भारतीय मानक

Indian Standard

IS 1885 (Part 17) : 2024
IEC 60050-441 : 1984

विद्युत तकनीकी शब्दावली

भाग 17 स्विचगियर और नियंत्रण गियर

(दूसरा पुनरीक्षण)

Electrotechnical Vocabulary

Part 17 Switchgear and Control Gear

(Second Revision)

ICS 01.040.29; 29.120.50; 29.130

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www.bis.gov.in www.standardsbis.in

May 2024 **Price Group 14**

Basic Electrotechnical Standard and Power Quality Sectional Committee, ETD 01

NATIONAL FOREWORD

This Indian Standard (Part 17) (Second Revision) which is identical to IEC 60050-441 : 1984 'International electrotechnical vocabulary (IEV) — Part 441: Switchgear, controlgear and fuses' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Basic Electrotechnical Standard and Power Quality Sectional Committee and approval of the Electrotechnical Division Council.

This standard was first revised in 1979 to align it with IEC 60050-441 : 1974. This second revision has been undertaken to take into consideration the developments that have taken place subsequently and also to align with the latest version of IEC 60050-441 : 1984

The text of IEC standard has been approved as suitable for publication as an Indian Standard without deviations. Certain terminologies and conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'; and

b) Comma (,) has been used as a decimal marker, while in Indian Standards the current practice is to use a point (.) as the decimal marker.

Only the English language text has been retained while adopting it in this Indian Standard, and as such, the page numbers given here are not the same as in the IEC Publication.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding of numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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Indian Standard

ELECTROTECHNICAL VOCABULARY

PART 17 SWITCHGEAR AND CONTROL GEAR

(Second Revision)

SECTION 441-11 - GENERAL TERMS

441-11-01
Switchgear and Controlgear

A general term covering switching devices and their combination with associated control, measuring, protective and regulating equipment, also assemblies of such devices and equipment with associated interconnections, accessories, enclosures and supporting structures.

441-11-02
Switchgear

A general term covering switching devices and their combination with associated control, measuring, protective and regulating equipment, also assemblies of such devices and equipment with associated interconnections, accessories, enclosures and supporting structures, intended in principle for use in connection with generation, transmission, distribution and conversion of electric energy.

441-11-03
Controlgear

A general term covering switching devices and their combination with associated control, measuring, protective and regulating equipment, also assemblies of such devices and equipment with associated interconnections, accessories, enclosures and supporting structures, intended in principle for the control of electric energy consuming equipment.

441-11-04
Indoor Switchgear and controlgear

Switchgear and controlgear designed solely for installation within a building or other housing, where the switchgear and controlgear is protected against wind, rain, snow, abnormal dirt deposits, abnormal condensation, ice and hoar frost.

441-11-05
Outdoor Switchgear and controlgear

Switchgear and controlgear suitable for installation in the open air, i.e. capable of withstanding wind, rain, snow, dirt deposits, condensation, ice and hoar frost.

441-11-06
Over-Current

A current exceeding the rated current.

441-11-07
Short-Circuit Current
An over-current resulting from a short circuit due to a fault or an incorrect connection in an electric circuit.

441-11-08
Overload

Operating conditions in an electrically undamaged circuit, which cause an over-current.

441-11-09
Conductive Part

A part which is capable of conducting current although it may not necessarily be used for carrying service current.

441-11-10
Exposed Conductive Part

A conductive part which can readily be touched and which is not normally alive, but which may become alive under fault conditions.

Note — Typical exposed conductive parts are walls of enclosures, operating handles, etc.

441-11-11
Segregation (of conductors)

An arrangement of conductors with earthed metal interposed between them in such a manner that disruptive discharges can only occur to earth.

441-11-12
Separation (of conductors)

An arrangement of conductors with solid insulation interposed in such a manner that disruptive discharges cannot occur between them.

441-11-13
Ambient Air Temperature

The temperature, determined under prescribed conditions, of the air surrounding the complete switching device or fuse.

Note — For switching devices or fuses installed inside an enclosure, it is the temperature of the air outside the enclosure.

SECTION 441-12 - ASSEMBLIES OF SWITCHGEAR AND CONTROLGEAR

441-12-01

Assembly (of switchgear and controlgear)

A combination of switchgear and/ or controlgear completely assembled with all internal electrical and mechanical interconnections.

441-12-02
Enclosed Assembly (of switchgear and controlgear)

An assembly enclosed on all sides, top and bottom in such a manner as to provide a specified degree of protection.

Note — The mounting surface may form a part of the enclosure when specified in the relevant publication.

441-12-03
Factory-Built Assembly (of switchgear and controlgear) (abbrev. FBA)

An assembly built and assembled under the responsibility of the manufacturer and conforming to an established type or system, without deviations likely to influence the performance significantly from that of the typical assembly verified to be in accordance with the relevant standard.

441-12-04
Metal-Enclosed Switchgear and Controlgear

Switchgear and controlgear assemblies with an external metal enclosure intended to be earthed, and complete except for external connections.

Note — This term generally plies to high-voltage switchgear and controlgear.

441-12-05
Gas-Insulated Metal-Enclosed Switchgear

Metal-enclosed switchgear in which the insulation is obtained, at least partly, by an insulating gas other than air at atmospheric pressure.

Note — This term generally applies to high-voltage switchgear and controlgear

441-12-06
Insulation-Enclosed Switchgear and Controlgear

Switchgear and controlgear assemblies with an external insulation enclosure and complete except for external connections

Note — This term generally applies to high-voltage switchgear and controlgear.

441-12-07
Busbar Trunking System

A factory-built assembly in the form of a conductor system comprising busbars which are spaced and supported by insulating material in a duct, trough or similar enclosure.

Note — This term generally applies to low-voltage systems.

