual service conditions exist:

- a) The temperature of the cooling air (ambient air temperature) surrounding the enclosure of the MEI switchgear is within the limits of -30°C and $+40^{\circ}\text{C}$.
- b) The altitude of the installation does not exceed 1000 m (3300 ft).
- c) The effect of solar radiation is not significant. (The principles stated in IEEE Std C37.24-1986 may be used for guidance.)
- d) Unusual service conditions such as outlined in 8.1 do not prevail.

5. Ratings

5.1 General

The ratings of a switchgear assembly are designations of operating limits under specific conditions of ambient temperature, temperature rise, etc. Where the switchgear assembly comprises a combination of primary and secondary circuits, each may be given ratings.

MEI switchgear having primary circuits shall have the following ratings:

- a) Rated maximum voltage
- b) Rated power frequency
- c) Rated insulation levels
- d) Rated continuous current
- e) Rated short-time withstand current
- f) Rated short-time withstand current duration (when other than 2 s)
- g) Rated momentary withstand current

The designated ratings listed in ANSI C37.22-1987 and this standard are preferred, but are not considered to be restrictive.

In addition to these ratings, MEI switchgear may have interrupting or switching capability, which is determined by the rating of the particular interrupting and switching devices that are integral parts of the switchgear assembly. Refer to specific standards for the ratings of these devices: IEEE Std C37.04-1999 (circuit breakers); IEEE PC37.20.4/D5a (interrupter switches); and ANSI C37.47-1981 (fuses).

5.2 Voltage and insulation levels

The preferred rated maximum voltages and corresponding insulation levels for MEI switchgear are listed in Table 1.

5.2.1 Rated maximum voltage

The rated maximum voltage of MEI switchgear is the highest root-mean-square (rms) voltage for which the equipment is designed and is the upper limit for operation.

5.2.2 Rated insulation levels

The rated insulation levels of MEI switchgear assembly shall consist of the following two items:

- a) Power-frequency withstand voltage
- b) Lightning-impulse withstand voltage

5.3 Rated power frequency

The rated power frequency of a device or an assembly is the frequency of the circuit for which it is designed. (Ratings are based on a frequency of 60 Hz.)