



IEEE Standard for Metal-Enclosed Interrupter Switchgear Rated above 1 kV AC up to and Including 48.3 kV AC

IEEE Power and Energy Society

Developed by the
Switchgear Committee

IEEE Std C37.20.3™-2023
(Revision of
IEEE Std C37.20.3-2013)



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Approved 29 June 2023

IEEE SA Standards Board

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

Keywords: IEEE C37.20.3™, MEI, metal-enclosed interrupter switchgear, metal-enclosed power switchgear, switchgear, switchgear assembly

The Institute of Electrical and Electronics Engineers, Inc.
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PDF: ISBN 978-1-5044-9940-8 STD26320
Print: ISBN 978-1-5044-9941-5 STDPD26320

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Introduction

This introduction is not part of IEEE Std C37.20.3-2023, IEEE Standard for Metal-Enclosed Interrupter Switchgear Rated above 1 kV AC up to and Including 48.3 kV AC.

This standard has been revised to reflect needed technical changes since the last revision was published in 2013. The significant changes include:

- Replacement of all references to IEEE Std C37.100.1™ with the appropriate text
- Update of normative references and bibliography entries to remove dated versions where possible and to correct titles
- Update of the definitions clause to remove entries that are duplicates of those included in the common definitions documents
- Harmonization of control wiring requirements by adding the content of IEEE Std C37.20.2™ Amendment A
- Clarification/expansion of the requirements for viewing window placement
- Updates to [Annex B](#) for partial discharge testing and [Annex C](#) for voltage dividers
- Deletion of requirements for air temperature surrounding cables in the cable compartment
- Addition of special considerations/requirements when generator circuit breakers are used in metal-enclosed interrupter (MEI) switchgear

For many years, IEEE Std C37.20™-1969 covered all switchgear assemblies, including metal-enclosed bus. The IEEE Switchgear Assemblies Subcommittee and the NEMA Power Switchgear Assemblies Technical Committee 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.

The IEEE Switchgear Assemblies Subcommittee of the IEEE Power and Energy Switchgear Committee was responsible for this revision. This edition is dedicated in memory of Allan Morse who passed away during the rewrite of this edition. Allan was instrumental in performing a good portion of the rewrite.

This publication is one of a series covering switchgear assemblies. The series includes the following:

IEEE Std C37.20.1™, IEEE Standard for Metal-Enclosed Low-Voltage (1000 Vac and below, 3200 Vdc and below) Power Circuit Breaker Switchgear.

IEEE Std C37.20.2™, IEEE Standard for Metal-Clad Switchgear.

IEEE Std C37.20.3™, IEEE Standard for Metal-Enclosed Interrupter Switchgear Rated above 1 kV AC up to and Including 48.3 kV AC.

IEEE Std C37.20.4™, IEEE Standard for Indoor AC Switches (1 kV to 52 kV) for Use in Metal-Enclosed Switchgear.

IEEE Std C37.20.6™, IEEE Standard for 4.76 kV to 38 kV Rated Ground and Test Devices Used in Enclosures.

IEEE Std C37.20.7™, IEEE Guide for Testing Switchgear Rated up to 52 kV for Internal Arcing Faults.

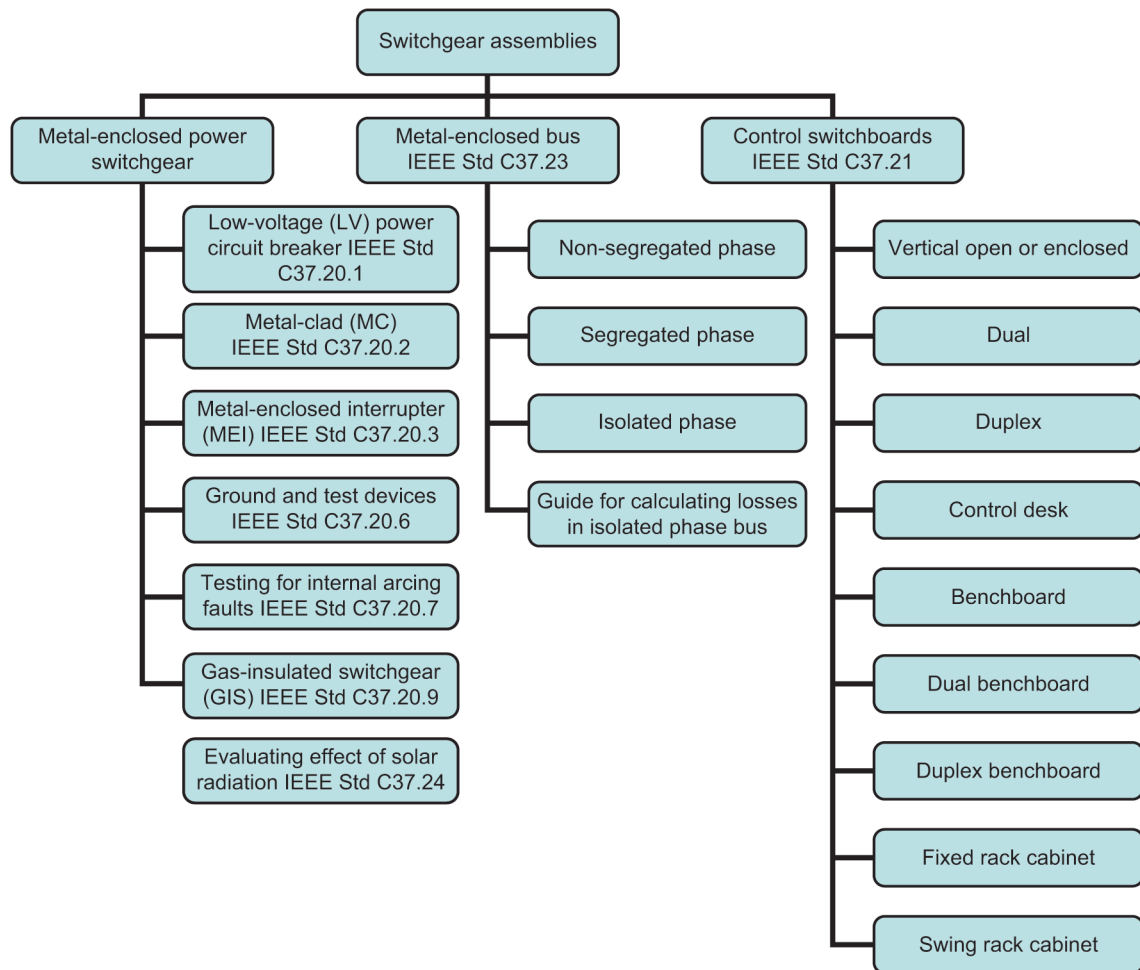
IEEE Std C37.20.9™, IEEE Standard for Metal-Enclosed Switchgear Rated 1 kV to 52 kV Incorporating Gas Insulating Systems.

IEEE Std C37.21™, IEEE Standard for Control Switchboards.

IEEE Std C37.23™, IEEE Standard for Metal-Enclosed Bus.

IEEE Std C37.24™, IEEE Guide for Evaluating the Effect of Solar Radiation on Outdoor Metal-Enclosed Switchgear.