441-12-08
Control Station

An assembly of one or more control switches fixed on the same panel or located in the same enclosure.

Note — A control station panel or enclosure may also contain related equipment, e.g., potentiometers, signal lamps, instruments, etc.

SECTION 441-13 - PARTS OF ASSEMBLIES

441-13-01
Enclosure (of an assembly)

A part of an assembly providing a specified degree of protection of equipment against external influences and a specified degree of protection against approach to or contact with live parts and against contact with moving parts.

441-13-02
Main Circuit (of an assembly)

All the conductive parts of an assembly included in a circuit which is intended to transmit electrical energy.

441-13-03
Auxiliary Circuit (of an assembly)

All the conductive parts of an assembly of switchgear and controlgear included in a circuit (other than the main circuit) intended to control, measure, signal and regulate.

Note — The auxiliary circuits of an assembly include the control and auxiliary circuits of the switching devices.

441-13-04
Functional Unit (of an assembly)

A part of an assembly of switchgear and controlgear comprising all the components of the main circuits and auxiliary circuits that contribute to the fulfilment of a single function.

Note — Functional units may be distinguished according to the function for which they are intended e.g.: incoming unit, through which electrical energy is normally fed into the assembly, outgoing unit through which electrical energy is normally supplied to one or more external circuits.

441-13-05
Compartment (of an assembly)

A part of an assembly enclosed except for openings necessary for interconnection, control or ventilation.

441-13-06
Partition (of an assembly)

A part of an assembly separating one compartment from other compartments.

441-13-07
Shutter (of an assembly)

A part of an assembly that can be moved from a position where it permits contacts of a removable part to engage fixed contacts, to a position where it becomes a part of the enclosure or partition shielding the fixed contacts.

441-13-08
Removable Part (of an assembly)

A part of an assembly that may be removed entirely from the assembly and replaced even though the main circuit is alive.

441-13-09
Withdrawable Part (of an assembly)

A removable part of an assembly that can be moved to one or more positions in which an isolating distance or a segregation between open contacts is established while the part remains mechanically attached to the assembly.

Note — The isolating distance or the segregation always relates to the main circuit. It may or may not refer to the auxiliary circuits or to control circuits.

SECTION 441-14 - SWITCHING DEVICES

441-14-01
Switching Device

A device designed to make or break the current in one or more electric circuits.

441-14-02
Mechanical Switching Device

A switching device designed to close and open one or more electric circuits by means of separable contacts.

Note — Any mechanical switching device may be designated according to the medium in which its contacts open and close, e.g. air, SF_6, oil.

441-14-03
Semiconductor Switching Device

A switching device designed to make the current in an electric circuit by means of the controlled conductivity of a semiconductor.

441-14-04
Fuse-Combination Unit

A combination of a mechanical switching device and one or more fuses in a composite unit, assembled by the manufacturer or in accordance with his instructions.

Note — Some fuse-combination units may be provided with a striker release such that the operation of any striker causes all poles of the associated mechanical switching device to open.

441-14-05
Disconnector

A mechanical switching device which provides, in the open position, an isolating distance in accordance with specified requirements.

Note — A disconnector is capable of opening and closing a circuit when either negligible current is broken or made, or when no significant change in the voltage across the terminals of each of the poles of the disconnector occurs. It is also capable of carrying currents under normal circuit conditions and carrying for a specified time currents under abnormal conditions such as those of short circuit.

441-14-06 [07]
Divided Support Disconnector [Earthing Switch]

A disconnector [earthing switch] in which the fixed and moving contacts of each pole are not supported by a common base or frame.

Notes
1 — A typical example is the pantograph or semi-pantograph dis -connector.
2 — This term applies to high-voltage disconnectors only.

441-14-08
Centre-Break Disconnector

A disconnector in which both contacts of each pole are movable and engage at a point substantially midway between their supports.

Note — This term applies to high voltage disconnectors only.

441-14-09
Double-Break Disconnector

A disconnector that opens a circuit at two points.

441-14-10
(Mechanical) **Switch**

A mechanical switching device capable of making, carrying and breaking currents under normal circuit conditions which may include specified operating overload conditions and also carrying for a specified time currents under specified abnormal circuit conditions such as those of short circuit.

Note — A switch may be capable of making but not breaking short-circuit currents.

441-14-11
Earthing Switch

A mechanical switching device for earthing parts of a circuit, capable of withstanding for a specified time currents under abnormal conditions such as those of short circuit, but not required to carry current under normal conditions of the circuit.

Note — An earthing switch may have a short-circuit making capacity.

441-14-12
Switch-Disconnector

A switch which, in the open position, satisfies the isolating requirements specified for a disconnector.

441-14-13
Gas Evolving Switch

A switch in which the gas is evolved and moved by the thermal action of the arc.

441-14-14 [15] [16]
Switch [Disconnector] [Switch-Disconnector]-Fuse

A switch [disconnector] [switch-disconnector] in which one or more poles have a fuse in series in a composite unit.

441-14-17[18] [19]
Fuse-Switch [Fuse-Disconnector] [Fuse switch-Disconnector]

A switch [disconnector] [switch-disconnector] in which a fuse-link or a fuse-carrier with fuse-link forms the moving contact.

441-14-20
Circuit-Breaker

A mechanical switching device, capable of making, carrying and breaking currents under normal circuit conditions and also making, carrying for a specified time and breaking currents under specified abnormal circuit conditions such as those of short circuit.

441-14-21
Current-Limiting Circuit-Breaker

A circuit-breaker with a break-time short enough to prevent the short-circuit current reaching its otherwise attainable peak value.

441-14-22
Integrally Fused Circuit-Breaker

A combination, in a single device, of a circuit-breaker and fuses, one fuse being placed in series with each pole of the circuit-breaker intended to be connected to a phase conductor.

