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NEUTRAL GROUNDING DEVICES

(Proposed AIEE Standard for trial use)



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Development of the Standards of the American Institute of Electrical Engineers

Recognizing the importance in the development of electrical engineering, of standardization in the electrical field, the AIEE in 1898 appointed a Committee on Standardization, consisting of seven members having qualifications and experience from designing, manufacturing and operating standpoints. The report of this Committee was accepted at a meeting of the Institute in June 1899.

Experience gained in applications of the standards and further developments in electrical apparatus and methods showed the necessity of revision, and a committee was appointed which after consultation with manufacturing and operating engineers presented the first revised report on Standardization Rules of the AIEE in June 1902.

The next revision was undertaken by a committee of ten, which presented its report in May 1906.

In September 1906, a Standards Committee of eleven members was appointed for further revision, and its report was presented in June 1907.

The appreciation of the importance and value of standardization resulted in the formation of a Standing Committee, with the title of Standards Committee of the AIEE. This became effective in the Constitution of June 1907. The scope and amount of work necessitated increasing the number of members from time to time until in 1922 there were 37 members divided into a number of subcommittees specializing on various subjects.

AIEE Standards published in a single volume as each revision was adopted were generally accepted as Standards of the electrical industry of the United States since the adoption of the first report in 1899. Subsequent reports on Standards were made and published, in some cases in several editions. The dates of adoption by the Board of Directors of such reports are as follows: June 20, 1902; June 21, 1907; June 27, 1912; July 10, 1914; June 30, 1915; June 28, 1916; November 8, 1918; October 8, 1920, and June 29, 1922.

On June 29, 1922, in view of the increasing complexity of the work, a reorganization of the Standards Committee was effected, and a working organization established which provided for an increase in standardization work and for the appointment on Working Committees of the Standards Committee of non-Institute members.

The present plan under which the Institute Standards are being issued involves the separation of the complete body of Standards into more than forty sections, each published as a separate pamphlet and dealing with a specific subject. Each section of the Standards has been formulated either by a Working Committee of the Standards Committee which was made as representative as possible for the work in hand, by an AIEE technical committee or subcommittee, or by a Sectional Committee organized according to the procedure of the American Standards Association. The division of the Standards into a number of separate publications simplifies the process of keeping the Standards revised to conform with the latest development and enables those interested in a particular field to obtain in concise form the material relating to that field. In framing the Institute Standards the chief purpose has been to define terms and conditions which characterize the rating and behavior of electrical machinery and apparatus, with special reference to the conditions of acceptance tests.

The AIEE Standards Committee takes this occasion to draw attention to the value of suggestions based upon experience gained in the application of the Standards to general practice. Any suggestions looking toward improvement in the Standards will be welcomed for the guidance of the Committee in preparation of future editions, and should be communicated to the Secretary of the AIEE Standards Committee, 33 West 39th Street, New York.

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The major work of preparing this proposed standard was carried out by a Subcommittee of the AIEE Committee on Protective Devices. The personnel of the present subcommittee and the names of former committeemen who also aided in the work, are as follows :

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STANDARDS OF THE American Institute of Electrical Engineers

NEUTRAL GROUNDING DEVICES

(Proposed AIEE Standard for Trial Use)

SCOPE

- 32-1** The standards of this section apply to grounding transformers, and to resistors, reactors, capacitors, and combinations of these, when used for grounding the neutrals of alternating-current electric systems.

DEFINITIONS

The following definitions apply specifically to neutral grounding devices. They will be included with all other definitions in a separate section. Numbers appearing at the end of the definition are those of the American Standard Definitions of Electrical Terms, C-42.

Systems and Circuits

- 32-50 Rated Circuit Voltage**—The rated voltage of a circuit is the highest rms rated voltage of the generators or secondaries of transformers supplying the circuit. (See 15.10.100)

NOTE: By "circuit voltage" is meant the voltage from phase to phase as distinguished from phase to neutral. This voltage rating applies to all parts of the circuit. In the case of transformers having series-multiple secondary connections, the circuit voltage is determined by the series or the multiple connections as used.

- 32-52 Grounded Circuit**—A grounded circuit is one in which one conductor or point (usually the middle wire or neutral point of transformer or generator windings) is intentionally grounded, either solidly or through a current-limiting device. (35.15.070.)

- 32-53 Grounded System**—A grounded system is a system of conductors in which at least one conductor or point (usually the middle wire or neutral point of transformer or generator windings) is intentionally grounded, either solidly, or through a current-limiting device. (35.15.075.)

Degree and Manner of Grounding

- 32-54 Solidly Grounded (Directly Grounded)**—Solidly grounded means grounded through adequate ground connection(s) in which no impedance has been inserted intentionally. (35.15.200.)

NOTE: "Adequate", as used herein, means "suitable for the purpose intended."

- 32-56 Impedance Grounded** — Impedance grounded means grounded through an impedance. (New).

- 32-57 Resistance Grounded** — Resistance grounded means grounded through an impedance, the principal element of which is resistance. (Modified from 35.15.210).

- 32-58 Reactance Grounded** — Reactance grounded means grounded through an impedance, the principal element of which is reactance. (Modified from 35.15.215).

NOTE: The reactance may be embodied in the form of a reactor, a grounding transformer, or one or more grounded power transformers or generators, the remaining power transformers or generators operating with isolated neutral.

