AIC (ampere interrupting capacity) - the amount of shortcircuit current safely handled by a circuit breaker or fuse.

air circuit breaker - a circuit breaker normally housed in switchgear, where air is the medium in which circuit interruption takes place.

alternating current - an electric current that reverses direction each half cycle.

ammeter - a divece that measures the magnitude of electric current.

ampacity - the maximum continuous current capacity of an electrical devuce expressed in amperes.

ampere (amp) - a unit of electric current; a measure of the flow (or current) of electrons.

anode - the negatively charged terminal of a primary cell or storage battey.

ANSI-American National Standards Institute.

armature - the moveable part of an electromagnetic device.

automatic transfer switch - equipment for automatically transferring one or more load conductor connections from one power source to another.

BIL rating (Basic Impulse Level) - indicates the ability of electrical equipment to Withstand high-voltage waves often caused by lightning strikes.

bi-metal strip - a fabrication of dissimilar flat metal strips with different coefficients of expansion when heat is applied the strip bends, similar-to thermostat operation.

branch circuit - the last circuit in a distribution system: in a home; leading to outlets: in industry: leading to motors, etc.

brush - a conductor used to maintain an electric connection between stationary and moving parts of a machine or apparatus

bucket (draw-out unit)- a two sided steel drawer that holds electrical components.

bus (busbar)- a copper- or- aluminum conductor- used as a common connector at two or more joints.

bus plug - a device that houses a protective device that attaches to busway.

busbar stabs - attachment points on a busbar that connect the busbar and a branch protector

cable drop - a free-hanging cable, unprotected by conduit and not fixed to a wall or ceiling. Typically dropped from a bus plug to feed a load.

cathode - the positively charged terminal ofa primary cell or storage battery.

center tap box - a tap box installed in the middle of a busway run to serve branch cable circuits.

CFCI (ground fault circuit interrupter)- a device that protects circuits and/or people from faults to ground.

circuit breaker - a device designed to open and close a circuit by non-automatic (manual) means, and to open the circuit automatically on a predetermined overload of current, without injury to itself when properly applied within its rating.

circuit breaker frame - a physical-size designation for a circuit breaker.

circuit overload - an excess current load beyond the ampacity rating of the device.

circuit protection device - a device that automatically disconnects the circuit in the event of an overload or short circuit, (i.e., a circuit breaker or fuse).

closed circuit - an electric circuit without an interruption in the current flow.

closed position - in a disconnect device, a state where the current is flowing without interruption.

conductor - a substance or medium, such as gold, silver, aluminum or copper that has many free electrons allowing electricity to flow very easily.

contactor - a device for- repeatedly establishing and interrupting an electric power circuit; a control device without circuit protection.

control circuit - the circuit that carries the electric signals directing the performance of a control device, but which does not carry the main power circuit.

control devices – individual device used to execute a function.

control relays - relays that open and close circuits in industrial sytems.

convenience receptacle - an outlet for the connection of a single attachment plug.

core - iron laminations in a transformer that provide a path for- the magnetic field produced by the windings.

core and coil transformer - a specific type of transformer that is provided without housing for OEM applications.

coulomb - a unit of energy equivalent to one amp per second passing a point.

current limiting reactor - a coil or winding that limits the current that can flow in a circuit under short-circuit or other operating conditions.

current rating (continuous) - the amount of current a device or busbar can conduct on a continuous basis without exceeding its rated temperature. May or may not equal ampere rating.

current sensor - small, precision internal current transformer used in circuit breakers with solid-state trip systems. Provides low-level analog signals, proportional to primary current, to the breaker's trip system.

cutout - an assembly of a fuse support with either a fuseholder, fuse carrier or disconnecting blade.

cycle – a period of time in which a full set of events takes place. In an AC power system, 60 cycles/sec. or 60 Hertz.

db - refers to transformer- sound ratings; given in decibels.

delta connection - in three-phase transformers, three coils connected in a series to form a triangle, like the Greek Letter “delta”.

delta-wye transformer - a confirmation of prirnay and secondary windings.

direct current (DC) - an electric current flowing in one direction.

disconnect - a device that allows circuits to be manually opened and closed.

disconnect device - an electrical switch that disconnects conductors from their source of voltage.

distribution panelboard - a panelboard in which 10% or less of the branch circuit breakers are rated for 30 amperes or less.

distribution section (feeder section) - a section of switchboard in which the main circuit is subdivided into feeder circuits; also houses disconnect or overcurrent devices.

distribution switchboard - a switchboard that divides the power from the feeder into branch circuits, each with its own power requirements and separate circuit breaker.

distribution transformer - a transformer used for transferring electrical energy from a primary to a secondary distribution circuit or consumer service circuit.

downstream load center- a subpanel to the principal load center.

draw-out unit (bucket)- an electrical assembly such as a circuit breaker- or contactor that is mounted on a sliding rail assembly and disconnects via sliding, spring-loaded members rather- than being "hardwired."

driptight enclosure (NEMA 12)- an enclosure constructed to protect against falling drops of liquid or solid particles: for indoor applications.

dust-tight enclosure (NEMrl 12)- an enclosure constructed so that dust will not enter the enclosing case; for indoor applications.

end box - a box placed at the end of busway to protect the busbar ends.

end tap box – a tap box at the end of busway run trasitioning a cable feed to busway.

energy – a capacity for work or action. Typicalforms of energy are ligt, heat, sound and mechanical.

EPIC MicroVersaTrip® - an integrated protection, power control and information management system based on the MicroVersaTrip RMSS trip system plus a communications link. Used with both AKD-8, low-voltage switchgear and POWER VAC® medium-voltage switchgear.

fast-acting fuse – a fuse that does not contain special time-delay elements.

fault current – an abnormally high current flowing as result of a downstream short circuit.

feeder – a conductor that carries power from the main service to other distribution equipment or to a single large load such as a motor, transformer or run of busway.

Feeder busway – busway section used for transmission runs when no take-off accessories are required.

flux – the rate of flow of energy in a magnetic field.

flux shifter - a device used by GE ED&C in its solid-state trip systems. Uses the low-level trip signal from the microprocessor to unseal an internal permanent magnet, releasing a tripping spring and tripping the breaker. It is powered by output from the breaker phase current transformers and requires no external power source to operate.

force – the capacity to do work or cause change.

full neutral - a neutral cable or bus with current rating equal to phase cable or bus rating.

function keys - both MicroVersaTrip Plus and MictroVersaTrip PM trip systems have four function keys. They are "Function," "Select," "Value" and "Enter." Function keys are used during the three operating modes to enter setpoints, monitor system values view breaker status.

general duty disconnect - a disconnect used in residential and light commercial applications, and rated 240 VAC and/or 250 VAC maximum;

generator - a machine containing a rotating shaft that converts mechanical energy into electrical energy.

ground - a conducting path (accidental or deliberate) through which current is transmitted to the earth. If deliberate, grounding is accomplished by connecting a cable or the third (grounding) wire in a cable between the load device and a metal rod in the earth.

ground fault - a fault between a live conductor and ground or enclosure or conduit.

ground fault - a ground fault is a short circuit between a phase conductor and ground. Some ground faults have high values of current. However, the protective issue is that most ground faults begin as highly destructive, low-level arcing Faults at current levels well below the long-time pickup values of the breakers and cannot be sensed by the overcurrent elements.

ground fault protection - a device designed to monitor current between a live line and ground, and trip when a preset level is exceeded.

heavy duty disconnect - a disconnect of rugged construction designed for use in industrial applications. May be rated 240V or 600 VAC.

Hertz (Wt) - a unit of frequency; one cycle per second equals one Hz.

High-pressure contact switch - a fusible disconnect switch that provides high current-carrying capacity without sacrificing high interrupting fault performance, via Class C current-limiting fuses.

hold-in circuit - a part of a three-wire control that prevents the equipment being controlled from restarting until the start button is pushed again.

horsepower - a unit of power: 33,000 foot-pounds per minute or 550 foot-pounds per second.

hot phase conductor- any ungrounded conductor.

instantaneous pickup - a value of current that will cause the breaker to trip without intentional time delay. All molded and insulated case circuit breakers have an instantaneous pickup.

insulator - materials that have few free electrons such as wood, fiber, plastic, vinyl, glass and paper, and therefore resist the flow of electricity.

interlock - a mechanical or electrical device that ensures that one set of contacts is opened before another is closed.

interrupting capacity- the maximum value of short-circuit current which can be safely interrupted by a circuit breaker or fuse.

interrupting rating- a rating based on the highest current that the device is able to interrupt under the conditions specified.

isolation barrier - an insulator that supports and isolates a busbar and busbar stab from the metal walls of an enclosure.

isolation transformer - a multiple winding transformer with the primary and secondary windings physically separated, which inductively couples its secondary winding to the primary winding.

kilowatt - one thousand watts. allows conduit to be connected to the enclosure.

kVA - refers to power ratings stated in thousands of volt-amperes.

ladder diagram - a control schematic consisting of ladder-like lines.

lighting circuit - the circuit that carries power to lighting devices.

lighting panelboard - a panelboard with individual circuits wired to a single-phase conductor to create 120-volt or 277-volt single-phase circuits; one in which more than 10% of the branch circuit breakers are rated for 30 amperes or less.

limit switches - mechanism for controlling circuits; can be mechanically or pressure-operated as well as photoelectric and proximity types.

line side - terminals for power source connection.

line voltage - the voltage between the lines (phases) of the supplying power system.

liquid crystal display (LCD)- MicroVersaTrip Plus and MicroVersaTrip PM circuit breakers have an LCD display that allows the user to see the protective setpoints, monitor breaker status and circuit values and determine the reason for any protective trip. Liquid crystal displays use low-level electrical energy to block or change the now of light to various segments of a flat panel display. The breaker's microprocessor output functions directly control the data visible on the LCD.

load - the power demand created by electrical devices on a circuit.

load center- a sheet metal or non-metallic enclosure that contains main connections and circuit protective devices for residential applications.

load side - terminals for connecting conductors to the load.

local area network (LAN)- a data exchange and communications link between two or more intelligent devices. A LAN may use a twisted pair of wires (e.g., the MicroVersaTrip PN trip system uses a single twisted pair), coaxial cable or fiber optic cable.