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1. Overview

1.1 Scope

This standard covers metal-enclosed interrupter (MEI) switchgear assemblies where air at ambient pressure is the primary insulating medium. Individual components within the switchgear may use other insulating means. The switchgear includes components such ~~containing, but not limited to, such devices~~ as interrupter switches; selector switches; power fuses; circuit breakers; control, instrumentation, and metering devices; and protective equipment. MEI switchgear ~~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 1 kV ac up to and including 48.3 kV ac. It includes equipment that is part of primary and secondary unit substations. It does not include gas-insulated substation equipment or switching devices mounted integrally within a transformer enclosure.

1.2 Purpose

The purpose of this standard is to provide the usual service conditions, definition of ratings, preferred ratings, design and production tests, construction requirements, an application guide, and a guide for handling, storage, and installation for MEI switchgear.

1.3 Word usage

The word *shall* indicates mandatory requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted (*shall* equals *is required to*).^{6,7}

The word *should* indicates that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required (*should* equals *is recommended that*).

The word *may* is used to indicate a course of action permissible within the limits of the standard (*may* equals *is permitted to*).

The word *can* is used for statements of possibility and capability, whether material, physical, or causal (*can* equals *is able to*).

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

⁶The use of the word *must* is deprecated and cannot be used when stating mandatory requirements; *must* is used only to describe unavoidable situations.

⁷The use of *will* is deprecated and cannot be used when stating mandatory requirements; *will* is only used in statements of fact.

Accredited Standards Committee C2-~~2012~~, National Electrical Safety Code® (NESC®).⁸[†]

[ANSI C37.54, American National Standard for Indoor Alternating Current High-Voltage Circuit Breakers Applied as Removable Elements in Metal-Enclosed Switchgear—Conformance Test Procedures.](#)⁹

ANSI C37.57, American National Standard for Switchgear—Metal-Enclosed Interrupter Switchgear Assemblies—Conformance [Testing](#) ~~Test Procedures~~².

ANSI Z535.4, American National Standard for Product Safety [Signs](#) ~~Sign~~ and [Labels](#) ~~Label~~.

[ANSI/UL 94, Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.](#)

[ANSI/UL 510, Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.](#)

[ANSI/UL 1332, Organic Coatings for Steel Enclosures for Outdoor Use Electrical Equipment.](#)

[ASTM A90/A90M, Standard Test Method for Weight \[Mass\] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.](#)¹⁰

[ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated \(Galvanized\) or Zinc-Iron Alloy-Coated \(Galvannealed\) by the Hot-Dip Process.](#)

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

ASTM D229, Standard Test Methods for Rigid Sheet and Plate Materials Used [for](#) ~~in~~ Electrical Insulation.

ASTM D714, Standard Test Method for Evaluating Degree of Blistering of Paints.

⁸ [†]The NESC is available from The Institute of Electrical and Electronics Engineers, ~~445 Hoes Lane, Piscataway, NJ 08854, USA~~ (<https://standards.ieee.org/>).

² ⁹-ANSI publications are available from the ~~Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA~~ (<https://www.ansi.org/>).

¹⁰ ³ASTM publications are available from the American Society for Testing and Materials, ~~100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA~~ (<https://www.astm.org/>).

ASTM D1535, Standard Practice ~~for of~~ Specifying Color by the Munsell System.

ASTM D1654, Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.

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

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

IEC/IEEE 62271-37-013TM, High-voltage switchgear and controlgear—Part 37-013: Alternating-current generator circuit breakers.¹¹

IEEE Std 4TM ~~1995~~, IEEE Standard ~~Techniques~~ for High-Voltage Testing Techniques.^{12,13} ~~4,5~~

~~IEEE Std 4ATM 2001, Amendment to IEEE Standard Techniques for High-Voltage Testing.~~

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

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

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

~~IEEE Std 242TM, IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book).~~

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[IEEE Std 386™, IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV.](#)

IEEE Std C37.04™~~-1999~~, IEEE Standard [for Ratings and Requirements](#) ~~Rating Structure~~ for AC High-Voltage Circuit Breakers [with Rated Maximum Voltage Above 1000 V.](#)

[IEEE Std C37.06.1™, IEEE Recommended Practice for Preferred Ratings for High-Voltage \(> 1000 Volts\) AC Circuit Breakers Designated Definite Purpose for Fast Transient Recovery Voltage Rise Times.](#)

[IEEE Std C37.09™, IEEE Standard Test Procedures for AC High-Voltage Circuit Breakers with Rated Maximum Voltage Above 1000 V.](#)

~~IEEE Std C37.06™, IEEE Standard for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis—Preferred Ratings and Related Required Capabilities for Voltages Above 1000 V.~~

~~IEEE Std 344™, IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations.~~

~~IEEE Std 446™, IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications (IEEE Orange Book).~~

IEEE Std C37.2™, IEEE Standard [for](#) Electrical Power System Device Function Numbers, [Acronyms](#), and Contact Designations.

[IEEE Std C37.20.2™, IEEE Standard for Metal-Clad Switchgear.](#)

IEEE Std C37.20.4™, IEEE Standard for Indoor AC Switches (~~Rated Above~~ 1 kV [to 52](#) ~~Through 38~~ kV) for Use in Metal-Enclosed Switchgear.

[IEEE Std C37.20.6™, IEEE Standard for 4.76 kV to 38 kV Rated Ground and Test Devices Used in Enclosures.](#)

[IEEE Std C37.20.10™, IEEE Standard Definitions for AC \(52 kV and below\) and DC \(3.2 kV and below\) Switchgear Assemblies.](#)

IEEE Std C37.24™, IEEE Guide for Evaluating the Effect of Solar Radiation on Outdoor Metal-Enclosed Switchgear.

[IEEE Std C37.40™, IEEE Standard Service Conditions and Definitions for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories.](#)

[IEEE Std C37.41™, IEEE Standard Design Tests for High-Voltage \(> 1000 V\) Fuses and Accessories.](#)

IEEE Std C37.42 47™, IEEE Standard Specifications for High-Voltage (> 1000 V) [Fuses and Accessories](#) ~~Distribution Class Current Limiting Type Fuses and Fuse Disconnecting Switches.~~

IEEE Std C37.48™-2005, IEEE Guide for the Application, Operation, and Maintenance of High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories.

~~IEEE Std C37.100™, IEEE Standard Definitions for Power Switchgear.~~

~~IEEE Std C37.100.1™-2007, IEEE Standard of Common Requirements for High Voltage Power Switchgear Rated Above 1000 V.~~

~~IEEE Std C37.301™, IEEE Standard for High Voltage Switchgear (Above 1000 V) Test Techniques—Partial Discharge Measurements.~~

IEEE Std C57.13™-2008, IEEE Standard Requirements for Instrument Transformers.

[NEMA 260, Safety Labels for Pad-mounted Switchgear and Transformers Sited in Public Areas.](#)¹⁴

NEMA CC1, Electric Power Connection for Substations.⁶

NEMA WC 70, Power Cables Rated 2000 V or Less for the Distribution of Electrical Energy (ICEA S-95-658).