441-14-23
Circuit-Breaker with Lock-Out Preventing Closing

A circuit-breaker in which none of the moving contacts can make current if the closing command is initiated while the conditions which should cause the opening operation remain established.

441-14-24
Moulded-Case Circuit-Breaker

A circuit-breaker having a supporting housing of moulded insulating material forming an integral part of the circuit-breaker.

441-14-25
Dead Tank Circuit-Breaker

A circuit-breaker with interrupters in an earthed metal tank.

441-14-26
Live Tank Circuit-Breaker

A circuit-breaker with interrupters in a tank insulated from earth.

441-14-27
Air Circuit-Breaker

A circuit-breaker in which the contacts open and close in air at atmospheric pressure.

441-14-28
Oil Circuit-Breaker

A circuit-breaker in which the contacts open and close in oil.

Note — Typical examples of oil circuit-breakers are live tank minimum oil circuit breakers and dead tank bulk oil circuit-breakers.

441-14-29
Vacuum Circuit-Breaker

A circuit-breaker in which the contacts open and close within a highly evacuated envelope.

441-14-30
Gas-Blast Circuit-Breaker

A circuit-breaker in which the arc develops in a blast of gas.

Note – Where the gas is moved by a difference in pressure established by mechanical means during the opening operation of the circuit-breaker, it is termed a single pressure gas-blast circuit-breaker. Where the gas is moved by a difference in pressure established before the opening operation of the circuit-breaker, it is termed a double pressure gas-blast circuit-breaker.

441-14-31
Sulphur Hexafluoride Circuit-Breaker; Sf_6 Circuit-Breaker

A circuit-breaker in which the contacts open and close in sulphur hexafluoride.

441-14-32
Air-Blast Circuit-Breaker

A gas-blast circuit-breaker in which the gas used is air.

441-14-33
(Mechanical) **Contactor**

A mechanical switching device having only one position of rest, operated otherwise than by hand, capable of making, carrying and breaking currents under normal circuit conditions including operating overload conditions.

Note — Contactors may be designated according to the method by which the force for closing the main contacts is provided.

441-14-34
Latched Contactor

A contactor, the moving elements of which are prevented by means of a latching arrangement from returning to the position of rest when the operating means are de-energized.

Notes
1 — The latching, and the release of the latching, may be mechanical, electromagnetic, pneumatic, etc.

2 — Because of the latching, the latched contactor actually acquires a second position of rest and, according to the definition of a contactor it is not, strictly speaking, a contactor. However, since the latched contactor in both its utilization and its design is more closely related to contactors in general than to any other classification of switching device, it is considered proper to require that it complies with the specifications for contactors wherever they are appropriate.

441-14-35
Contactor Relay

A contactor used as a control switch.

441-14-36
Instantaneous Contactor Relay

A contactor relay operating without any intentional time delay.

Note — Unless otherwise stated, a contactor relay is an instantaneous contactor relay.

441-14-37
Time-Delay Contactor Relay

A contactor relay with specified time-delay characteristics.

Note — The time-delay may be associated with energization (“e” delay) or with de-energization (“d” delay) or both.

41-14-38
Starter

The combination of all the switching means necessary to start and stop a motor in combination with suitable overload protection.

Note — Starters may be designated according to the method by which the force for closing the main contacts is provided.

41-14-39
Manual Starter

A starter in which the force for closing the main contacts is provided exclusively by manual energy.

41-14-40
Direct-on-Line Starter

A starter which connects the line voltage across the motor terminals in one step.

41-14-41
***n*-Step Starter**

A starter in which there are (*n* — l) intermediate accelerating positions between the off and full on positions.

41-14-42
Rheostatic Starter

A starter utilizing one or several resistors for obtaining, during starting, stated motor torque characteristics and for limiting the current.

41-14-43
Rheostatic Rotor Starter

A rheostatic starter for an asynchronous wound-rotor motor which, during the starting period, cuts out successively one or several resistors previously provided in the rotor circuit.

41-14-44
Star-Delta Starter

A starter for a three-phase induction motor such that in the starting position the stator windings are connected in star and in the final running position they are connected in delta.

41-14-45
Auto-Transformer Starter

A starter for an induction motor which uses for starting one or more reduced voltages derived from an auto-transformer

41-14-46
Control Switch (for Control and Auxiliary Circuits)

A mechanical switching device which serves the purpose of controlling the operation of switchgear or controlgear, including signalling, electrical interlocking, etc.

Note — A control switch consists of one or more contact elements with a common actuating system.

41-14-47
Rotary (Control) **Switch**

A control switch having an actuator intended to be operated by rotation.

41-14-48
Pilot Switch

A non-manual control switch actuated in response to specified conditions of an actuating quantity.

Note — The actuating quantity may be pressure, temperature, velocity, liquid level, elapsed time, etc.

41-14-49
Position Switch

A pilot switch the actuating system of which is operated by a moving part of a machine, when this part reaches a predetermined position.

41-14-50
Limit Switch

A position switch having positive opening operation.

41-14-51
Proximity Switch

A position switch which is operated without mechanical contact with the moving part.

41-14-52
Foot Switch

A control switch having an actuator intended to be operated by foot.

41-14-53
Push-Button

A control switch having an actuator intended to be operated by force exerted by a part of the human body, usually the finger or palm of the hand, and having stored energy (spring) return.

SECTION 441-15 - PARTS OF SWITCHING DEVICES

441-15-01
Pole of a Switching Device

The portion of a switching device associated exclusively with one electrically separated conducting path of its main circuit and excluding those portions which provide a means for mounting and operating all poles together.

> Note — A switching device is called single-pole if it has only one pole. If it has more than one pole, it may be called multipole (two-pole, three-pole, etc.) provided the poles are or can be coupled in such a manner as to operate together.