Long-time delay- MicroVersaTrip Plus and MicroVeMTrip PM aip systems include an adjustable time delay for anticipated moderate overloads to prevent nuisance tripping during normal events, such as motor starting.

long-time pickup - the long-time tripping characteristic of a circuit breaker with a solid-state trip system is determined by the rating plug ampere rating. plus any adjustment afforded by the design of the trip system. This becomes the breaker's ampere rating. When the sustained rms current of any phase exceeds the long-rime pickup value, the breaker will eventually trip.

low voltage power circuit breaker - a switchgear iron-frame air circuit breaker used in industrial and utility applications of 600 volts or less.

lug - a cable fitting attached to the line or load side of a breaker or disconnect.

main circuit - the circuit in a distribution system that carries the largest current load.

main circuit breaker load center - a load center that uses a circuit breaker as the main disconnect.

main disconnect - a disconnect that feeds all other devices.

main lug load center - a load center containing line lugs rather than a main circuit breaker or fuses.

main lugs - connection devices used to accept line side cables.

manual motor starter - a manual device consisting of a start/stop switch and a thermal overload relay, used to start and stop a motor.

manual switch - a manual device for opening and closing contacts.

mass - a unified body of matter.

metal clad switchgear (medium voltage)- medium-voltage circuit breakers inside an enclosure built to specified standards; serves as a distribution assembly.

meter center - an enclosure that contains utility metering equipment as well.as distribution and circuit protective devices; used in multi-family and apartment applications.

meter socket -jaws that hold the terminals of a plug-in watthour meter.

microcomputer - a small computer built around a microprocessor.

microprocessor - a miniature computing integrated circuit chip that

processes all input data (e.g. current), makes all necessary computations (e.g., rms current values), compares actual current values against stored tripping instructions, outputs breaker trip signals when required and displays breaker trip and status data when possible.

modem - an abbreviation for modulator-demodulator. A device that converts and processes digital data (e.g., from a breaker with a MicroVersaTrip® PM trip unit) for transmission to another device via a phone line or some other communications link. Modems also convert and process incoming data or commands received through the same communications link (e.g., to a breaker with a MicroVersaTrip PM trip unit).

momentary contact push button - in both normally opened and normally closed push buttons, the effect of pushing the button lasts only as long as the button is held down.

motor circuit contactor - a heavy-duty relay rated for the high currents used in industrial motor applications.

motor circuit- the circuit that carries power to a motor.

motor starter - a device used to start and stop motors; includes a switch or relay and an overcurrent protection device.

multitasking - a computer with an operating system designed for simultaneous use by more than one party with independent access to and use of all computer functions.

MVA - refers to power rating stated in millions of volt-amperes.

NEMA - National Electrical Manuf~icturers Association.

NEMA 1 enclosure (general purpose)- an enclosure rated for standard indoor general-purpose applications.

NEMA 12 enclosure (oil and dust-tight)- intended for indoor use to provide protection against dust, falling dirt and dripping, non-corrosive liquids.

NEMA 2 enclosure (drip-proof) - an enclosure designed to be used indoors where dripping water or falling dirt may be present.

NEMA 3R enclosure (weather-resistant) - an enclosure designed for semi-protected, outdoor applications to provide a degree of protection against rain, sleet and external ice formation.

NEMA 4 enclosure (water-tight) - an enclosure specified anywhere non-corrosive fluids are moved in large quantities or hoses are present

neutral bus - in 3 phase 4 wire service, or in single-phase 3 wire service, a neutral bus can be located adjacent to the horizontal ground bus and is generally rated at one-half the main bus ampere rating or "full neutral," the same as the main power bus. The neutral carries the single-phase currents back to the source.

neutral current sensor - when ground fault protection is ordered, a neutral current sensor is required for all single-phase three-wire and three-phase four-wire power systems (e.g., 480Y/277 Vac or 600Y/347 Vac). A neutral current sensor is a special current transformer whose secondary outputs are compatible with the MicroVersaTrip Plus and MicroVersaTrip PM breaker phase current sensors. The neutral current sensor accounts for neutral current which would otherwise appear as ground fault current.

neutral lead - a fourth lead added at thejunction of the three coils of the wye winding.

non-fusible disconnect- a disconnect device without fuses.

normal closed push button contacts - contacts which permit current to flow through a circuit unless the button is pushed.

normal opened push button contacts - contacts which prevent current from flowing through a circuit until the button is pushed.

off position - when a device's moveable contact or blade is not in contact with the Stationary contact

Off-set - one of a series of premeasured and preassembled parts of busway that allow shifting of the busway up or down and left or right.

Ohm's law- the relationship of voltage to current tamps) and resistance (ohms) in an electric circuit.

on position - moving a disconnect to the on position, allows a completed circuit and enables current to flow from the line to the load.

open circuit - an electric circuit with an interruption in the current flow.

open position - in a disconnect device, a situation where current cannot flow.

operating current rating - see current rating.

operating modes - MicroVersaTrip Plus and MicroVersaTrip PM trip systems have three operating modes: 1) Setup - the initial programming of the breaker's protective functions; 2) Metering - monitoring phase current (and other system values in a MicroVersaTrip PM system); 3) Status - special displays before and after the operation of a protective function.

operating system - the internal information handling system of any computer. The operating system defines how the computer receives, stores, processes and outputs data. IBiM-type personal computers generally use DOS® or OS/2® systems, and multitasking minicomputers frequently use VMS® or UNIX® systems. peer-to-peer communications - communications capabilities between two intelligent devices in two different systems.

over travel - the brief, but continued movement of the operating arm in a limit switch after the contacts are closed.

overcunrent protective device - a device to protect circuits from overload and short-circuit currents.

overcurrent - any current in excess of the rated current of equipment or the ampacity of a conductor.

overload - loading in excess of the normal rated capacity of a circuit.

panelboard - one or more panel units assembled in a single enclosure and used as the service for medium-duty commercial and industrial applications; handles current levels to 1,200 amperes.

parallel circuit- a circuit in which current divides in its flow from one **point** to another.

personal computer (PC)- a computer designed for use by a single user. Personal computers are generally single-task devices.

phase unbalance - uneven current flow in a multi-phase circuit.

pilot light - indicates whether or not a device is energized.

plug-in busway - busway with conveniently spaced plug outlets for installing bus plugs; allows the connection of new equipment or circuitry.

pole - in a disconnect device, a hinged, moveable contact resembling a knife blade; in a circuit breaker, the number of ungrounded conductors the breaker will handle.

power - the rate at which work is done; measured in units such as watts or horsepower.