~~NEMA LH-2012, Industrial Laminating Thermosetting Products.~~

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NFPA 70, National Electrical Code® (NEC®).^{15 7}

~~UL 94, Tests for Flammability of Plastic Materials for Parts in Devices and Appliance.⁸~~

UL 486A-486B, Wire Connectors.¹⁶

3. Definitions, acronyms, and abbreviations

3.1 Definitions

For the purposes of this document, the following terms and definitions apply.

When multiple definitions exist, the definitions shall be evaluated in the following priority:

- a) Definitions embedded in this standard shall be used.
- b) For terms not defined within this standard, the definitions within IEEE Std C37.20.10™ shall be used.
- c) For terms not defined in either this standard or IEEE Std C37.20.10, the IEEE Standards Dictionary Online should be consulted~~for terms not defined in this clause.~~^{17 9}

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 matter treated in this standard. ~~If a term is not defined in this standard, the definition in IEEE Std C37.100 applies.~~

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

¹⁵ NFPA publications are published by the National Fire Protection Association (<https://www.nfpa.org/>).

⁷ ~~The NEC is available from Publications Sales, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101, USA (<http://www.nfpa.org/>).~~

^{16 8} UL publications are available from Underwriters Laboratories (<https://www.ul.com/>), ~~Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096, USA.~~

^{17 9} IEEE Standards Dictionary Online ~~subscription~~ is available at: <http://dictionary.ieee.org>. An IEEE account is required for access to the dictionary, and one can be created at no charge on the dictionary sign-in page http://www.ieee.org/portal/innovate/products/standard/standards_dictionary.html.

~~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 6.5.4 for method of measurement.¹⁰~~

~~**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.~~

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

~~**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.~~

~~NOTE 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.~~

~~NOTE 2—Design tests are sometimes called type tests.~~

disconnecting switch (or isolating switch): A mechanical switching device used for changing the connections in a circuit, or for isolating a circuit or equipment from the source of power.

~~It is required to carry normal load current continuously, and abnormal or short circuit currents for short intervals as specified. It is also required to open or close circuits either when negligible current is broken or made, or when no significant change in the voltage across the terminals of each of the switch poles occurs. *Synonym:* isolating switch (IEEE Std C37.100).~~

insulation, barrier: Insulation material used primarily to separate one item or area from another item or area within the equipment. Barrier insulation may be subdivided into two general types: Type 1 barriers that are not in contact with, and are not penetrated by, energized parts; and Type 2 barriers that are in contact with, or are penetrated by, energized parts.

NOTE—Examples include a) interphase barriers between poles of an interrupter switch; b) bus barriers separating the bus compartment of one vertical section of switchgear from another; and c) barriers used to shield grounded metal from electrical or thermal effects of circuit interruption within the equipment.¹⁸

~~**field tests:** Tests made after the assembly has been installed at its place of utilization.~~

~~**inorganic coating:** A coating that is composed of chemical compounds that do not contain carbon as the principal element (excepting carbonates, cyanides, and cyanates), that is, matter other than plant or animal.~~

interrupter compartment: The portion of the switchgear assembly that contains one interrupting device (such as an interrupter switch, power fuse interrupter switch combination, a drawout circuit breaker, or stationary circuit breaker with an isolating switch) and the associated primary conductors.

metal-enclosed interrupter switchgear: Metal-enclosed power switchgear including the following equipment as required:

- a) Interrupter (interrupter switches and/or circuit breakers)
- b) Power fuses (current-limiting or noncurrent-limiting)

¹⁸ ⁴⁰ Notes in text, tables, and figures of a standard are given for information only and do not contain requirements needed to implement this standard.

- c) Bare bus and connections
- d) Instrument transformers
- e) Control wiring and accessories
- f) An isolating switch with visible break contacts for stationary circuit breakers (non-drawout)

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.

organic coating: A coating (such as paint, lacquer, enamel, or film) in which the principal ingredients are derived from animal or vegetable matter or from some compound of carbon.

~~**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.~~

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

~~NOTE—Production tests are sometimes called routine tests.~~

~~**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.~~

~~**switchgear assembly:** 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.~~

~~NOTE—See Figure a in the introduction.~~

~~**tin-surfaced or equivalent:** Metallic materials having satisfactory long term performance that operate within the temperature rise limits established for tin-surfaced electrical contact parts and conduction-mechanical joints.~~

vertical section: That portion of the switchgear assembly between two successive vertical delineations and may contain one or more interrupters, auxiliary devices, and associated primary conductors.

4. ~~Normal (usual) and special (unusual)~~ 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 $-30\text{ }^{\circ}\text{C}$ and $40\text{ }^{\circ}\text{C}$. If ambient temperatures below $-5\text{ }^{\circ}\text{C}$ will be experienced while in service, the manufacturer should consider addition of space heating or other means to enable proper switching device operation.

NOTE—If the switching device is suitable for operation in an ambient of $-30\text{ }^{\circ}\text{C}$ (instead of the IEEE Std C37.04TM minimum ambient of $-5\text{ }^{\circ}\text{C}$), no special measures are required.

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 C37.24TM may be used for guidance.)

d) The ambient air is not significantly polluted by dust, smoke, corrosive gas vapors, or salt. The pollution does not exceed the site pollution severity (SPS) class “light” according to IEEE Std C37.04.

NOTE—For additional information on site pollution severity class (SPS) and example of typical environments, see Annex C of IEEE Std C37.04.

e) The conditions of humidity are as follows:

- 1) The average value of the relative humidity measured over a period of 24 h does not exceed 95%.
- 2) The average value of the water vapor pressure over a period of 24 h does not exceed 2.2 kPa.
- 3) The average value of the relative humidity over a period of one month does not exceed 90%.
- 4) The average value of the water vapor pressure over a period of one month does not exceed 1.8 kPa.

For these conditions, condensation may occasionally occur.

NOTE 1—Condensation can be expected where sudden temperature changes occur in periods of high humidity.

NOTE 2—Condensation may be prevented by special design of the building or housing, by suitable ventilation and heating of the station, or by the use of dehumidifying equipment. Other options include heaters with thermostats/humidistat inside the switchgear. Condensation may also be due to ground-level rainwater or for underground applications, from incoming cable raceways connected to switchgear.

f) Vibration due to causes external to the switchgear and controlgear or earth tremors are insignificant relative to the normal operating duties of the equipment and do not exceed the low performance level defined in IEEE Std 693™.

NOTE—The interpretation of the term *insignificant* is the responsibility of the user or specifier of the equipment. Either the user is not concerned with seismic event, or the analysis shows the risk is “insignificant.”

g) Unusual service conditions, such as those outlined in 8.1, do not prevail.

The user should review 8.1 for unusual service conditions and other considerations when preparing specifications for MEI switchgear because those unusual conditions impact the equipment design.