441-15-02
Main Circuit (of a Switching Device)

All the conductive parts of a switching device included in the circuit which it is designed to close or open.

441-15-03
Control Circuit (of a Switching Device)

All the conductive parts (other than the main circuit) of a switching device which are included in a circuit used for the closing operation or opening operation, or both, of the device.

441-15-04
Auxiliary Circuit (of a Switching Device)

An the conductive parts of a switching device which are intended to be included in a circuit other than the main circuit and the control circuits of the device.

> Note — Some auxiliary circuits fulfil supplementary functions such as signalling, interlocking, etc., and, as such, they may be part of the control circuit of another switching device.

441-15-05
Contact (of a Mechanical Switching Device)

Conductive parts designed to establish circuit continuity when they touch and which, due to their relative motion during an operation, open or close a circuit or, in the case of hinged or sliding contacts, maintain circuit continuity.

441-15-06
Contact (Piece)

One of the conductive parts forming a contact.

441-15-07
Main Contact

A contact included in the main circuit of a mechanical switching device, intended to carry, in the closed position, the current of the main circuit.

441-15-08
Arcing Contact

A contact on which the arc is intended to be established.

Note — An arcing contact may serve as a main contact; it may be a separate contact so designed that it opens after and closes before another contact which it is intended to protect from injury.

441-15-09
Control Contact

A contact included in a control circuit of a mechanical switching device and mechanically operated by this device.

441-15-10
Auxiliary Contact

A contact included in an auxiliary circuit and mechanically operated by the switching device.

441-15-11
Auxiliary Switch (of a Mechanical Switching Device)

A switch containing one or more control and/or auxiliary contacts mechanically operated by a switching device.

441-15-12
“a” Contact;
Make Contact

A control or auxiliary contact which is closed when the main contacts of the mechanical switching device are closed and open when they are open.

441-15-13
“b” Contact;
Break Contact

A control or auxiliary contact which is open when the main contacts of a mechanical switching device are closed and closed when they are open.

441-15-14
Butt Contact
A contact in which relative movement of the contact pieces is substantially in a direction perpendicular to the contact surface.

441-15-15
Sliding Contact

A contact in which relative movement of the contact pieces is substantially in a direction parallel to the contact surface.

441-15-16
Rolling Contact

A contact in which one contact piece rolls on the other.

441-15-17
Release (of a Mechanical Switching Device)

A device, mechanically connected to a mechanical switching device, which releases the holding means and permits the opening or the closing of the switching device.

441-15-18
Arc Control Device

A device, surrounding the arcing contacts of a mechanical switching device, designed to confine the arc and to assist in its extinction.

441-15-19
Arc Chute

A chamber into which the arc is transferred to assist in its extinction.

441-15-20
Blow-Out Coil

A coil designed to produce a magnetic field arranged to deflect an arc, e.g. into an arc-chute.

441-15-21
Actuating System (of a Control Switch)

All the operating means of a control switch which transmits the actuating force to the contact elements.

Note — The operating means of an actuating system may be mechanical, electromagnetic, hydraulic, pneumatic, thermal, etc.

441-15-22
Actuator

The part of the actuating system to which an external actuating force is applied.

Note — The actuator may take the form of a handle, knob, push-button, roller, plunger, etc.

441-15-23
Contact Element (of a Control Switch)

All the structural parts, fixed and movable, conducting and insulating, of a control switch necessary to close and open one single conducting path of a circuit.

441-15-24
Electrically Separated Contact Elements

Contact elements belonging to the same control switch, but adequately insulated from each other so that they can be connected into electrically separated circuits.

441-15-25
Position Indicating Device

A part of a mechanical switching device which indicates whether it is in the open, closed, or where appropriate, earthed position.

SECTION 441-16 – OPERATION

441-16-01
Operation (of a Mechanical Switching Device)

The transfer of the moving contact(s) from one position to an adjacent position.

Notes
1 — For a circuit-breaker, this may be a closing operation or an opening operation.

2 — If distinction is necessary, an operation in the electrical sense, e.g. make or break, is referred to as a switching operation, and an operation in the mechanical sense, e.g. close or open, is referred to as a mechanical operation.

441-16-02
Operating Cycle (of a Mechanical Switching Device)

A succession of operations from one position to another and back to the first position through all other positions, if any.

441-16-03
Operating Sequence (of a Mechanical Switching Device)

A succession of specified operations with specified time intervals.

441-16-04
Manual Control

Control of an operation by human intervention.

441-16-05
Automatic Control

Control of an operation without human intervention, in response to the occurrence of predetermined conditions.

441-16-06
Local Control

Control of an operation at a point on or adjacent to the controlled switching device.

441-16-07
Remote Control

Control of an operation at a point distant from the controlled switching device.

441-16-08
Closing Operation (of a Mechanical Switching Device)

An operation by which the device is brought from the open position to the closed position.

441-16-09
Opening Operation (of a Mechanical Switching Device)

An operation by which the device is brought from the closed position to the open position.

441-16-10
Auto-Reclosing (of a Mechanical Switching Device)

The operating sequence of a mechanical switching device whereby, following its opening, it closes automatically after a predetermined time.

441-16-11
Positive Opening Operation (of a Mechanical Switching Device)

An opening operation which, in accordance with specified requirements, ensures that all the main contacts are in the open position when the actuator is in the position corresponding to the open position of the device.

441-16-12
Positively Driven Operation

An operation which, in accordance with specified requirements, is designed to ensure that auxiliary contacts of a mechanical switching device are in the respective positions corresponding to the open or closed position of the main contacts.

441-16-13
Dependent Manual Operation (of a Mechanical Switching Device)

An operation solely by means of directly applied manual energy, such that the speed and force of the operation are dependent upon the action of the operator.