POWER LEADER™ - an integrated protection, power system control and information management system based on the use of the MicroVersaTrip PM trip system. Incorporates remote programming, complete power system monitoring and event reporting, metering and protective relaying.

primary coil - the transformer coil connected to the power source.

primary switch - a switch feeding the primary or line side of a transformer.

programmable logic controller (PLC)- a broad family of industrial microcomputers designed to interface directly with external industrial control input and output devices such as push button switches, relay contacts, relay and starter coils.

protective equipment - the envelope containing circuit breakers or fusible devices.

protective relays - MicroVersaTrip PM trip systems offer five optional protective relay functions. They are voltage unbalance, current unbalance, overvoltage, undervoltage and power reversal. Each relay function has a wide range of pickup and discrete--not inverse--time delay settings. Any or all five of these functions can be enabled when the relay option is ordered.

pull section (modular metering)- an area in a meter center which houses lugs for connecting to the utility feed.

pull section (switchboard) - optional section of a switchboard used to accommodate underground entrances of utility service.

rating plug - a plug-in, scaling and current-rating device used in conjunction with some solid-state trip systems. short-time 1^2t delay- a function furnished with breakers containing adjustable short-time pickup and delay. When energized, it adds more delay via an Pt "ramp" to the intersection of short-time pickup and short-time delay, improving coordination with downstream fuses or thermal magnetic protective

devices. short-time pickup - short-time overcurrents are high values of phase overcurrent that may be normal, such as motor locked-rotor current, or may be abnormal (i.e., fault) conditions. Adjustable short-time pick-up settings are optional for MicroVersaTrip Plus and MlicroVersaTrip PM trip systems.

recording instrument - a device that makes a graphic record of the value of one or more quantities as a function of another variable, such as time.

rectifier - a converter that changes alternating to direct current.

relay- a device used to open or close contacts either automatically or by remote control.

residual magnetism - magnetism that is retained after an electromagnet's current is shut off.

resistance - the characteristic of a substance that inhibits the flow of electrons.

reverse current- current that flows in reverse of its normal flow.

riser- a vertical busbar.

schematic - the electrical blueprint of the components in an electrical circuit.

secondary coil - the transformer coil connected to the load.

secondary distribution switchboard - a switchboard fed by the secondary of a power transformer.

series circuit - a circuit in which the same current passes through each device in a series.

series connected rating - a rating based on the tested interrupting capacity of a combination of main and branch breakers.

series connection - the arrangement of cells in a battery made by connecting the positive terminal of each successive cell to the negative terminal of **the next** adjacent cell so that their voltages are additive; or in equipment, the connection of a main breaker feeding a branch breaker.

service entrance - the point inside a building where a utility's power supply is connected to the building's electrical distribution system.

service section - that portion of a switchboard into which the main service enters; also may include provisions for metering, disconnect and overcurrent protection devices.

sheet metal enclosure - a metal box shaped to hold a variety of electrical distribution devices.

short circuit- an unintentional connection between two elements in an electric circuit that allows current to flow in unintended paths.

short circuit duty current rating - a rating that specifies the maximum short circuit current level that a protector must withstand without damage if a fault occurs.

short-time pickup delay- short-time pickup delays permit the breaker to carry overcurrents higher than short-time pickup values for short periods of time (e.g., from 0.15 to 0.43 seconds). Short-time pickup delays are adjustable, and are designed to permit the breaker either to carry normal overcurrents such as magnetic inrush currents (motors and transformers), or to permit a downstream device to clear a fault before the breaker does. Short-time delay is standard on breakers with a short-time pickup function. (See also short-time I^2t delay.)

shunt trip roil - a device that, when energized, trips the breaker and opens the circuit.

single pole double throw (SPDT) - a disconnect with one pole and one positions.

single-phase circuit- an alternating-current circuit with two conductors.

solenoid - an electromagnet with wire coil and metal core.

solid state programmer - an electronic current-sensing device.

Spectra RMS trip system - a solid-state trip system using interchangeable rating plugs, adjustable instantaneous overcurrent trip setpoint and a non-adjustable short-time tripping characteristic which tracks the instantaneous setpoint adjustment

Spectra RMS™ breakers - GE ED&C's trade name for a family of molded case circuit breakers with one of three solid-state nip systems: 1) basic Spectra RMS, 2) MicroVersaTrip® Plus and 3) MicroVersaTrip® PM.

splice-bar joint - a busway connection that uses busbars cut and shaped to connect end to end.

split-ring commutator - a commutator that produces direct current by causing the armature brush to make contact for only one half of the cycle.

splits - units of one, two or three vertical sections of a motor control center or switch-board packaged for shipping.

starting currents - a typically high initial flow of current in AC motors.

stationary contact - part of an electrical device that completes the circuit in conjunction with a moveable contact.

stepdown - a power transformation from a higher to a lower voltage.

stepdown transformer - a transformer with a turns ratio-where the primary turns outnumber the secondary turns, resulting in decreased voltage.

stepup - a power transformation from a lower to a higher voltage.

stepup transformer - a transformer with a turns ratio where the secondary turns oumumber the primary turns, resulting in increased voltage.

storage battery- a rechargeable eletrochemical cell, using lead-acid or nickel-cadmium, or other materials.

straight section - one of a series of premeasured and preassembled parts of a busway.

Sub-feed lug configuration - a panelboard design in which the double main lug is attached to the main feed end of the busbars on the first panelboard.

Sub-feeder- a secondary feeder.

substation - a group of equipment for switching power circuits and to transform power from one voltage to another.

subsystem - a part of a system containing two or more integrated components which do not fully perform the specific function of a system but can be isolated for design, test or maintenance.

switch - a device used to break, or open, an electric circuit.

switch contacts - see contacts.

switchboard - a sheet metal enclosure that contains distribution and control devices; performs similar functions to load centers and panelboards.

tap - an available connection that permits changing the active portion of a device in a circuit. tap boxes - an interchange between the busway, cable and conduit serving anything from a local circuit to a single machine.

target- a visual indication that a circuit breaker has nipped. The targets of MicroVersaTrip Plus and MicroVersaTrip PM circuit breakers also indicate the trip reason with words or symbols such as "Overload," "Short Circuit" and "GF." Targets for protective relays use abbreviations such as "PR" and "OV" coupled with "Overload."

tee - one of a series of premeasured and preassembled parts of busway

terminal - the conducting element of a circuit intended for connection to an external conductor.

terminal block - an insulating base with terminals for connecting secondary and control wiring.

Terminal lug – see terminal.

thermal damage - during a short-circuit and breaker coordination study, the responsible elecnical consulting engineer will plot time versus current thermal damage curves for conductors and various items of load equipment (e.g., motors, transformers). Values of current and time in excess of the thermal damage cun~e may cause irreversible damage to the affected conductor or other equipment. It is that engineer's responsibility to be sure that the circuit breaker or some other device (e.g., a motor starter) will clear the circuit during overcurrent conditions before thermal damage occurs.

thermal overload relay- a heat-activated circuit protector; cuts current automatically in the event of a circuit overload by causing the starter to open. **Thermostat -** a temperature operated switch.

three phase motor circuit- an alternating current circuit with three ungrounded conductors.

three pole switches - switches that must open and close three ungrounded conductors simultaneously.

three step distribution system - a system containing a main circuit and Feeder, subfeeder and branch circuits.

three wire control - a motor control with two momentary contact push buttons.

through-feed lug - in a main breaker panelboard, these lugs are mounted on the phase bus at ends opposite the main breaker and feed a second panelboard section.

thru-bolt joint - a connector using a single thru-bolt with a belleville spring washer, used to connect busway sections end to end.

time delay fuse - a fuse that allows a disconnect to handle high starting current for a short period of time.

torque - a form of energy created by a turning or twisting force, such as in an electric motor.

tracking short-time - standard Specna RMS circuit breakers have a tracking short-time tripping characteristic which depends on the breaker's frame current rating, the rating-plug ampere value and the instantaneous uip setpoint.

transfer switch - permits the transfer of a conductor connection from one circuit to another.

transformer - a device used to raise or lower the voltage in an electrical distribution system.

transmission voltage - voltage at which power is carried over a long distance.

trip system - an assembly used to provide the circuit breaker's overcurrent detection and measuring circuiuy coupled with the mechanical, electromechanical, electromagnetic or electronic means of tripping the breaker.

trip unit - R-frame molded case, Power Break®, Type AKR and POWER VAC® circuit breakers package MicroVersaTrip Plus and MicroVersaTrip PM trip systems into physically discrete units, or "trip units." Spectra RMS breakers through SK-Frame physically integrate their trip system within the breaker assembly. Trip units cannot be removed from the Spectra RMS breaker.

trip unit disconnect - R-frame molded case, Power Break and Type AKR breakers with discrete MicroVersaTrip Plus or MicroVersaTrip PM trip units use a 36 pin plug at the rear of the trip units for all control, power and communication interconnections. This 36 pin plug is called the "trip unit disconnect."

turns - coils in the winding of a transformer.

turns ratio - the relationship of the number of loops in the primary coil to the number of loops in the secondary coil in a transformer.

TVRMS test kit - test kit for MicroVersaTrip RMSS, MicroVersaTrip Plus and MicroVersaTrip PM trip systems. Is also used to power up displays for setting values or reading trip targets.

two pole switch - a switch with two sets of contacts.

two wire control - a control circuit consisting of one wire on either side of the push button contacts.

unit substation - a substation consisting of one or more transformers connected mechanically or electrically with switchgear at the same location.

vacuum circuit breaker- a breaker whose contacts interrupt a circuit in a vacuum.

vertical sections - an independent unit of a motor control center or switchboard containing busbars, plug-in motor starters, and related auxiliary control devices.

volt - the International System unit of electric potential and electromotive force, equal to the difference of electric potential between two points on a conducting wire carrying a constant current of one ampere when the power dissipated between the points is one watt.

voltage module - all MicroVersaTrip PM trip systems require an external voltage module. The voltage module provides signal conditioning of the individual phase voltage inputs to the breaker's microprocessor. In addition, the voltage module provides a source of +24 Vdc control power to energize the breaker's LCD display.

voltage rating-voltage that can be applied to an electrical device; may be nominal or maximum value.

voltmeter - an instrument for measuring voltage.

water-tight motor control enclosure (NEMA 4)- an enclosure designed for locations with large quantities of liquids or where hosedown may occur.

watt - a unit of electric energy in the International System equal to one joule per second.