~~Clause 2 of IEEE Std C37.100.1-2007 applies.~~

~~4.1 Normal (usual) and special (unusual) service conditions~~

~~4.1.1 Indoor switchgear~~

~~Subclause 2.1.1 of IEEE Std C37.100.1-2007 applies.~~

~~4.1.2 Outdoor switchgear~~

~~Subclause 2.1.2 of IEEE Std C37.100.1-2007 applies.~~

~~4.2 Special (unusual) service conditions for both indoor and outdoor switchgear~~

~~Subclause 2.2 of IEEE Std C37.100.1-2007 applies with the following addition:~~

~~Any unusual service conditions should be specified by the user.~~

~~4.2.1 Altitude~~

~~Subclause 2.2.1 of IEEE Std C37.100.1-2007 does not apply.~~

~~4.2.2 Exposure to excessive pollution~~

~~Subclause 2.2.2 of IEEE Std C37.100.1-2007 applies.~~

~~4.2.3 Temperature and humidity~~

~~Subclause 2.2.3 of IEEE Std C37.100.1-2007 applies with the following modifications:~~

~~When MEI switchgear is applied where the ambient air temperature is higher than 40 °C, the total temperature limits for parts and materials as listed in 5.4.2 shall not be exceeded. Therefore, for the higher ambient, the equipment should be derated to a continuous current value that maintains the total temperature limits.~~

~~When MEI switchgear is applied where the ambient air temperature is less than 30 °C, space heating and thermal insulation to minimize the effects of such exposure should be considered.~~

~~4.2.4 Exposure to abnormal vibration, shock, or tilting~~

~~Subclause 2.2.4 of IEEE Std C37.100.1-2007 applies.~~

~~4.2.5 Other special (unusual) service conditions~~

~~Subclause 2.2.5 of IEEE Std C37.100.1-2007 applies.~~

~~4.2.5.1 Exposure to damaging fumes, vapor, steam, oil vapors, salt air, and hot and humid climate~~

~~Subclause 2.2.5.1 of IEEE Std C37.100.1-2007 applies.~~

~~4.2.5.2 Exposure to excessive dust or abrasive, magnetic, or metallic dust~~

~~Subclause 2.2.5.2 of IEEE Std C37.100.1-2007 applies.~~

~~4.2.5.3 Exposure to explosive mixtures of dust or gases~~

~~Subclause 2.2.5.3 of IEEE Std C37.100.1-2007 applies.~~

~~4.2.5.4 Unusual space limitations~~

~~Subclause 2.2.5.4 of IEEE Std C37.100.1-2007 applies.~~

~~4.2.6 Other parameters~~

~~Subclause 2.2.6 of IEEE Std C37.100.1-2007 applies.~~

5. Ratings

5.1 General

~~Clause 4 of IEEE Std C37.100.1-2007 applies with the following modifications:~~

- ~~a) Item 4b should be Rated insulation level (U_d), (U_p)~~
- ~~b) Add the following paragraphs:~~

The ratings of a switchgear assembly are designations of operating limits under specified ~~specific~~ conditions of ambient temperature, temperature rise, etc. Where the switchgear assembly includes ~~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 (V) or (U_r)
- b) Rated power frequency (f_r)
- c) Rated insulation levels (U_d), (U_p)
- d) Rated continuous current (I_r)
- e) Rated peak withstand (momentary) current (I_p)
- f) Rated short-time withstand current (I_k)
- g) Rated short-time withstand current duration (when other than 2 s)

The designated ratings values in this standard are preferred but are not considered to be restrictive.

In addition to these ratings, MEI switchgear may have interrupting or switching capabilities that are ~~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 C37.04TM (circuit breakers),[‡] IEEE Std C37.20.4TM (interrupter switches),[‡] and IEEE Std C37.42TM 47 (fuses).

- ~~e) The ratings listed in IEEE Std C37.20.4, IEEE Std C37.06, and this standard are preferred, but are not considered to be restrictive.~~

5.2 Voltage and insulation levels

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

5.2.1 Rated maximum voltage (V) or (U_r)

The rated maximum voltage of MEI switchgear is the highest line-to-line root-mean-square (rms) voltage for which the equipment is designed and is the upper limit for operation. See 8.2.

~~Subclause 4.1 of IEEE Std C37.100.1-2007 applies with the following modifications:~~

- ~~a) Rated maximum voltages are 4.76 kV, 8.25 kV, 15 kV, 27 kV, and 38 kV.~~
- ~~b) Rated maximum voltages for Range I, Series B (245 kV and below) and all of Range II (above 245 kV) do not apply.~~

~~NOTE—~~MEI switchgear may utilize voltage-sensitive components, such as voltage transformers and surge arresters, with a rated maximum voltage less than the rated maximum voltage of the MEI switchgear. The upper limit for operation shall ~~may~~ be determined by the rating of these components.

5.2.2 Rated insulation levels (~~level~~, U_d), (U_p)

~~Subclause 4.2 of IEEE Std C37.100.1-2007 applies with the following modifications:~~

The rated insulation levels ~~level~~ of MEI switchgear shall consist of ~~be selected for~~ the following:
~~values given in Table 1.~~

- a) Power frequency withstand voltage
- b) Dry and wet (where applicable) power frequency withstand voltages for outdoor applications.
- c) Lightning impulse withstand voltage (also referred to as basic impulse level or BIL)

5.2.3 Voltages and insulation levels

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

Table 1 — Preferred voltage and insulation levels for MEI switchgear

Rated maximum voltage (kV rms) with stress cone type terminations (with IEEE Std 386™ type terminations)	Power frequency withstand (kV rms) test voltage		Lightning impulse withstand (BIL) (kV peak) test voltage	Wet test voltages for external insulation exposed to weather (including IEEE C37.017 bushings) (kV rms) test voltage
	For switchgear with stress cone type terminations	For switchgear with separable insulated connector type terminations per IEEE Std 386		
4.76	19	19	60	---
8.25	36	34	95	30
15.0 (14.4)	36	34	95	30
27.0 (26.3)	60	40	125	50
38.0 (36.6)	80	50	150	75
48.3	105	---	250	95

(New)

Rated maximum voltage (kV)	Power-frequency withstand (rms) (kV) (U_d)		Impulse withstand (kV) (formerly BIL) (U_p)
	For switchgear with stress cone type terminations	For switchgear with separable insulated connector type terminations per IEEE Std 386	
4.76	19	19	60
8.25	36	34	95
15.0 (14.4)	36	34	95
27.0 (26.3)	60	40	125
38.0 (36.6)	80	50	150

(Deleted)

NOTE—For field dielectric test values, see 6.5.

Incorporating generator circuit breakers rated in accordance with IEC/IEEE 62271-37-013™ in MEI switchgear does not alter the requirements shown in Table 1. The overall assembly shall have preferred ratings for power frequency withstand voltage and for lightning impulse withstand voltage (BIL) in accordance with Table 1.

MEI switchgear may utilize components such as voltage transformers, control power transformers, or other components with rated insulation levels (power frequency withstand or lightning impulse withstand, or both) that are less than the levels shown in Table 1. In such cases, the operating limits of the assembly are those of the lowest rated component in the assembly.

5.3 Rated power frequency (f_r)

The rated power frequency of a device or an assembly is the frequency of the circuit for which it is designed. All ratings in this standard are based on a rated power frequency of 60 Hz.