441-16-14
Dependent Power Operation (of a Mechanical Switching Device)

An operation by means of energy other than manual, where the completion of the operation is dependent upon the continuity of the power supply (to solenoids, electric or pneumatic motors, etc.).

441-16-15
Stored Energy Operation (of a Mechanical Switching Device)

An operation by means of energy stored in the mechanism itself prior to the completion of the operation and sufficient to complete it under predetermined conditions.

Note — This kind of operation may be subdivided according to:

1. The manner of storing the energy (spring, weight, etc.);

2. The origin of the energy (manual, electric, etc.);

3. The manner of releasing the energy (manual, electric, etc.).

441-16-16
Independent Manual Operation (of a Mechanical Switching Device)

A stored energy operation where the energy originates from manual power, stored and released in one continuous operation, such that the speed and force of the operation are independent of the action of the operator.

441-16-17[18]
Actuating Force [Moment]

The force [moment] applied to an actuator necessary to complete the intended operation.

441-16-19 [20]
Restoring Force [Moment]

The force [moment] provided to restore an actuator or a contact element to its initial position.

441-16-21
Travel (of a Mechanical Switching Device or a Part Thereof)

The displacement (translation or rotation) of a point on a moving element.

Note — Distinction may be made between pre-travel, over travel, etc.

441-16-22
Closed Position (of a Mechanical Switching Device)

The position in which the predetermined continuity of the main circuit of the device is secured.

441-16-23
Open Position (of a Mechanical Switching Device)

The position in which the predetermined clearance between open contacts in the main circuit of the device is secured.

441-16-24
Position of Rest (of a Contactor)

The position which the moving elements of the contactor take up when its electromagnet or its compressed-air device is not energized.

441-16-25
Service Position (of a removable part);
Connected Position (of a removable part)

The position of a removable part in which it is fully connected for its intended function.

441-16-26
Earthing Position (of a removable part)

The position of a removable part in which the closing of a mechanical switching device causes a main circuit to be short-circuited and earthed.

441-16-27
Test Position (of a withdrawable part)

The position of a withdrawable part in which an isolating distance or segregation is established in the main circuit and in which the auxiliary circuits are connected.

441-16-28
Disconnected Position (of a Withdrawable Part);
Isolated Position (of a Withdrawable Part)

The position of a withdrawable part in which an isolating distance or segregation is established in all the circuits of the withdrawable part, that part remaining mechanically attached to the assembly.

> Note — In enclosed high-voltage switchgear and controlgear the auxiliary circuits may not be disconnected.

441-16-29
Removed Position (of a removable part)

A position of a removable part when it is outside and mechanically and electrically separated from the assembly.

441-16-30
Fixed Trip Mechanical Switching Device

A mechanical switching device which cannot be released except when it is in the closed position.

441-16-31
Trip-Free Mechanical Switching Device

A mechanical switching device, the moving contacts of which return to and remain in the open position when the opening operation is initiated after the initiation of the closing operation, even if the closing command is maintained.

Note — To ensure proper breaking of the current which may have been established, it may be necessary that the contacts momentarily reach the closed position.

441-16-32
Instantaneous Release

A release which operates without any intentional time-delay.

441-16-33
Over-Current Release

A release which permits a mechanical switching device to open with or without time-delay when the current in the release exceeds a predetermined value.

Note — This value can in some cases depend upon the rate-of-rise of current.

441-16-34
Definite Time-Delay Over-Current Release

An over-current release which operates with a definite time-delay, which may be adjustable, but is independent of the value of the overcurrent.

441-16-35
Inverse Time-Delay Over-Current Release

An over-current release which operates after a time-delay inversely dependent upon the value of the over-current.

Note — Such a release may be designed so that the time delay approaches a definite minimum value for high values of over-current.

441-16-36
Direct Over-Current Release
An over-current release directly energized by the current in the main circuit of a mechanical switching device.

441-16-37
Indirect Over-Current Release

An over-current release energized by the current in the main circuit of a mechanical switching device through a current transformer or a shunt.

441-16-38
Overload Release

An over-current release intended for protection against overloads.

441-16-39
Thermal Overload Release

An inverse time-delay overload release depending for its operation, including its time-delay, on the thermal action of the current flowing in the release.

441-16-40
Magnetic Overload Release

An overload release depending for its operation on the force exerted by the current in the main circuit exciting the coil of an electromagnet.

Note — Such a release usually has an inverse time-delay/current characteristic.

441-16-41
Shunt Release

A release energized by a source of voltage.

Note — The source of voltage may be independent of the voltage of the main circuit.

441-16-42
Under-Voltage Release
A shunt release which permits a mechanical switching device to open or close, with or without time-delay, when the voltage across the terminals of the release falls below a predetermined value.

441-16-43
Reverse Current Release (d.c. only)

A shunt release which permits a mechanical switching device to open, with or without time-delay, when the current flows in reverse direction and exceeds a predetermined value.

441-16-44
Inching

Energizing a motor or solenoid repeatedly for short periods to obtain small movements of the driven mechanism.

441-16-45
Operating Current (of an over-current release)

The current value at and above which the release can operate.

441-16-46
Current Setting (of an over-current release)

The value of the operating current for which the release is adjusted and in accordance with which its operating conditions are defined.

441-16-47
Current Setting Range (of an overcurrent release)

The range between the minimum and maximum values over which the current setting of the release can be adjusted.

441-16-48
Anti-Pumping Device

A device which prevents reclosing after a close-open operation as long as the device initiating closing is maintained in the position for closing.

441-16-49
Interlocking Device

A device which makes the operation of a switching device dependent upon the position or operation of one or more other pieces of equipment.

SECTION 441-17 — CHARACTERISTIC QUANTITIES OF SWITCHGEAR, CONTROLGEAR AND FUSES

Certain characteristic quantities referring to switching devices or fuses may be extended to assemblies of switch gear and controlgear. The corresponding terms are denoted by an asterisk.