Watt hour - a unit of electric energy equal to the energy of one watt acting for one hour; equivalent to 3,600 joules.

Watt hour meter - a device mounted outside a building that measures kilowatt (energy) usage.

weather-resistant motor control enclosure (NEMA 3R)- constructed with solid steel bottoms and tops and an overhanging sloping roof to protect components from wind, rain, snow and dust.

winding (primary) - a coil of wire wound around one side of a transformer core which receives the incoming AC power.

winding (secondary) - a coil of wire wound around one side of a transformer core which connects to the outgoing load.

wireway- a sheet metal trough that routes and protects electric wires and cable.

work - the effect of a force on a mass.

wye connection - in three-phase transformers, three coils with one lead from each joined at the center to form the letter "k:" This center position is the neutral conductor.

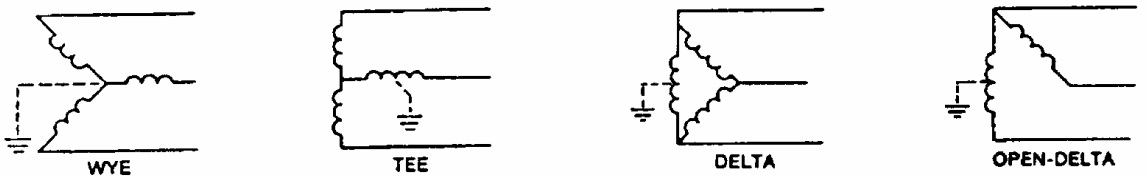
معلومات فنيـــــة

TECHNICAL DATA

Voltage
Equipment are applied in systems whose voltage does not exceed the equipment rating. Principal transformer secondary connections to supply the system voltages are:

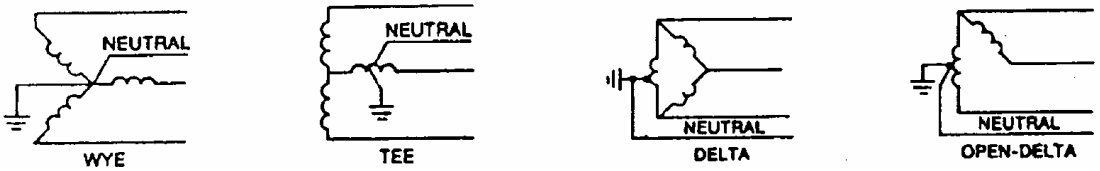
Single-phase Systems

Three-phase Three-wire Systems

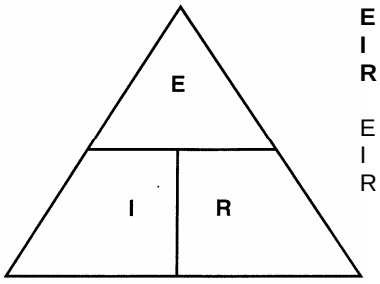


Note in delta connections the ground may be connected as shown if midpoint available,

Three-phase Four-wire Systems



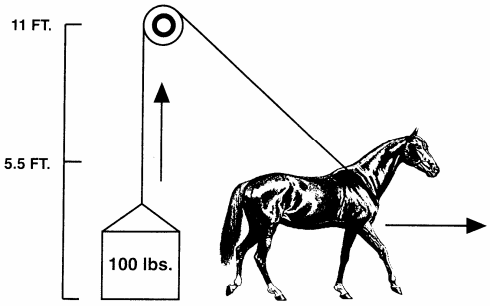
OHM'S LAW



E = IR
I = E/R
R = E/I

E = Voltage
I = Current (amps)
R = Resistance (ohms)

Ohm's Law:
- Voltage equals amps times ohms – E = IR
- Amps equal Volts divided by ohms – I = E/R
- Ohms equal volts divided by amps – R = E/I



If the horse lifts the load 5.5 ft. in one second, it will have generated one horsepower.
100 lbs. x 5.5 ft. = 550 ft-pounds = 1HP
1 sec. 1 sec.
If it lifts the same load 11 ft. in one second, it will have generated two horsepower.
100 lbs. x 11 ft. = 1,100 ft-pounds/sec. = 2HP
550 ft-pounds/sec.

- Work involves moving an object over a distance.
- 100 lbs. Lifted 10 ft. equals 1,000 ft-pounds of work.
- Power defines work performed in a given time period.
- One horsepower equals 350 ft-pounds per second.

Electrical Formula-For Obtaining kW, kVA, Hp, and Amps

Wanted	Single-phase	Three-phase
Kilowatts (KW)	$\frac{I \times E \times PF}{1000}$	$\frac{I \times E \times 1.73 \times PF}{1000}$
KVA	$\frac{I \times E}{1000}$	$\frac{I \times E \times 1.73}{1000}$
Horsepower (HP)	$\frac{I \times E \times \% EH. \times PF}{746}$	$\frac{I \times E \times 1.73 \times \% EH. \times PF}{746}$
Amps from KVA	$\frac{KVA \times 1000}{E}$	$\frac{KVA \times 1000}{1.73 \times E}$
Amps from KW	$\frac{KW \times 1000}{E \times PF}$	$\frac{KW \times 1000}{1.73 \times E \times PF}$
Amps from Horsepower	$\frac{HP \times 746}{E \times \% Eff. \times PF}$	$\frac{HP \times 746}{1.73 \times E \times \% Eff. \times PF}$

E = Volts I = Amps % Eff. = Percent Efficiency PF = Power Factor

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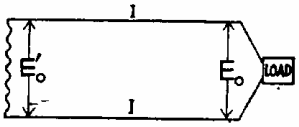
LINE CURRENT AND VOLTAGE DROP

In the following formulas for line current and voltage drop, the meaning of most of the symbols will be found on the circuit diagrams. For completeness, they are also defined here. It should be emphasized that the letter E with subsscripts is always used to designate a circuit voltage. The primed values describe sending end conditions; and unprimed values, receiving end conditions. The letter V with subscripts always signifies a voltage drop.

Let I = line current, amps.
E'_o, E_o = sending and receiving end voltages to neutral, volts
E'_l, E_l = sending and receiving end voltages between lines, volts
E'_p, E_p = sending and receiving end voltages per phase, volts
$V_o = E'_o - E_o$ = voltage drop to neutral, volts
$V_l = E'_l - E_l$ = voltage drop between lines, volts
$V_p = E'_p - E_p$ = voltage drop per phase, volts
R = D. C. or A. C. resistance of line, ohms per 1000 ft. per conductor
X = 60 cycle Reactance of line, ohms per 1000 ft. per conductor
Z = 60 cycle Impedance of line, ohms per 1000 ft. per conductor
l = length of line, feet
W = watts delivered
$p.f.$ = cos θ = power factor of load
θ = power factor angle of load

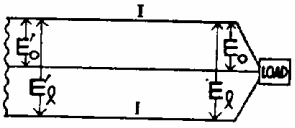
D. C. — 2 WIRE



$$I = \frac{W}{E_o} \text{ amps.}$$

$$V = E'_o - E_o = \frac{I \times R \times 2\,l}{1000} \text{ volts drop}$$

D. C. — 3 WIRE — BALANCED LOAD

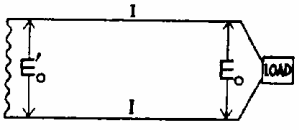


$$I = \frac{W}{2\,E_o} = \frac{W}{E_l} \text{ amps.}$$

$$V_o = E'_o - E_o = \frac{I \times R \times l}{1000} \text{ volts drop to neutral}$$

or $$V_l = E'_l - E_l = \frac{I \times R \times 2\,l}{1000} \text{ volts drop between lines}$$

A. C. — SINGLE PHASE — 2 WIRE

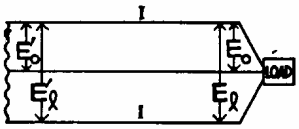


$$I = \frac{W}{E_o \times p.f.} \text{ amps.}$$

$$V_o = E'_o - E_o = [\sqrt{(E_o \cos\theta + IR)^2 + (E_o \sin\theta + IX)^2} - E_o] \times \frac{2\,l}{1000} \text{ volts drop}$$

$$= \frac{I \times Z \times 2\,l}{1000} \text{ volts drop (approx.)}$$

A.C. - THREE-PHASE - 3 WIRE - BALANCED LOAD



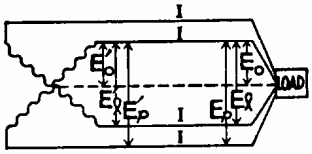
$$I = \frac{W}{2\,E_o \times p.f.} = \frac{W}{E_l \times p.f.} \text{ amps.}$$

$$V_o = E'_o - E_o = [\sqrt{(E_o \cos\theta + IR)^2 + (E_o \sin\theta + IX)^2} - E_o] \times \frac{l}{1000} \text{ volts drop to neutral}$$

$$= \frac{I \times Z \times l}{1000} \text{ volts drop to neutral (approx.)}$$

$$V_l = E'_l - E_l = \frac{I \times Z \times 2\,l}{1000} \text{ volts drop between lines (approx.)}$$