~~Subclause 4.3 of IEEE Std C37.100.1-2007 applies.~~

5.4 Rated ~~continuous (normal) current and temperature rise~~

5.4.1 Rated continuous ~~(normal)~~ current (I_r)

~~Subclause 4.4.1 of IEEE Std C37.100.1-2007 does not apply.~~

The rated continuous current of MEI switchgear is the maximum current in rms amperes at the rated power frequency that ~~which~~ can be carried continuously by the primary circuit components, including buses and connections, without causing temperatures or temperature rises in excess of specified limits for ~~the following~~:

- a) Any primary or secondary circuit component
- b) Any insulating medium, ~~or~~ structural or enclosing member.

The specified temperature limits and temperature rise limits applicable to switchgear assemblies are given in 5.5.1 through 5.5.5 ~~5.4.2 and Table 2~~.

5.4.2 Continuous current ratings

The preferred ~~values of rated~~ continuous current ratings of the main bus in MEI switchgear are ~~shall~~ be 600 A, 1200 A, ~~and~~ 2000 A, 3000 A, and 4000 A.

The continuous current rating of the individual interrupter compartments shall be equal to the ratings of the switching and interrupting devices used, except as may be modified by lower continuous current ratings of ~~for~~ current transformers, power fuses, etc.

5.4.3 Rated peak withstand (momentary) current (I_p)

The rated peak withstand (momentary) current of MEI switchgear is the maximum peak current that it shall be required to withstand. The current shall be the peak value, including the dc component, at the major peak of the maximum cycle as determined from the envelope of the current wave of the maximum offset phase during a test period of at least 10 cycles. The symmetrical current shall be the rated short-time withstand current and the peak current value shall be 2.6 times its rated short-time withstand current at the major peak of the maximum cycle (this is also referred to as the *peak withstand current*).

For assemblies including only generator circuit breakers (and no other switching devices) complying with IEC/IEEE 62271-37-013, the peak current value shall be 2.74 times the rated short-time withstand current. If the assembly includes other switching devices not complying with IEC/IEEE 62271-37-013, the peak value for the complete assembly shall be 2.6 times the rated short-time current.

5.4.4 ~~Rated~~ Peak withstand (momentary) current rating (I_p)

~~Subclause 4.6 of IEEE Std C37.100.1-2007 applies with the following modification:~~

~~The preferred ratings are given in Table 3.~~

The peak withstand (momentary) current rating ~~ratings~~ of the individual interrupter compartments of MEI switchgear shall be equal to the lowest one of the following:

- a) The peak withstand (momentary) current rating of the interrupting device~~7~~
- b) The fault-making current rating of the interrupter switch or rated closing and latching current capability of the ~~for a~~ circuit breaker~~7-or~~

- c) The total asymmetrical ~~integrated~~ short-circuit current ratings of the fused interrupter switching device ~~devices~~ used.

NOTE—In this standard, the rated peak withstand (momentary) current requires a 10-cycle current duration with a designated peak value. In other standards, the peak withstand current may be different. When applying devices having a rated peak withstand current, the user or manufacturer should convert the peak rating to asymmetrical current to determine whether the application is appropriate.

Refer to IEEE Std C37.04, IEEE Std C37.20.4, or IEC/IEEE 62271-37-013, as applicable.

~~NOTE—This rating was previously called the rated momentary current and was an rms asymmetrical current. In other documents this value may also be referred to and can be equated to “peak withstand current.” If the peak withstand current rating is 2.6 times the rated short time symmetrical current and the duration of the test is 10 cycles, then the requirements for “rated momentary withstand current” have been met. The new rated peak withstand current is equivalent to the historic rated momentary current.~~

5.4.5 Rated short-time withstand current (I_k)

~~Subclause 4.5 of IEEE Std C37.100.1-2007 applies with the following modifications:~~

The rated short-time withstand current of the MEI switchgear assembly is the average maximum rms symmetrical current that the bus and connections shall ~~be required to~~ carry for 2 s. ~~the rated duration of short circuit.~~

~~The preferred ratings are given in Table 3.~~

This ~~preferred~~ rated time of 2 s is based on the maximum permissible tripping time delay (Y) for ~~indoor~~ circuit breakers in accordance with ~~Refer to IEEE Std C37.04-1999, subclause 5.8.2.3.b.~~

~~NOTE—Short-time current is the peak withstand current divided by 2.6.~~

For assemblies including only generator circuit breakers (and no other switching devices) complying with IEC/IEEE 62271-37-013, the short-time current value shall be the peak withstand current divided by 2.74. If the assembly includes other switching devices not complying with IEC/IEEE 62271-37-013, the short-time value for the complete assembly shall be the peak withstand current divided by 2.6.

Table 3 — Preferred short-time current ratings for MEI switchgear

Line No.	Ratings		Reference Momentary Withstand Current kA, rms (Asymmetrical)
	Rated Short-Time Withstand Current kA, rms (Symmetrical)	Rated Peak Withstand Current kA, peak	
	Col 2	Col 3	Col 4
1	12.5	32.5	20
2	14	36.4	22.4
3	25	65	40
4	38	98.8	61
5	50	130	80

(Deleted)

5.4.6 Rated ~~duration of~~ short-time withstand current ~~duration circuit (t_{sc})~~

~~Subclause 4.7 of IEEE Std C37.100.1-2007 applies with the following modifications:~~

The rated short-time withstand current duration is the maximum time interval that the assembly shall be required to carry the rated short-time withstand current. The preferred duration of short-time withstand current is 2 s ~~seconds~~. The ~~duration period~~ for the MEI switchgear assembly may be limited to a shorter time by a protective device, ~~switch~~, or current transformer rating, but shall not reduce the requirement for the bus and connections (see IEEE Std C57.13™-1993).

When the ~~short-time withstand current~~ ~~rated~~ duration ~~rating of short circuit~~ of the load interrupter switch is less than the preferred rating of 2 s, then the MEI switchgear assembly shall be assigned a rated short-time withstand current duration rating equal to the rating of the switch and the rating shall be noted on the nameplate. (See 7.4.1.)

5.4.7 Short-time withstand current rating

The short-time withstand current ~~rating~~ ~~ratings~~ of the individual ~~switch~~ interrupter compartments of the MEI switchgear shall be equal to the short-time ~~rating~~ ~~withstand ratings~~ of the switching ~~device~~ ~~and protective devices~~ used ~~or the short time rating of the current transformers~~ (see IEEE Std C57.13, ~~IEEE Std~~ C37.04, and IEEE Std C37.20.4). The preferred ratings are given in Table 2.

**Table 2—Preferred short-time and momentary withstand current ratings
for MEI switchgear**

Ratings		Reference momentary withstand current kA, rms (asymmetrical)
Rated short-time withstand current kA, rms (symmetrical)	Rated momentary withstand current kA, peak	
12.5	32.5	19.4
14	36.4	21.7
16	41.6	24.8
20	52	31.0
25	65	38.8
31.5	81.9	48.8
38	98.8	58.9
40	104	62.0
50	130	77.5
63	163.8	97.7

(New)

5.5 Temperature limitations

5.5.1 Limiting temperature

The limiting temperature for MEI switchgear is the maximum temperature permitted for:

- a) Any component, such as insulation, buses, instrument transformers, and switching and interrupting devices
- b) Any noncurrent-carrying structural parts

c) Air surrounding devices

5.5.2 Temperature limits for insulating materials

The temperature to which insulating materials are subject shall not exceed the values listed in Table 3 for the various classes of insulating materials.