441-17-01 *
Prospective Current (of a circuit and with respect to a switching device or a fuse)

The current that would flow in the circuit if each pole of the switching device or the fuse were replaced by a conductor of negligible impedance.

Note — The method to be used to evaluate and to express the prospective current is to be specified in the relevant publications.

441-17-02 *
Prospective Peak Current

The peak value of a prospective current during the transient period following initiation.

Note — The definition assumes that the current is made by an ideal switching device, i.e. with instantaneous transition from infinite to zero impedance. For circuits where the current can follow several different paths, e.g. poly-phase circuits, it further assumes that the current is made simultaneously in all poles, even if only the current in one pole is considered.

441-17-03 *
Prospective Symmetrical Current (of an a.c. circuit)

The prospective current when it is initiated at such an instant that no transient phenomenon follows the initiation.

Notes

1. — For poly-phase circuits, the condition of non-transient period can only be satisfied for the current in one pole at a time.

2. — The prospective symmetrical current is expressed by its r.m.s.

441-17-04 *
Maximum Prospective Peak Current (of an a.c. circuit)

The prospective peak current when initiation of the current takes place at the instant which leads to the highest possible value.

Note — For a multiple device in a poly-phase circuit, the maximum prospective peak current refers to a single pole only.

441-17-05
Prospective Making Current (for a pole of a switching device)

The prospective current when initiated under specified conditions.

Note — The specified conditions may relate to the method of initiation, e.g. by an ideal switching device, or to the instant of initiation, e.g. leading to the maximum prospective peak current in an a.c. circuit, or to the highest rate of rise. The specification of these conditions is found in the relevant publications.

441-17-06
Prospective Breaking Current (for a pole of a switching device or a fuse)

The prospective current evaluated at a time corresponding to the instant of the initiation of the breaking process.

Note — Specifications concerning the instant of the initiation of the breaking process are to be found in the relevant publications. For mechanical switching devices or fuses, it is usually defined as the moment of initiation of the arc during the breaking process.

441-17-07
Breaking Current (of a switching device or a fuse)

The current in a pole of a switching device or in a fuse at the instant of initiation of the arc during a breaking process.

441-17-08
Breaking Capacity (of a switching device or a fuse)

A value of prospective current that a switching device or a fuse is capable of breaking at a stated voltage under prescribed conditions of use and behaviour.

Notes

1. — The voltage to be stated and the conditions to be prescribed are dealt with in the relevant publications.

2. — For switching devices, the breaking capacity may be termed according to the kind of current included in the prescribed conditions, e.g. line-charging breaking capacity, cable charging breaking capacity, single capacitor bank breaking capacity, etc.

441-17-09
Making Capacity (of a Switching Device)

A value of prospective making current that a switching device is capable of making at a stated voltage under prescribed conditions of use and behaviour.

Note — The voltage to be stated and the conditions to be prescribed are dealt with in the relevant specifications.

441-17-10
Short-Circuit Making Capacity

A making capacity for which the prescribed conditions include a short circuit at the terminals of the switching device.

441-17-11
Short-Circuit Breaking Capacity

A breaking capacity for which the prescribed conditions include a short circuit at the terminals of the switching device.

441-17-12
Cut-Off Current;
Let-Through Current

The maximum instantaneous value of current attained during the breaking operation of a switching device or a fuse.

Note — This concept of particular importance when the switching device or the fuse operates in such a manner that the prospective peak current of the circuit is not reached.

441-17-13
Time-Current Characteristic

A curve giving the time, e.g. prearcing time or operating time, as a function of the prospective current under stated conditions of operation.

441-17-14
Cut-Off (Current) **Characteristic;**
Let-Through (Current) **Characteristic**

A curve giving the cut-off current as a function of the prospective current, under stated conditions of operation.

Note — In the case of a.c., the values of the cut-off currents are the maximum values which can be reached whatever the degree of asymmetry. In the case of d.c., the values of the cut-off currents are the maximum values reached related to the time constant as specified.

441-17-15
Over-Current Discrimination

Co-ordination of the operating characteristics of two or more overcurrent protective devices such that, on the incidence of over-currents within stated limits, the device intended to operate within these limits does so, while the other(s) does (do) not.

Note — Distinction is made between series discrimination, involving different over-current protective devices passing substantially the same over-current, and network discrimination involving identical protective devices passing different proportions of the over-current.

441-17-16
Take-Over Current

The current co-ordinate of the intersection between the time-current characteristics of two over-current protective devices.

441-17-17*
Short-Time Withstand Current

The current that a circuit or a switching device in the closed position can carry during a specified short time under prescribed conditions of use and behaviour.

441-17-18*
Peak Withstand Current

The value of peak current that a circuit or a switching device in the closed position can withstand under prescribed conditions of use and behaviour.

441-17-19*
Utilization Category (for a switching device or a fuse)

A combination of specified requirements related to the condition in which the switching device or the fuse fulfils its purpose, selected to represent a characteristic group of practical applications.

Note — The specified requirements may concern e.g. the values of making capacities (if applicable), breaking capacities and other characteristics, the associated circuits and the relevant conditions of use and behaviour.

441-17-20
Conditional Short-Circuit Current (of a circuit or a switching device)

The prospective current that a circuit or a switching device, protected by a specified current limiting device, can satisfactorily withstand for the operating time of that current limiting device under specified conditions of use and behaviour.

441-17-21
Fused Short-Circuit Current

The conditional short-circuit current when the current limiting device is a fuse.

441-17-22
Conventional Non-Tripping Current (of an over-current release)

A specified value of current which the release can carry for a specified time (conventional time) without operating.

441-17-23
Conventional Tripping Current (of an over-current release)

A specified value of current which causes the release to operate within a specified time (conventional time).