- 32-59 Resonant Grounded** — Resonant grounded means reactance-grounded through such values of reactance that, during a fault between one of the conductors and earth, the rated-frequency current flowing in the grounding reactances and the rated frequency capacitance current flowing between the unfaulted conductors and earth shall be substantially equal. In the fault these two components of the fault current will be substantially 180 degrees out of phase. (New).

NOTE: When a system is resonant grounded, it is expected that the rated-frequency single-phase-to-ground fault current will be so small that an arc fault in air will be self-extinguishing.

- 32-60 Ungrounded** — Ungrounded means without an intentional connection to ground except through potential indicating or measuring devices. (New).

Grounding Devices (New)

- 32-69 Grounding Transformer**—A grounding transformer is a transformer intended primarily to provide a neutral point for grounding purposes. (Modified from 15.20.045).

- 32-70 Resonant-Grounding Transformer** — A resonant-grounding transformer is a grounding transformer whose zero-sequence impedance may be so adjusted that the system to which it is connected will be resonant grounded. (New).

NOTE: In such transformers the primary winding is usually star-connected, with the neutral grounded, and the secondary, not connected to any external circuit, is arranged in delta, with an adjustable reactor connected in one corner of the delta.

32-71 Neutral Grounding Device—A neutral-grounding device is an impedance device used to connect the neutral point of a system of electrical conductors to the earth, in order to control the ground current. The device may consist of resistance, inductance, or capacitance elements, or a combination of them. Protective devices, such as lightning arresters, may also be included, as part of the device.

32-72 Neutral-Grounding Resistor — A neutral-grounding resistor is a neutral-grounding device, in which the principal element is resistance.

32-73 Neutral-Grounding Reactor — A neutral-grounding reactor is a neutral-grounding device, in which the principal element is inductive reactance.

32-74 Resonant Neutral-Grounding Reactor — A resonant neutral-grounding reactor is a neutral-grounding reactor which can be so adjusted that the system to which it is connected will be resonant-grounded.

NOTE: Resonant neutral-grounding reactors are frequently termed "Petersen coils."

32-75 Ground-Fault Neutralizer — A ground-fault neutralizer is a grounding device which provides an inductive reactive component of current in a ground fault that is substantially equal to, and therefore neutralizes, the rated-frequency capacitive component of the ground fault current, thus rendering the system resonant grounded. A ground-fault neutralizer may consist of either a resonant-grounding transformer or a resonant neutral-grounding reactor.

32-76 Neutral-Grounding Capacitor — A neutral-grounding capacitor is a neutral-grounding device in which the principal element is capacitance.

NOTE: A neutral-grounding capacitor is normally used in combination with other elements, such as reactors or resistors.

32-78 Neutral-Grounding Impedor — A neutral-grounding impedor is a neutral-grounding device comprising an assembly of at least two of the elements, resistance, inductance, or capacitance.

32-78 Neutral Wave Trap—A neutral wave trap is a neutral-grounding device comprising parallel-connected inductance and capacitance elements of such value that they form a substantially parallel-resonant circuit at one or more frequencies in the neutral current.

Rating

32-90 Rating—The rating of a machine, apparatus or device is a designated limit of operating characteristics based on definite conditions. (05.50.040.)

The rating of a grounding device shall include some or all of the following items:

- (a) Rated current.
- (b) Rated voltage.
- (c) Rated frequency.
- (d) Rated time interval.
- (e) Rated insulation class.
- (f) Rated circuit voltage—(see 32-50).

32-91 Rated Current—The rated current of a grounding device is the rms neutral current, in amperes, which it will carry under usual or specified service conditions (see 32-200), for its rated time interval, without exceeding standard or specified limitations. (New).

32-92 Rated Voltage—The rated voltage of a grounding device is the rms voltage, at rated frequency which may be impressed between its terminals, under usual or specified service conditions (see 32-200), for its rated time interval, without exceeding standard or specified limitations. (New).

32-93 Rated Frequency—The rated frequency of a grounding device is the frequency of the alternating current for which it is designed. (New).

NOTE: Some devices, such as neutral wave traps, may have two or more rated frequencies, one the rated frequency of the circuit, and the others the frequencies of the harmonic or harmonics it is designed to control.

32-94 Rated Time Interval—The rated time interval of a grounding device is the time interval during which it will carry its rated current, or withstand its rated voltage, or both, under usual or specified service conditions (see 32-200), without exceeding standard or specified limitations. (New).

32-95 Continuous Rating—Continuous rating is a rating in which the rated time interval is indefinitely long. (Changed from 05.50.045).

32-96 Short-time Rating—Short-time rating is a rating in which the rated time interval is a short and definitely specified time. (Changed from 05.50.050).

32-97 Rated Insulation Class—The rated insulation class of a grounding device is the insulation class, expressed in rms kilovolts, which determines, in accordance with these standards, the insulation tests that the device shall be capable of withstanding. (New).

Losses and Impedance Drop

32-110 Losses—The losses of a grounding device shall consist of the I^2R loss in the windings, core loss, dielectric losses (for capacitors), losses due to stray magnetic fluxes in the windings and other metallic parts of the device, and in cases involving parallel windings, losses due to circulating currents. The losses as here defined shall not include any losses produced by the grounding device in adjacent apparatus or materials not a part of the device. (New).