Table 3—Temperature limits for insulating materials as used in switchgear assemblies

Class of insulating material	Limit of hottest-spot temperature rise (°C)	Limit of hottest-spot total temperature (°C)
Class 90	50	90
Class 105	65	105
Class 120	80	120
Class 130	90	130
Class 155	115	155
Class 180	140	180
Class 220	180	220

(New)

For additional information on temperature limits, see IEEE Std 1™ [B4].¹⁹

5.5.3 Temperature limits for buses and connections

The temperature limit and temperature rise of buses and connections shall not exceed the values listed in Table 4.

¹⁹ ⁴⁴ The numbers in brackets correspond to those of the bibliography in Annex D. €.

**Table 4— Temperature limits for buses and connections as used in
switchgear assemblies**

Type of bus or connection ^{b, c, d}	Limit of hottest-spot temperature rise (°C)	Limit of hottest-spot total temperature (°C)
Buses and connections with unplated copper-to-copper connecting joints	30	70
Buses and connections silver-surfaced or equivalent connecting joints	65	105
Buses and connections tin-surfaced or equivalent connecting joints	65	105
Connection to insulated cables unplated copper-to-copper ^a	30	70
Connection to insulated cables silver-surfaced or equivalent ^a	45	85
Connections to insulated cables tin-surfaced or equivalent ^a	45	85

(New)

^aBased on 90 °C insulated cable.

^bAll aluminum buses shall have silver-surfaced or equivalent, or tin-surfaced or equivalent, connecting joints.

^cWelded bus connections are not considered connecting joints.

^dWhen buses or connections have differing materials or coatings, the allowable temperature rise and temperature values shall be those of the conductor or coating having the lowest value permitted in the table.

5.5.4 Temperature limitations for air surrounding devices within an enclosed assembly

The temperature of the air surrounding all devices within an enclosed assembly, considered in conjunction with their rating and loading as used, shall not cause these devices to operate outside their rated temperature range when the enclosure of the assembly is surrounded by air within an ambient temperature range of -30 °C through 40 °C.

5.5.5 Temperature limitations for external parts subject to contact by personnel ~~rise~~

- a) External parts handled by operators in the normal course of their duties shall have no higher total temperature than 50 °C.
- b) External surfaces accessible to operators in the normal course of their duties shall have no higher total temperature than 70 °C.

~~Subclause 4.4.2 of IEEE Std C37.100.1-2007 does not apply. Subclause 4.4.3 of IEEE Std C37.100.1-2007 applies only where points are referenced in Table 2 of this standard.~~

~~The temperature rise and total temperature of any part of the switchgear shall not exceed the limits specified in Table 2 of this standard under the conditions specified in the test clauses.~~

- c) External surfaces not accessible to operators ~~an operator~~ in the normal course of their duties shall have no higher total temperature than 110 °C.

Table 2 — Limits of temperature rise for various parts, materials, and dielectrics of high-voltage switchgear^{a,b,c}

Nature of the part of the material and of the dielectric (see items below)		Maximum value	
		Temperature (°C)	Temperature rise at ambient air temperature not exceeding 40 °C ^b (K)
1	Does not apply	—	—
2	Connections, bolted or the equivalent (see point 4) — Bare-copper, bare-copper alloy or bare-aluminum alloy in air — Silver-coated or nickel-coated in air — Tin-surfaced in air	70 105 105	30 65 65
3	All other contacts or connections made of bare metals or coated with other materials	(See point 7)	(See point 7)
4	Terminals for the connection to external conductors by screws or bolts (see point 8) — Bare — Silver, nickel or tin-surfaced — Other coatings	(See point 14) 70 85 (See point 7)	(See point 14) 30 45 (See point 7)
5	Does not apply	—	—
6	Metal parts acting as springs	(See point 11)	(See point 11)
7	Materials used as insulation and metal parts in contact with insulation of the following classes: — Y — A — E — B — F — H — C	(See point 12) 90 105 120 130 155 180 220	(See point 12) 50 65 80 90 115 140 180
8	Does not apply	—	—
9	Accessible parts ^c — Expected to be touched in normal operation — Which need not be touched in normal operation	50 70	—

(Deleted)

^aThis table is based on Table 3 of IEEE Std C37.100.1-2007. Points 1, 4, 7, 8, and 14 in 4.4.3 of IEEE Std C37.100.1-2007 apply. Points 5, 6, 9, 10, 11, 12 and 13 in 4.4.3 of IEEE Std C37.100.1-2007 do not apply. Refer to Annex J in IEEE Std C37.100.1-2007 for a discussion of this table with respect to the comparable table in IEC 62271-1:2007 and to the requirements of several relevant equipment standards.

~~^bThe symbol "K" for the kelvin is used in this standard to refer to a temperature increment. As a temperature increment (e.g., temperature rise), the degree Kelvin is equal to the degree Celsius, 1 K = 1 °C = 1.8 °F; as temperature on a scale, 273.15 K = 0 °C = 32 °F and 0 °K is absolute zero. The Kelvin is written as "K" without the "°" degree symbol.~~

~~^cThe maximum value temperatures for group 9 are lower than those given in the comparable table in IEC 62271-1. See Annex J in IEEE Std C37.100.1.~~

5.6 Current transformer ratings

5.6.1 Current transformer mechanical ratings

The mechanical ratings of current transformers shall be such that they can ~~will~~ successfully withstand the momentary ~~peak~~ withstand current for which the associated circuit interrupting devices are applied. When the primary circuit is protected by current-limiting fuses, the current transformers shall successfully withstand the maximum let-through current (see IEEE Std C37.41TM) of the fuses. Unless specifically limited to a shorter time by the associated protective equipment, the duration of the momentary ~~short-circuit~~ current shall be considered as being 10 cycles. (~~See IEEE Std C57.13 for short-time mechanical current ratings.~~)

5.6.2 Current transformer thermal ratings

The thermal ratings of current transformers shall be such that they can ~~will~~ successfully withstand the short-circuit current for which the associated circuit interrupting devices are applied. When the primary circuit is protected by fuses, the current transformers shall successfully withstand the maximum I^2t let-through (clearing I^2t) of the fuses (see IEEE Std C37.41). Unless specifically limited to a shorter time by the associated protective equipment, the duration of the short circuit shall be considered as 1 s. (See IEEE Std C57.13 for short-time thermal current ratings.)

5.6.3 Current transformer ambient temperature

Current transformers for use in switchgear assemblies shall be rated on the basis of at least 55 °C ambient temperature in accordance with IEEE Std C57.13-~~2008, 4.1.1.2.~~

5.6.4 Current transformer accuracies

For installation in MEI switchgear, the typical current transformer accuracies for metering and relaying are listed in Table 5. Accuracies tabulated hereafter are the minimum that shall be supplied. The manufacturer should be consulted if higher accuracies are required by the purchaser. It should be recognized that wound-type current transformers with higher accuracies may not meet the requirements of 5.6.