A. C. — TWO-PHASE — 4 OR 5 WIRE — BALANCED LOAD



$$E_o = \frac{1}{\sqrt{2}} E_l = \tfrac{1}{2} E_p$$

$$I = \frac{W}{4\,E_o \times p.f.} = \frac{W}{2\sqrt{2}\,E_l \times p.f.} = \frac{W}{2\,E_p \times p.f.} \text{ amps.}$$

$$V_o = E'_o - E_o = [\sqrt{(E_o \cos\theta + IR)^2 + (E_o \sin\theta + IX)^2} - E_o] \times \frac{l}{1000} \text{ volts drop to neutral}$$

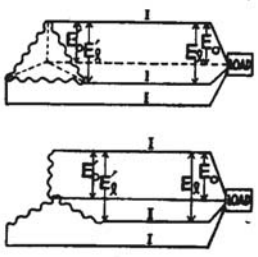
$$= \frac{I \times Z \times l}{1000} \text{ volts drop to neutral (approx.)}$$

$$V_l = E'_l - E_l = \frac{I \times Z \times \sqrt{2}\,l}{1000} \text{ volts drop between lines (approx.)}$$

$$V_p = E'_p - E_p = \frac{I \times Z \times 2\,l}{1000} \text{ volts drop per phase (approx.)}$$

When the line supplies a balanced load, the neutral wire carries no current. Therefore, the formulas are the same whether there is a neutral wire or not (4 or 5-wire circuit).

A.C. - THREE-PHASE - 3 or 4 WIRE - BALANCED LOAD



$$E_o = \frac{1}{\sqrt{3}} E_l$$

$$I = \frac{W}{3\,E_o \times p.f.} = \frac{W}{\sqrt{3}\,E_l \times p.f.} \text{ amps.}$$

$$V_o = E'_o - E_o = [\sqrt{(E_o \cos\theta + IR)^2 + (E_o \sin\theta + IX)^2} - E_o] \times \frac{l}{1000} \text{ volts drop to neutral}$$

$$= \frac{I \times Z \times l}{1000} \text{ volts drop to neutral (approx.)}$$

$$V_l = E'_l - E_l = \frac{I \times Z \times \sqrt{3}\,l}{1000} \text{ volts drop between lines (approx.)}$$

When the line supplies a balanced load, the neutral wire carries no current. Therefore, the formulas are the same whether there is a neutral wire or not (3 or 4-

Voltage Drop

The tabulated voltage drop values are based on a load power factor of 85% lagging and given for a current of a one meter run. For any given cable length, the values should multiplied by the length(in meters) and by the current (in amperes) that the cables are to carry.

EXAMPLE

Consider a length of 150 meters of three core, PVC insulated (rated 85°C) PVC sheathed to be installed in air, and to carry 100 amps load, the supply voltage is 380 volt, 3-phase system, 60 Hz.
The formula applicable is the following:

$$Vap = \frac{Vp \times 1000}{1 \times L}$$

Where
I = Current in Amperes
L = Route length in meters
Vap = Approximate voltage drop/ampere/meter
Vp = Maximum permissible voltage drop (say 2.5% of 380 volts)
By substituting current, route length and maximum permissible voltage drop,

$$Vap = \frac{9.5 \times 1000}{100 \times 150} = 0.63 \text{ mV}$$

To determine a suitable size of conductor, select a cable from table attached such that the voltage drop value from this column is less than the calculated value of 0.63. Also ensure that it will carry the desired current. For this example, the nearest voltage drop is 0/58 mV corresponding to size 70 mm².
In situations where the load power factor is other than 85% lagging, the following equations should be used to calculate the voltage drop.

Single phase system

V = 2 x (Rac. Cos ئ + XL. Sin ئ)

Three phase system

V = √3 x (Rac. Cos ئ + XL. Sin ئ)

where V = Voltage drop volt/amp/meter
XL = Inductive reactance of cable Ohm/meter
Cosئ= Power factor of load
Rac. = A.C. resistance of conductor at maximum conductor temperature Ohm/meter

Approximate voltage drop at 60 Hz for stranded copper conductors, 600/1000 volts

m V / amp / meters

Nominal area of conductor mm²	PVCinsulation PVC sheath			XLPE Insulation		PVC sheath
	1core		3 core	1core		3 core
	PVCrated 85°C		PVC rated 85°C			
	Flat	Trefoil		Flat	Trefoil	
1.5	22.60	22.50	22.50	22.90	22.80	22.80
2.5	13.90	13.80	13.80	14.10	14.10	14.00
4	8.70	8.60	8.60	8.80	8.80	8.70
6	5.90	5.80	5.80	5.90	5.90	5.90
10	3.30	3.50	3.50	3.60	3.60	3.50
16	2.30	2.20	2.20	2.30	2.30	2.20
25	1.50	1.40	1.40	1.50	1.50	1.50
35	1.10	1.10	1.10	1.10	1.10	1.10
50	0.83	0.82	0.80	0.84	0.83	0.81
70	0.61	0.60	0.58	0.61	0.60	0.58
95	0.47	0.45	0.44	0.47	0.48	0.44
120	0.39	0.38	0.37	0.39	0.38	0.37
120	0.34	0.33	0.32	0.34	0.33	0.31
185	0.29	0.28	0.27	0.29	0.28	027
240	0.26	0.24	0.23	0.25	0.24	0.23
300	0.22	0.21	0.20	0.22	0.21	0.20
400	0.20	0.18	0.18	0.19	0.18	0.18
500	0.18	0.17	0.15	0.17	0.16	0.16
630	0.16	0.16		0.16	0.15	

Current Carrying Capacities

General

Current carrying capacities have been calculated in accordance with IEC 287: 1982 Calculation of the continuous current rating of cables. The values given in the tables are valid for one circuit in a three-phase system under conditions specified below.

For the grouping of cable derating factors must be used.
The construction of all PVC and XLPE cables is based on IEC 502 with the exception of single-core PVC insulated non-sheathed cables (bulding wire) which conform to Saudi Arabian Standards SSA 55/1977. As a base for calculations, the practical constructional data and tolerances is used which may slightly vary from manufacturer to manufacturer.

All conductor data is based on IEC 228 cl.2. The conductors of single-core cables 25mm² and above have sectoral conductors.

It is to be observed that, the current carrying capacities are intended as a guide to assist operating engineers in selecting cables for safety and reliability.

The current capacities are in no sense guaranteed values.

Basic Assumptions and conditions of installation

Ambient ground temperature..... 35°C
Ambient air temperature..... 35°C
Depth of Cable burial ..... 35°C
Thermal resistivity of soil ..... 35°C

Cables in air are assumed to be protected from direct solar radiation.

Single Core Cables

Install as indicated in the tables. Spacing between cables in flat formation is assumed to be one cable diameter.

Three and Four-Core Cables

It is usual to assume the same current capacity for four-core cables as foe three-core cables (See also VDE 0298). Calculated values are based actually on three-core cables. These values are suitable with enough accuracy also for four-core cables in most cases.

Cables in ducts or pipes

The term “ducts” applies to earthen-ware material having thermal resistivity 1.2K.m/W.
The term “pipes” applies to fiber material having thermal resistivity 4.8 K.m/W. The tables are sufficiently accurate also for metal, concrete or asbestos ducts/ pipes except that in case of single-core cables in AC systems, ferrous ducts or pipes shall not be used.
The dimensions of ducts or pipes are assumed as follows:

Cable diameter	Ducts or pipes diameter	
	Inside	Outside
mm	mm	mm
Upto and including 65	100	130
Above 65	125	160

The above duct/pipe dimensions have been the basis for calculation mainly in order to conform with international practice. However, in actual installations the more realistic approach will be inner diamete of duct/pipe approximate 1.5 times diameter of cable.