441-17-24
Applied Voltage (for a switching device)

The voltage which exists across the terminals of a pole of a switching device just before the making of the current.

441-17-25
Recovery Voltage

The voltage which appears across the terminals of a pole of a switching device or a fuse after the breaking of the current.

Note — This voltage may be considered in two successive intervals of time, one during which a transient voltage exists, followed by a second one during which the power frequency or the steady-state recovery voltage alone exists.

441-17-26
Transient Recovery Voltage (abbrev. T.R.V.)

The recovery voltage during the time in which it has a significant transient character.

Notes

1 — The transient recovery voltage may be oscillatory or non-oscillatory or a combination of these depending on the characteristics of the circuit and the switching device. It includes the voltage shift of the neutral of a polyphase circuit.

2 — The transient recovery voltages in three-phase circuits is, unless otherwise stated, that across the first pole to clear, because this voltage is generally higher than that which appears across each of the other two poles.

441-17-27
Power Frequency Recovery Voltage

The recovery voltage after the transient voltage phenomena have subsided.

441-17-28
d.c. Steady-state recovery voltage

The recovery voltage in a d.c. circuit after the transient voltage phenomena have subsided, expressed by the mean value where ripple is present

441-17-29
Prospective Transient Recovery Voltage (of a circuit)

The transient recovery voltage following the breaking of the prospective symmetrical current by an ideal switching device.

Note — The definition assumes that the switching device or the fuse, for which the prospective transient recovery voltage is sought, is replaced by an ideal switching device, i.e. having instantaneous transition from zero to infinite impedance at the very instant of zero current, i.e. at the "natural" zero. For circuits where the current can follow several different paths, e.g. a polyphase circuit, the definition further assumes that the breaking of the current by the ideal switching device takes place only in the pole considered.

441-17-30
Peak Arc Voltage (of a mechanical switching device)

The maximum instantaneous value of voltage which under prescribed conditions appears across the terminals of a pole of a switching device during the arcing time.

441-17-31
Clearance

The distance between two conductive parts along a string stretched the shortest way between these conductive parts.

441-17-32
Clearance between Poles

The clearance between any conductive parts of adjacent poles.

441-17-33
Clearance to Earth

The clearance between any conductive parts and any parts which are earthed or intended to be earthed.

441-17-34
Clearance between Open Contacts

The total clearance between the contacts, or any conductive parts connected thereto, of a pole of a mechanical switching device in the open position.

441-17-35
Isolating Distance (of a pole of a mechanical switching device)

The clearance between open contacts meeting the safety requirements specified for disconnectors.

441-17-36
Opening Time (of a mechanical switching device)

The interval of time between the specified instant of initiation of the opening operation and the instant when the arcing contacts have separated in all poles.

> Note — The instant of initiation of the opening operation, i.e. the application of the opening command (e.g. energizing the release, etc.) is given in the relevant specifications.

441-17-37
Arcing Time (of a pole or a fuse)

The interval of time between the instant of the initiation of the arc in a pole or a fuse and the instant of fi -nal arc extinction in that pole or that fuse.

441-17-38
Arcing Time (of a multipole switching device)

The interval of time between the instant of the first initiation of an arc and the instant of final arc extinction in all poles.

441-17-39
Break-Time

The interval of time between the beginning of the opening time of a mechanical switching device (or the pre-arcing time of a fuse) and the end of the arcing time.

441-17-40
Make-Time

The interval of time between the initiation of the closing operation and the instant when the current begins to flow in the main circuit.

441-17-41
Closing Time

The interval of time between the initiation of the closing operation and the instant when the contacts touch in all poles

441-17-42
Close-Open Time

The interval of time between the instant when the contacts touch in the first pole during a closing operation and the instant when the arcing contacts have separated in all poles during the subsequent opening operation.

441-17-43
Make-Break Time

The interval of time between the instant when the current begins to flow in a pole and the instant of final arc extinction in all poles, with the opening release energized at the instant when current begins to flow in the main circuit.

441-17-44
Dead Time (during auto-reclosing)

The interval of time between final arc extinction in all poles on the opening operation and the first reestablishment of current in any pole on the subsequent closing operation.

441-17-45
Re-Ignition (of an a.c. mechanical switching device)

A resumption of current between the contacts of a mechanical switching device during a breaking operation with an interval of zero current of less than a quarter cycle of power frequency.

441-17-46
Restrike (of an a.c. mechanical switching device)

A resumption of current between the contacts of a mechanical switching device during a breaking operation with an interval of zero current of a quarter cycle of power frequency or longer.

SECTION 441-18 – FUSES

441-18-01
Fuse

A device that by the fusing of one or more of its specially designed and proportioned components, opens the circuit in which it is inserted by breaking the current when this exceeds a given value for a sufficient time. The fuse comprises all the parts that form the complete device.

441-18-02
Fuse-Base;
Fuse-Mount

The fixed part of a fuse provided with contacts and terminals.

441-18-03[04][05]
Fuse-Base, [Fuse-Link], (Fuse-Carrier) Contact

The contact piece of a fuse-base, [fuse-link], [fuse-carrier] designed to engage with a corresponding part of the fuse.

441-18-06
Isolating Distance (for a fuse)

The shortest distance between the fuse-base contacts or any conductive parts connected thereto, measured on a fuse with the fuse-link or fuse-carrier removed.

441-18-07
Drop-Out Fuse

A fuse in which the fuse-carrier automatically drops into a position providing an isolating distance after the fuse has operated.

441-18-08
Fuse-Element

A part of the fuse-link designed to melt under the action of current exceeding some definite value for a definite period of time.

441-18-09
Fuse-Link

The part of a fuse (including the fuse-element(s)) intended to be replaced after the fuse has operated.