When multi-ratio current transformers are supplied, the metering and relaying accuracies listed in Table 5 apply only to the full winding in accordance with IEEE Std C57.13.

~~Refer to IEEE Std C37.20.2 for current transformer accuracies.~~

Table 5— Standard accuracy ratings^a for current transformers in MEI switchgear

Ratio	Metering accuracy at standard burden					Relaying accuracy ^c
	B0.1	B0.2	B0.5	B0.9 ^b	B1.8 ^b	
50:5	1.2	2.4 ^d	—	—	—	C or T10
75:5	1.2	2.4 ^d	—	—	—	C or T10
100:5	1.2	2.4 ^d	—	—	—	C or T10
150:5	0.6	1.2	2.4 ^d	—	—	C or T20

(New)

Table 5—Standard accuracy ratings^a for current transformers in MEI switchgear (continued)

Ratio	Metering accuracy at standard burden					Relaying accuracy ^c
	B0.1	B0.2	B0.5	B0.9 ^b	B1.8 ^b	
200:5	0.6	1.2	2.4 ^d	—	—	C or T20
300:5	0.6	1.2	2.4 ^d	2.4 ^d	—	C or T20
400:5	0.3	0.6	1.2	1.2	2.4 ^d	C or T50
600:5	0.3	0.3	0.3	1.2	2.4 ^d	C or T50
800:5	0.3	0.3	0.3	0.6	1.2	C or T50
1200:5	0.3	0.3	0.3	0.3	0.3	C100
1500:5	0.3	0.3	0.3	0.3	0.3	C100
2000:5	0.3	0.3	0.3	0.3	0.3	C100
3000:5	0.3	0.3	0.3	0.3	0.3	C100
4000:5	0.3	0.3	0.3	0.3	0.3	C100
5000:5	0.3	0.3	0.3	0.3	0.3	C100

(New)

^aSee IEEE Std C57.13.

^bThese were formerly standard burdens of B1.0 and B2.0, respectively, which now are classified as relaying burdens in IEEE Std C57.13.

^cThese accuracies may not be sufficient for proper relaying performance under all conditions. To enable proper relaying performance, the user should make an analysis of current transformer (CT) performance considering the relaying requirements for the specific short circuit currents and secondary circuit impedances (see 8.7.1).

^dThis metering accuracy is not in IEEE Std C57.13.

5.7 Voltage transformers

Voltage transformers used for metering and relay applications shall meet the requirements of IEEE Std C57.13.

5.8 Current-sensing devices other than conventional current transformers

Upon agreement between the manufacturer and user, current-sensing devices, such as Rogowski coils or other types of current sensors, may be utilized with compatible relays or instruments in place of conventional current transformers. Rogowski coils and other low-power passive current transformers shall comply with IEC 61869-11 [B2]. Other types of current sensors shall comply with the parts of IEC 61869 that are applicable to the particular type of current-sensing device. If the switchgear design does not provide means for utilizing conventional current transformers, the requirement specified in 6.2 for current transformers included in the test arrangement is not applicable and the test arrangement shall include the maximum number of physically largest Rogowski coils or other type of current sensors suitable for the equipment. If the switchgear design provides means for utilizing conventional current transformers, the test arrangement specified in 6.2 is applicable in addition to the inclusion of the maximum number of physically largest Rogowski coils or other type of current sensors suitable for the equipment.

6. Tests

6.1 General

~~Clause 6 of IEEE Std C37.100.1-2007 applies, with the following addition(s):~~

This subclause ~~clause~~ establishes physical and electrical conditions for tests and methods of determining temperatures and test values. All switching devices, apparatus, and other devices in the power circuit shall be mounted in their normal locations during tests. When the design allows for a removable primary interrupting device to be located in an upper or lower position, unless the position is specified by this document, tests shall be conducted with the interrupting device in the position offering the more severe conditions. No statement in this subclause ~~clause~~ is to be construed as modifying the test requirements for devices included in switchgear assemblies.

Tests are classified as design tests, production tests, conformance tests, and field tests ~~(see Clause 3).~~

Except for the main switching or interrupting device, other devices ~~—~~ (such as voltage and control power transformers and surge arresters that ~~—which~~ are mounted in the switchgear assemblies ~~—~~ shall ~~—may~~ be disconnected at the device terminals during ~~the~~ dielectric tests ~~test~~. Such devices are individually tested in accordance with the standards that apply ~~applying~~ to them.

~~Design (type) tests as applicable shall be made in accordance with 6.2 through 6.16. Production (routine) tests shall be made in accordance with 6.17. Conformance tests shall be made in accordance with 6.16. Field dielectric tests shall be made in accordance with 6.18.~~

6.2 Design ~~Grouping of~~ tests

6.2.1 Introduction

~~Subclause 6.1 of IEEE Std C37.100.1-2007 does not apply.~~

~~The~~ Design ~~(type)~~ tests, as applicable, shall be ~~carried out on representative test specimens~~ made in accordance with 6.2.2 through 6.2.10. Several tests may be conducted on a single test specimen, at the option of the manufacturer.

Each test specimen of switchgear shall conform to drawings and be representative of its type and shall be subjected to one or more design ~~type~~ tests.

Each individual design ~~type~~ test shall be made on a complete vertical section in the condition as required for service (components filled with the specified types and quantities of liquid or gas at specified pressure and temperature, if applicable), with their operating devices and auxiliary equipment, all of which in principle should be in, or restored to, a new and clean condition at the beginning of each design ~~type~~ test. The test specimen ~~sample~~ shall consist of one vertical section plus an additional adjacent vertical section, when required, to verify the horizontal through bus and bus splice. When the vertical section is self-contained, does not have through bus, and does not require other vertical sections for application, the adjacent vertical section is not required to perform design ~~type~~ tests. If the design is intended to be furnished with through bus (main bus), then the test specimen shall include through bus and shall include a bus splice.

A test specimen is a complete vertical section, unless otherwise specified when the poles are mechanically linked (i.e., one operating mechanism) or when the design ~~type~~ tests are mainly three-pole tests.

Each test arrangement shall include the maximum available number of current transformers per phase of standard accuracy class or greater, in accordance with Table 5, and shall be installed in the switching device vertical section's standard locations. Current transformers shall have the secondary windings short-circuited and grounded for all tests and be rated as shown in Table 6.