Current Carrying Capacities for copper Conductor Cables										PVC Insulated and PVC Sheathed 600 / 1000 V					
	Single Core								Three & Four Core						
	Conductor	Resistance	In ground			In air			Conductor Resistance	In ground			In air		
Cross section area of conductor	AC 85°C In flat formation	AC 85°C In trefoil formation	Direct Laid	Direct Laid	In ducts	Free	Free	In pipes	AC at 85°C	Unarm oured		Armoured	Unarm oured		Armoured
										Direct Laid	Laid in ducts	Direct Laid	Free	In pipes	Free
mm^2	Approx. Ohm/km	Approx. Ohm/km	Approx. Amps	Approx. Amps	Approx. Amps	Approx. Amps	Approx. Amps	Approx. Amps	Approx. Ohm/km	Approx. Amps	Approx. Amps	Approx. Amps	Approx. Amps	Approx. Amps	Approx. Amps
1.5	15.2000	15.2000	29	28	21	25	21	18	15.2000	24	20		20	17	
2.5	9.3000	9.3000	38	37	28	33	27	23	9.3000	32	27		27	22	
4	5.7900	5.7900	49	48	36	45	37	31	5.7900	42	35	42	36	29	36
6	3.8700	3.8700	52	59	45	57	46	38	3.8700	52	44	52	45	37	45
10	2.3000	2.3000	82	79	61	78	63	52	2.3000	70	58	70	61	50	62
16	1.4400	1.4400	106	102	78	103	84	68	1.4400	91	75	90	82	65	82
25	0.9130	0.9130	136	130	101	136	110	88	0.9130	117	97	121	107	84	114
35	0.6580	0.6580	163	156	122	167	135	107	0.6580	146	118	145	131	101	135
50	0.4870	0.4870	193	185	145	204	165	129	0.4870	174	141	172	161	122	165
70	0.3370	0.3370	238	227	179	259	209	161	0.3370	213	173	210	202	152	206
95	0.2430	0.2440	285	271	217	321	259	197	0.2440	255	208	252	249	185	252
120	0.1930	0.1940	326	309	247	374	301	226	0.1940	291	237	288	289	213	291
150	0.1570	0.1580	365	346	278	428	345	257	0.1580	327	268	319	332	243	331
185	0.1260	0.1270	414	390	315	495	399	293	0.1270	368	303	358	381	277	377
240	0.0965	0.0984	481	450	366	591	474	344	0.0982	426	352	409	451	325	439
300	0.0777	0.0801	544	506	413	684	547	391	0.0798	479	397	455	517	370	497
400	0.0619	0.0649	621	572	468	798	633	447	0.0644	544	452	504	601	426	585
500	0.0496	0.0532	706	641	526	929	728	507	0.0526	610	617	553	687	492	630
630	0.0401	0.0446	805	716	588	1090	835	572							

Current Carrying Capacities for copper Conductor Cables										XLPE Insulated and PVC Sheathed 600 / 1000 V					
	Single Core								Three & Four Core						
	Conductor	Resistance	In ground			In air			Conductor Resistance	In ground			In air		
Cross section area of conductor	AC 90°C In flat formation	AC 90°C In trefoil formation	Direct Laid	Direct Laid	In ducts	Free	Free	In pipes	AC at 85°C	Unarm oured		Armoured	Unarm oured		Armoured
										Direct Laid	Laid in ducts	Direct Laid	Free	In pipes	Free
mm^2	Approx. Ohm/km	Approx. Ohm/km	Approx. Amps	Approx. Amps	Approx. Amps	Approx. Amps	Approx. Amps	Approx. Amps	Approx. Ohm/km	Approx. Amps	Approx. Amps	Approx. Amps	Approx. Amps	Approx. Amps	Approx. Amps
1.5	15.4000	15.4000	31	30	22	27	22	19	15.4000	27	22		22	18	
2.5	9.4500	9.4500	40	39	29	36	29	24	9.4500	35	29		29	24	
4	5.8800	5.8800	52	50	38	47	38	32	5.8800	45	37	46	38	31	39
6	3.9300	3.9300	65	63	47	60	49	40	3.9300	58	46	57	48	39	50
10	2.3300	2.3300	87	83	63	82	66	54	2.3300	76	62	76	67	52	87
16	1.4700	1.4700	112	107	82	109	88	70	1.4700	98	80	98	88	68	89
25	0.9270	0.9270	144	137	105	145	116	92	0.9270	128	104	128	118	90	120
35	0.6680	0.6680	172	165	127	178	143	112	0.6680	157	125	158	142	107	149
50	0.4940	0.4940	204	195	151	218	175	134	0.4940	187	149	188	175	129	182
70	0.3420	0.3430	251	238	187	277	222	168	0.3430	229	183	229	220	161	229
95	0.2470	0.2480	301	286	225	344	274	205	0.2480	276	220	274	272	196	280
120	0.1960	0.1970	345	327	258	409	326	237	0.1970	313	251	310	316	226	622
150	0.1590	0.1600	385	363	290	461	367	269	0.1600	350	283	346	363	258	368
185	0.1280	0.1290	436	410	330	534	425	308	0.1290	395	321	387	418	295	420
240	0.0980	0.1000	507	474	382	638	505	361	0.0998	458	372	444	196	346	491
300	0.0790	0.0815	573	532	431	740	583	411	0.0812	516	420	494	571	394	557
400	0.0629	0.0661	654	600	489	865	676	469	0.0656	584	478	549	665	454	636
500	0.0504	0.0543	744	673	550	1009	779	533	0.0536	655	538	597	760	515	705
630	0.0407	0.0453	847	752	615	1184	900	603							

Rating Factors for low voltage Cables

If the site conditions are not the same as the same standard condition for which the ampacities are evaluated, the current ratings in tables above are to multiplied by the appropriate rating factors given below.

Rating factors for variation in ground temperature

Ground temp. (°C)	25	30	35	40	45	50	55
XLPE insul. cables	1.09	1.04	1.00	0.95	0.90	0.85	0.80
PVC (rated 85 °C) cables	1.10	1.05	1.00	0.95	0.90	0.84	0.77
PVC (rated 70 °C) cables	1.13	1.07	1.00	0.95	0.90	0.76	0.65

Rating factors for variation in thermal resistivity for soil

Thermal resistivity of soil (K.m / W)	0.8	0.9	1.0	1.2	1.5	2.0	2.5
Rating factors	1.17	1.12	1.07	1.00	0.91	0.80	0.73

Rating factors for variation in air temperature

Air temp. (°C)	25	30	35	40	45	50	55
XLPE insul. cables	1.09	1.04	1.00	0.95	0.90	0.85	0.80
PVC (rated 85 °C) cables	1.10	1.05	1.00	0.95	0.90	0.84	0.77
PVC (rated 70 °C) cables	1.13	1.07	1.00	0.95	0.90	0.76	0.65

Rating factors for variation in depth of burial
(to center of cable in the terfoil group of cables)

Depth of laying m	Up to 50 mm^2	70 mm^2 to 300 mm^2	Above 300 mm^2
0.60	0.99	0.98	0.97
0.80	0.97	0.96	0.94
1.00	0.95	0.93	0.92
1.25	0.94	0.92	0.89
1.50	0.93	0.90	0.87
1.75	0.92	0.89	0.86
2.00	0.91	0.88	0.85

Ground rating factors for three single core cables in trefoil formation

No. of cables in group	Spacing Touching	0.15 m	0.30 m
2	0.78	0.83	0.89
3	0.66	0.73	0.79
4	0.61	0.68	0.73
5	0.56	0.64	0.73
6	0.53	0.61	0.71

Ground rating factors for multi-core cables in flat formation

No. of circuits	Spacing Touching	0.15 m	0.30 m
2	0.81	0.87	0.91
3	0.70	0.78	0.84
4	0.63	0.74	0.81
5	0.59	0.70	0.7
6	0.55	0.68	