441-18-10
Current-Limiting Fuse-Link

A fuse-link that, during and by its operation in a specified current range, limits the current to a substantially lower value than the peak value of the prospective current.

441-18-11
Expulsion Fuse

A fuse in which operation is accomplished by expulsion of gases produced by the arc.

441-18-12
Enclosed Fuse-Link

A fuse-link in which the fuse-element(s) is (are) totally enclosed, so that during operation within its rating it cannot produce any harmful external effects e.g. due to development of an arc, the release of gas or the ejection of flame or metallic particles.

441-18-13
Fuse-Carrier

The movable part of a fuse designed to carry a fuse-link.

441-18-14
Fuse-Holder

The combination of a fuse-base with its fuse-carrier.

441-18-15
Refill-Unit

A set of replacement parts intended to restore a fuse-link to its original condition after an operation.

441-18-16
Renewable Fuse-Link

A fuse-link that, after operation, may be restored for service by a refill-unit.

441-18-17
Indicating Device;
Indicator

A part of a fuse provided to indicate whether the fuse has operated.

441-18-18
Striker

A mechanical device forming part of a fuse-link which, when the fuse operates, releases the energy required to cause operation of other apparatus or indicators or to provide interlocking.

441-18-19
Striker Fuse

A fuse provided with a striker.

441-18-20
Indicating Fuse

A fuse provided with an indicator.

441-18-21
Pre-Arcing Time;
Melting Time

The interval of time between the beginning of a current large enough to cause a break in the fuse-element(s) and the instant when an arc is initiated.

441-18-22
Operating Time;
Total Clearing Time

The sum of the pre-arcing time and the arcing time.

441-18-23
***I^2t*; Joule Integral**

The integral of the square of the current over a given time interval:

$$I^2t = \int_{t_0}^{t_1} i^2 \mathrm{d}t$$

Notes

1. — The pre-arcing I^2t is the 721 integral extended over the pre-arcing time of the fuse.

2. — The operating I^2t is the I^2t integral extended over the operating time of the fuse.

3. — The energy in joules liberated in one ohm of resistance in a circuit protected by a fuse is equal to the value of the operating I^2t expressed in A^2. s.

441-18-24
***I*²*t* Characteristic**

The value of I^2t under prescribed conditions as a function of prospective current and/or voltage.

Note — The I^2t characteristics generally stated relate to pre-arcing or operating periods.

441-18-25
Time-Current Zone

A zone between the pre-arcing and the operating time-current characteristics determined under prescribed conditions of fuse

441-18-26
Time-Current Zone Limits

Specified limitations for the time current co-ordinates of the time-current zones for standardized fuses.

Note — These limits take into account both manufacturer's tolerances and design deviation between manufacturers. They do not take into account the influence of environmental conditions.

441-18-27
Conventional Non-Fusing Current

A value of current specified as that which the fuse-link is capable of carrying for a specified time (conventional time) without melting.

441-18-28
Conventional Fusing Current

A value of current specified as that which causes operation of the fuse-link within a specified time (conventional time).

441-18-29
Minimum Breaking Current

A minimum value of prospective current that a fuse-link is capable of breaking at a stated voltage under prescribed conditions of use and behaviour.

441-18-30
Arc Voltage (of a fuse)

The instantaneous value of voltage which appears across the terminals of a fuse during the arcing time.

441-18-31
Switching Voltage

The maximum instantaneous value of voltage which appears across the terminals of a fuse during its operation.

Note — The switching voltage may be the arc voltage or may occur during the time of transient recovery voltage.

441-18-32
Overload Characteristics (of a fuse)

Combinations of time and current (in excess of rated current) that a fuse can withstand repeatedly under prescribed conditions of use and behaviour.

441-18-33
Non-Interchangeability

Limitations on shape and/or dimensions with the object of avoiding in a specific fuse-base the inadvertent use of fuse-links having electrical properties other than those ensuring the desired degree of protection.

441-18-34
Homogeneous Series (of fuse-links)

A series of fuse-links, deviating from each other only in such characteristics that, for a given test, the testing of one or a reduced number of particular fuse-link(s) of that series may be taken as representative for all the fuse-links of the homogeneous series.

Note — The relevant publications specify the characteristics by which the fuse-links of a homogeneous series may deviate, the particular fuse-links to be tested and the specific test concerned.

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Amendment 1

International Electrotechnical Vocabulary

Chapter 441:
Switchgear, controlgear and fuses

AMENDMENT No. 1 TO IEV CHAPTER 441: SWITCHGEAR, CONTROLGEAR AND FUSES

SECTION 441-18 – FUSES

Add the following entries:

441-18-35

rated value

a quantity value assigned, generally by the manufacturer, for a specified operating condition of a component, device or equipment [IEV 151-04-03 MOD]

NOTE Examples of rated values usually stated for fuses: voltage, current, breaking capacity.

441-18-36

rating

the set of rated values and operating conditions [IEV 151-04-04]

441-18-37

virtual time (of a fuse-link)

value of $I^2 t$ divided by the square of the value of the prospective electric current

NOTE The values of virtual times usually stated for a fuse-link are the values of pre-arcing time and of operating time.

441-18-38

power dissipation (in a fuse-link) *(to be placed, together with 441-18-39, after 441-18-32 in a future revision of Chapter 441)*

power released in a fuse-link carrying a stated value of electric current under prescribed conditions of use and behaviour

NOTE The prescribed conditions of use and behaviour generally include a constant r.m.s. value of the electric current after steady-state temperature conditions are reached.

441-18-39

acceptable power dissipation (of a fuse-base or a fuse-holder)

stated value of power dissipation in a fuse-link which a fuse-base or a fuse-holder can accept under prescribed conditions of use and behaviour

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This Indian Standard has been developed from Doc No.: ETD 01 (20095).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Published by BIS, New Delhi