Table 6—Current transformer ratio based on switching device rating

Switching device rating (A)	Current transformer ratio
200	300:5
600	800:5
1200	1500:5
2000	3000:5
3000	4000:5
4000	5000:5

(New)

~~6.1.1 Information for identification of specimens~~

~~Subclause 6.1.1 of IEEE Std C37.100.1-2007 applies.~~

~~6.1.2 Information to be included in design test (type test) reports~~

~~Subclause 6.1.2 of IEEE Std C37.100.1-2007 applies, with the following addition:~~

~~Design test (type test) reports in accordance with this clause are to be retained by the manufacturer.~~

~~The manufacturer may provide test report summaries to purchasers.~~

6.2 Dielectric tests

~~Subclause 6.2 of IEEE Std C37.100.1-2007 applies except as shown in 6.2.1 through 6.2.12.~~

~~6.2.1 Ambient air conditions during tests~~

~~Subclause 6.2.1 of IEEE Std C37.100.1-2007 applies.~~

~~6.2.2 Wet test procedure~~

~~Subclause 6.2.2 of IEEE Std C37.100.1-2007 applies.~~

~~6.2.3 Conditions of switchgear during dielectric tests~~

~~Subclause 6.2.3 of IEEE Std C37.100.1-2007 applies except that test sample shall be as described in 6.1 of this standard.~~

~~6.2.4 Criteria to pass the test~~

~~Subclause 6.2.4 of IEEE Std C37.100.1-2007 applies.~~

~~6.2.5 Application of the test voltage and test conditions~~

~~Subclause 6.2.5 of IEEE Std C37.100.1-2007 applies.~~

6.2.2 Dielectric tests

6.2.2.1 Introduction

~~6.2.5.1 General case~~

~~Subclause 6.2.5.1 of IEEE Std C37.100.1-2007 does not apply.~~

Power ~~Rated power~~ frequency withstand ~~voltage~~ tests (see 6.2.2.2 ~~6.1~~) and lightning_impulse withstand ~~voltage~~ tests (see 6.2.2.3 ~~6~~) shall be performed on MEI switchgear assemblies to demonstrate the ability of the insulation system to withstand rated voltages in accordance with Table 1. In addition, dielectric tests shall be made on the bus-bar insulation, as specified in 6.2.8.2.

The tests on the insulation system shall be made under the temperature and humidity conditions normally prevailing at the test site with ~~obtained under conditions of commercial testing.~~ appropriate correction factors for relative air density and humidity ~~shall be~~ applied as outlined in IEEE Std 4TM (method 2) ~~1995~~. Humidity correction factors shall be based on ~~the~~ curves for rod gaps as stated in IEEE Std 4 (method 2) ~~4a-2001~~. The equipment shall be clean and in good condition.

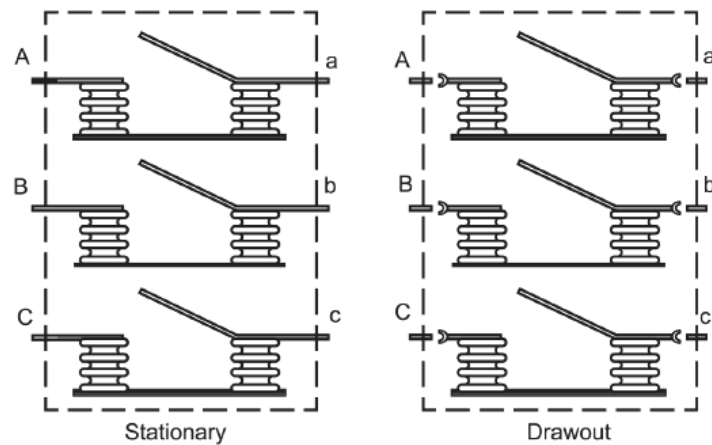
Test voltages shall be applied between the primary circuits and ground in the following manner per Figure 1:

- a) For equipment with stationary mounted devices ~~interrupter or isolating switches~~ and for equipment with drawout devices with the removable elements in the connected position:
 - 1) With the switching device contacts closed; ~~;~~ between each phase of the switchgear assembly individually with the frame and all other phases grounded.
 - 2) With the switching device contacts open; ~~;~~ between each terminal (incoming and outgoing) of the switchgear assembly with the frame and ~~all~~ other terminals grounded.
- b) For equipment with drawout devices with the removable elements in the test position and the main switching devices in the closed position, apply the test voltage to primary circuits:
 - 1) Simultaneously to all the incoming terminals of the switchgear assembly with the frame and outgoing terminals grounded. Repeat tests by applying test voltage to the outgoing terminals with the frame and incoming terminals grounded.
 - 2) Simultaneously between all incoming and outgoing terminals of the switchgear assembly. The test shall be made with a value of voltage 10% higher than that ~~the voltage~~ specified in Table 1. This test may be omitted if the equipment has grounded metal shutters (see 7.8).
- c) For stationary mounted interrupter or isolating switches, with the switch in the open position, apply test voltage that is 10% higher than the voltage specified in Table 1:
 - 1) First to all incoming terminals with all outgoing terminals grounded.
 - 2) Then to all outgoing terminals with all incoming terminals grounded.

~~For~~ Tests described in 6.2.2.1b) and 6.2.2.1c) are performed to prove the dielectric withstand capability of the open gap. For the test across the open gap at 10% higher voltage, an intermediate point of the voltage source may, if practicable, be connected to ground and to the frame of the assembly ~~so in order~~ that the voltage between any live part and the frame ~~does~~ shall not exceed ~~that the voltage~~ specified in Table 1. If this is not practical ~~practicable~~, the frame may be insulated from ground.

Power-frequency withstand voltage tests and lightning ~~, lightning~~-impulse withstand voltage tests shall be made in accordance with Figure 1. ~~and~~ Where applicable, wet tests on entrance bushings and bus-bar insulation tests shall be made in accordance with 6.2.2.4 and 6.2.8.2.

NOTE—Successful completion of these tests does not necessarily provide assurance that with the switch or circuit breaker in the test or open position, or both, it will always flashover to ground instead of across the open gap between line and load terminals. Switchgear insulation does not provide surge protection for the open gap. Where surge protection of the open gap is required, suitable protective devices should ~~shall~~ be applied.



Dielectric test arrangement

Line	Phase						Enclosure ground or floating	Interrupter connect or test position	Interrupter open or closed
	Incoming terminals			Outgoing terminals					
	A	B	C	a	b	c			
1	V	G	G	V	G	G	G	C ₁	C
2	G	V	G	G	V	G	G	C ₁	C
3	G	G	V	G	G	V	G	C ₁	C
4	V	G	G	G	G	G	G	C ₁	O
5	G	G	G	V	G	G	G	C ₁	O
6	G	V	G	G	G	G	G	C ₁	O
7	G	G	G	G	V	G	G	C ₁	O
8	G	G	V	G	G	G	G	C ₁	O
9	G	G	G	G	G	V	G	C ₁	O
10	V	V	V	G	G	G	G	T	C
11	G	G	G	V	V	V	G	T	C
12	V ₁	V ₁	V ₁	G	G	G	F	T	C
13	G	G	G	V ₁	V ₁	V ₁	F	T	C
14	V ₁	V ₁	V ₁	G	G	G	F	—	O
15	G	G	G	V ₁	V ₁	V ₁	F	—	O

Lines 1–9 are for equipment with stationary or drawout interrupters

Lines 10–13 are for equipment with drawout interrupter

Lines 14–15 are for equipment with stationary mounted interrupter or isolating switches

V = Test voltage (see Table 1)

V₁ = 1.1 × power frequency withstand test voltage (see Table 1)

C = Closed

O = Open

C₁ = Connect

T = Test

G = Ground

F = Floating

(New)