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Wire Gauge Comparison

SOLID CONDUCTOR

Gauge Numbers					Gauge Numbers				
Diamete Mils	Square mm	American Wire Gauge (AWG)	British Standard Wire Gauge (Imperial)	Metric Wire Gauge	Diamete Mils	Square mm	American Wire Gauge (AWG)	British Standard Wire Gauge (Imperial)	Metric Wire Gauge
460.10	107.146	4/0	—	—	39.40	0.785	—	—	10
432.00	95.033	—	5/0	—	36.00	0.656	—	20	—
409.60	84.949	3/0	—	—	35.90	0.653	19	—	—
400.00	81.713	—	4/0	—	35.40	0.636	—	—	9
393.70	78.540	—	—	100	32.00	0.519	20	21	—
372.00	70.138	—	3/0	—	31.50	0.503	—	—	8
364.80	67.433	2/0	—	—	28.50	0.412	21	—	—
354.00	63.617	—	—	90	28.00	0.397	—	22	—
348.00	61.375	—	2/0	—	27.60	0.385	—	—	7
324.90	53.482	1/0	—	—	25.30	0.325	22	—	—
324.00	53.197	—	1/0	—	24.00	0.292	—	23	—
315.00	50.265	—	—	80	23.60	0.283	—	—	6
300.00	45.604	—	1	—	22.60	0.259	23	—	—
289.30	42.406	1	—	—	22.00	0.245	—	24	—
276.00	38.595	—	2	—	20.10	0.205	24	—	—
276.00	38.484	—	—	70	20.00	0.203	—	25	—
257.00	33.624	2	—	—	19.70	0.195	—	—	5
252.00	32.170	—	3	—	18.00	0.164	—	26	—
236.00	28.274	—	—	60	17.90	0.163	25	—	—
232.00	27.247	—	4	—	17.70	0.159	—	—	4.5
229.40	26.667	3	—	—	16.40	0.137	—	27	—
212.00	22.733	—	5	—	15.90	0.128	26	—	—
204.30	21.147	4	—	—	15.70	0.128	—	—	4
197.00	19.635	—	—	50	14.80	0.111	—	28	—
192.00	18.704	—	6	—	14.20	0.102	27	—	—
181.90	16.764	5	—	—	13.80	0.096	—	—	3.5
177.20	15.904	—	—	45	13.60	0.093	—	29	—
176.00	15.693	—	7	—	12.60	0.080	28	—	—
162.00	13.299	6	—	—	12.40	0.078	—	30	—
160.00	12.946	—	8	—	11.80	0.071	—	—	3
157.00	12.566	—	—	40	11.60	0.068	—	31	—
144.30	10.550	7	—	—	11.30	0.065	29	—	—
144.00	10.521	—	9	—	10.80	0.059	—	32	—
138.00	9.621	—	—	35	10.00	0.051	30	33	—
128.50	8.367	8	—	—	9.84	0.049	—	—	2.5
128.00	8.296	—	10	—	9.20	0.043	—	34	—
118.00	7.069	—	—	30	8.90	0.040	31	—	—
116.00	6.835	—	11	—	8.40	0.036	—	35	—
114.40	6.633	9	—	—	8.00	0.032	32	—	—
104.00	5.474	—	12	—	7.87	0.031	—	—	2
101.90	5.260	10	—	—	7.60	0.029	—	36	—
98.40	4.909	—	—	25	7.10	0.025	33	—	—
92.00	4.301	—	13	—	7.09	0.025	—	—	1.8
90.70	4.155	11	—	—	6.80	0.024	—	37	—
80.80	3.301	12	—	—	6.30	0.020	34	—	1.6
80.00	3.237	—	14	—	6.00	0.018	—	38	—
78.70	3.142	—	—	20	5.91	0.018	—	—	1.5
72.00	2.630	13	15	—	5.60	0.016	35	—	—
70.90	2.545	—	—	18	5.51	0.015	—	—	1.4
64.10	2.087	14	—	—	5.20	0.014	—	39	—
64.00	2.087	—	16	—	5.12	0.013	—	—	1.3
63.00	2.011	—	—	16	5.00	0.013	36	—	—
57.10	1.651	15	—	—	4.80	0.012	—	40	—
58.00	1.584	—	17	—	4.72	0.011	—	—	1.2
55.10	1.539	—	—	14	4.50	0.010	37	—	—
50.80	1.307	16	—	—	4.40	0.010	—	41	—
48.00	1.169	—	18	—	4.33	0.010	—	—	1.1
47.20	1.131	—	—	12	4.00	0.008	38	42	—
45.30	1.039	17	—	—	3.94	0.008	—	—	1
40.30	0.817	18	—	—	3.60	0.007	—	43	—
40.00	0.817	—	19	—	3.50	0.006	39	—	—

STRANDED CONDUCTOR

Square mm	No. & diameter of strands mm	AWG
0.014	7 x 0.05	—
0.035	7 x 0.08	32
0.047	24 x 0.05	—
0.055	7 x 0.1	30
0.079	10 x 0.1	—
0.079	7 x 0.12	—
0.093	7 x 0.13	28
0.094	12 x 0.1	—
0.094	48 x 0.05	—
0.096	19 x 0.08	28
0.113	10 x 0.12	—
0.118	60 x 0.05	—
0.118	15 x 0.1	—
0.124	7 x 0.15	26
0.149	19 x 0.1	26
0.177	10 x 0.15	24
0.188	24 x 0.1	—
0.212	27 x 0.1	—
0.212	12 x 0.15	—
0.220	7 x 0.2	24
0.251	32 x 0.1	—
0.252	19 x 0.13	24
0.291	37 x 0.1	—
0.314	40 x 0.1	—
0.336	19 x 0.15	22
0.344	7 x 0.25	22
0.377	12 x 0.2	—
0.377	48 x 0.1	—
0.389	22 x 0.15	—
0.459	26 x 0.15	20
0.491	10 x 0.25	20
0.495	7 x 0.3	—
0.503	16 x 0.2	—
0.563	7 x 0.32	20
0.597	19 x 0.2	20
0.636	36 x 0.15	—
0.754	24 x 0.2	—
0.785	16 x 0.25	18
0.848	12 x 0.3	—
0.880	7 x 0.4	18
0.933	19 x 0.25	18
0.990	58 x 0.15	—
1.005	32 x 0.2	—
1.276	26 x 0.25	16
1.343	19 x 0.3	16
1.374	7 x 0.5	16
1.473	30 x 0.25	—
1.508	12 x 0.4	—
1.828	19 x 0.35	14
1.885	60 x 0.2	—
1.909	27 x 0.3	—
1.979	7 x 0.6	—
2.011	16 x 0.4	—
2.013	41 x 0.25	14
2.454	50 x 0.25	14
3.022	19 x 0.45	12
3.142	16 x 0.5	—
3.181	45 x 0.3	—
3.191	65 x 0.25	12
3.393	48 x 0.3	—
3.958	56 x 0.3	—
4.650	37 x 0.4	—
4.714	7x7 x 0.35	—
5.154	105 x 0.25	—
5.160	73 x 0.3	10
5.300	75 x 0.3	10

Conduit Capacity

Conduit Trade Size				1/2	3/4	1	1¼	1½	2	2½	3	3½	4	5
Internal Dia., inches				0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	3.548	4.028	5.047
Internal Dia., cm				1.580	2.093	2.664	3.505	4.089	5.250	6.271	7.793	9.012	10.226	12.819
Permissible Area, sq. in.*				0.12	0.21	0.34	0.60	0.82	1.34	1.92	2.95	3.95	5.09	8.00
Permissible Area, sq. in.*				0.774	1.355	2.194	3.871	5.290	8.645	12.387	19.032	25.548	32.839	51.613
Cable O.D.		Cable Area												
in.	mm	sq. in.	mm^2											
0.125	3.175	0.0123	0.0792	9	17	27	48	66	108	156	239	321	413	650
0.150	3.810	0.0177	0.1140	6	11	19	33	46	75	108	166	223	287	451
0.175	4.445	0.0241	0.1552	4	8	14	24	34	55	79	122	164	211	331
0.200	5.080	0.0314	0.2027	3	6	10	19	26	42	61	93	126	162	254
0.225	5.175	0.0398	0.2585	3	5	8	15	20	33	48	74	99	127	201
0.250	6.350	0.0491	0.3167	2	4	6	12	16	27	39	60	89	103	162
0.275	6.985	0.0594	0.3832	2	3	5	10	13	22	32	49	66	85	134
0.300	7.620	0.0707	0.4560	1	2	4	8	11	18	27	41	56	71	113
0.325	8.255	0.0830	0.5352	1	2	4	7	9	16	23	35	47	61	96
0.350	8.890	0.0962	0.6207	1	2	3	6	8	13	19	30	41	52	83
0.375	9.525	0.1104	0.7126	1	1	3	5	7	12	17	26	35	48	72
0.400	10.160	0.1257	0.8107	—	1	2	4	6	10	15	23	31	40	63
0.425	10.795	0.1419	0.9152	—	1	2	4	5	9	13	20	27	35	56
0.450	11.430	0.1590	1.0261	—	1	2	3	5	8	12	18	24	32	50
0.475	12.065	0.1772	1.1433	—	1	1	3	4	7	10	16	22	28	45
0.500	12.700	0.1963	1.2668	—	1	1	3	4	6	9	15	20	25	40
0.525	13.335	0.2165	1.3966	—	—	1	2	3	6	8	13	18	23	36
0.550	13.970	0.2376	1.5328	—	—	1	2	3	5	8	12	16	21	33
0.575	14.605	0.2597	1.6753	—	—	1	2	3	5	7	11	15	19	30
0.600	15.240	0.2827	1.8241	—	—	1	2	2	4	6	10	14	18	28
0.625	15.875	0.3068	1.9373	—	—	—	1	2	4	6	9	12	16	26
0.650	16.510	0.3318	2.1408	—	—	—	1	2	4	5	8	11	15	24
0.675	17.145	0.3578	2.3087	—	—	—	1	2	3	5	8	11	14	22
0.700	17.780	0.3848	2.4829	—	—	—	1	2	3	4	7	10	13	20
0.725	18.415	0.4128	2.6634	—	—	—	1	1	3	4	7	9	12	19
0.750	19.050	0.4418	2.8502	—	—	—	1	1	3	4	6	8	11	18
0.775	19.685	0.4717	3.0434	—	—	—	1	1	2	4	6	8	10	16
0.800	20.320	0.5027	3.2429	—	—	—	1	1	2	3	5	7	10	15
0.825	20.955	0.5346	3.4488	—	—	—	1	1	2	3	5	7	9	14
0.850	21.590	0.5674	3.6610	—	—	—	1	1	2	3	5	6	8	14
0.875	22.225	0.6013	3.8795	—	—	—	—	1	2	3	4	6	8	13
0.900	22.860	0.6362	4.1043	—	—	—	—	1	2	3	4	6	8	12
0.925	23.495	0.6720	4.3355	—	—	—	—	1	2	3	4	6	8	11
0.950	24.130	0.7088	4.5730	—	—	—	—	1	1	2	4	5	7	11
0.975	24.765	0.7466	4.8169	—	—	—	—	1	1	2	3	5	6	10
1.000	25.400	0.7854	5.0871	—	—	—	—	1	1	2	3	5	6	10
1.025	26.035	0.8252	5.3236	—	—	—	—	—	1	2	3	4	6	9
1.050	26.670	0.8659	5.5864	—	—	—	—	—	1	2	3	4	5	9
1.075	27.305	0.9076	5.8558	—	—	—	—	—	1	2	3	4	5	8
1.100	27.940	0.9503	6.1312	—	—	—	—	—	1	1	3	4	5	8
1.125	28.575	0.9940	6.4130	—	—	—	—	—	1	1	2	3	5	8
1.150	29.210	1.0387	6.7012	—	—	—	—	—	1	1	2	3	4	7
1.175	29.845	1.0843	6.9957	—	—	—	—	—	1	1	2	3	4	7
1.200	30.480	1.1310	7.2966	—	—	—	—	—	1	1	2	3	4	7
1.225	31.115	1.1788	7.6038	—	—	—	—	—	1	1	2	3	4	6
1.250	31.750	1.2272	7.9173	—	—	—	—	—	1	1	2	3	4	6
1.275	32.385	1.2768	8.2372	—	—	—	—	—	1	1	2	3	3	6
1.300	33.020	1.3273	8.5833	—	—	—	—	—	1	1	2	2	3	6
1.325	33.655	1.3789	8.8959	—	—	—	—	—	—	1	2	2	3	5
1.350	34.290	1.4314	9.2347	—	—	—	—	—	—	1	2	2	3	5
1.375	34.925	1.4849	9.5799	—	—	—	—	—	—	1	1	2	3	5
1.400	35.560	1.5394	9.9315	—	—	—	—	—	—	1	1	2	3	5
1.425	36.195	1.5948	10.2893	—	—	—	—	—	—	1	1	2	3	5
1.450	36.830	1.6513	10.6535	—	—	—	—	—	—	1	1	2	3	4
1.475	37.465	1.7087	11.0240	—	—	—	—	—	—	1	1	2	2	4
1.500	38.100	1.7671	11.4009	—	—	—	—	—	—	1	1	2	2	4
1.525	38.735	1.8265	11.7841	—	—	—	—	—	—	1	1	2	2	4
1.550	39.370	1.8869	12.1736	—	—	—	—	—	—	—	1	2	2	4
1.575	40.005	1.9483	12.5695	—	—	—	—	—	—	—	1	2	2	4
1.600	40.640	2.0106	12.9717	—	—	—	—	—	—	—	1	1	2	3
1.625	41.275	2.0739	13.3802	—	—	—	—	—	—	—	1	1	2	3
1.650	41.910	2.1382	13.7951	—	—	—	—	—	—	—	1	1	2	3
1.675	42.545	2.2035	14.2163	—	—	—	—	—	—	—	1	1	2	3
1.700	43.180	2.2698	14.6438	—	—	—	—	—	—	—	1	1	2	3
1.725	43.815	2.3370	15.0777	—	—	—	—	—	—	—	1	1	2	3
1.750	44.450	2.4053	15.5179	—	—	—	—	—	—	—	1	1	2	3
1.775	45.085	2.4745	15.9644	—	—	—	—	—	—	—	1	1	2	3
1.800	45.720	2.5447	16.4173	—	—	—	—	—	—	—	1	1	2	3

Figures shown indicate number of cables of a given size O.D. that can be pulled through conduit size listed.
** Based on National Electrical Code for non-lead sheathed cables when three or wires or cables occupy the same conduit (4096 fill)*

Wire/Cable Capacities of Conduit and Trunking -

IEE Wiring Regulations 15th Edition
Based on single core PVC insulated cable unless otherwise shown. The conduit or trunking which can be used is the size having a factor equal to or greater than the sum of the cable factors. As a guideline, the number and sizes of cables permitted to be installed in conduit must allow a space factor of 40%, and where being laid in trunking a space factor of 45%.

Conduit -

a. Straight runs less than 3 meters in length.
For each cable to be used, obtain factor from table A, add all the factors obtained together and compare with conduit factors in Table B.

b. Straight runs more than 3 meters in length, or runs of any length with bends or sets.
For each cable to be used, obtain factor from table C, add all the factors obtained together and divide into the conduit factors in Table D, taking into consideration the length of run and the number of bends and sets.

Table A
Cable Factors for short straight runs

Conductor size mm²	Fact ors	
	Solid	Standard
1.0	22	—
1.5	27	31
2.5	39	43
4.0	—	58
6.0	—	88
10.0	—	146

Table B
Conduit Factors for short straight runs

Conductor Diameter, mm	Factor
16	290
20	460
25	800
32	1400

Table C
Cable Factors for long straight runs or runs with bends

Conductor Diameter, mm²	Factor
1.0	16
1.5	22
2.5	30
4.0	43
6.0	58
10.0	105

Table D *Conduit Factors for long straight runs or runs incorporating bends*

Length of run	Straight			O ne bend			Two bends			Three bends			Four bends		
m	20 mm	25 mm	32 mm	20 mm	25 mm	32 mm	20 mm	25 mm	32 mm	20 mm	25 mm	32 mm	20 mm	25 mm	32 mm
1.0				303	543	947	288	514	900	258	463	818	213	388	692
1.5		Covered		294	528	923	270	487	857	233	422	750	182	333	600
2.0		by tables		286	514	900	258	463	818	213	388	692	159	292	529
2.5		A and B		278	500	878	244	442	783	196	358	643	141	260	474
3.0				270	487	857	233	422	750	182	333	600	—	—	—
3.5	290	521	911	263	475	837	222	404	720	169	311	563	—	—	—
4.0	286	514	900	256	483	818	213	388	692	159	292	529	—	—	—
4.5	282	507	889	250	452	800	204	373	667	149	275	500	—	—	—
5.0	278	500	878	244	442	783	198	358	643	141	260	474	—	—	—
6.0	270	487	857	233	422	750	182	333	600	—	—	—	—	—	—
7.0	263	475	837	222	404	720	169	311	583	—	—	—	—	—	—
8.0	258	483	818	213	388	692	159	292	529	—	—	—	—	—	—
9.0	250	452	800	204	373	667	149	275	500	—	—	—	—	—	—
10.0	244	442	783	196	358	643	141	260	474	—	—	—	—	—	—

Trunking
Obtain cable factor for each cable to be used from cable table E, add all the factors obtained together and compare with Trunking Table F.

Table E *Cable Factors*

Conductor size mm²	Fact ors	
	Solid	Standard
1.0	7.1	8.1
2.5	10.2	11.4
4.0	—	15.2
6.0	—	22.9
10.0	—	36.3

Table F *Trunking Factors*

Trunking Size mm	Factor
50 x 37.5	767
50 x 50	1037
75 x 25	738
75 x 37.5	1146
75 x 50	1555
75 x 75	2371
100 x 25	993
100 x 37.5	1542
100 x 50	2091
100 x 75	3189
100 x 100	4252

Mini-Trunking
Add together the total cross-sectional area of the cables required from Cable Table G and copmare with trunking capacity in Trunking Table H

Table G *Cables*

Cable size mm²	Flat Twin and Earth mm²	Single PVC mm²
1.0	30.30	6.6
1.5	38.45	7.6
2.5	54.00	9.6
4.0	66.40	14.5
6.0	87.87	18.8
10.0	—	29.3

Table H *Trunking*

Size mm	45 % Capacity mm²
16 x 16	66
25 x 16	113
38 x 16	183
38 x 25	323
50 x 25	466

Cable Pulled into Ducts and Conduits

Generally, cable pulled into ducts and conduits is done via a winch attached to the cable by means of a pulling eye or cable grip. The coefficient of friction can be further decreased by applying lubricants to the cables.

In Straight Duct:

Tension required to pull cable:
T=Lwf

Where:
T = Tension required to pull cable, lbs
L = Length of cable, ft.
w = Weight of cable, lbs/ft.
f = Coefficient of friction
(see table A)

Tension Limitations:

(a) Using a pulling eye
TE=ANS

Where:
TE = Maximum allowable pulling tension of each cable using a pulling eye, lbs.
A = Cross sectional area of conductor, kCM
N = Number of conductors
S = Maximum allowable pulling stress, lb/MCM
(see table B for typical values)

(b) Usinq a cable grip
TG = 3.1418 Kt (d-t)

Where:
TG = Maximum allowable pulling tension of each cable using a pulling qrip, lbs.
K = Maximum allowable pullinq stress, lbs/in² (see table C for typical values)
d = Cable O.D., in. t = Jacket thickness, in.

Table A
Approximate Coefficient of Friction
(Non-Iubricated cable)

Conduit or Duct Material	Jacket Material XLPE	PVC	Neoprene
Fiberglass Reinforced EPOX	0.233	0.385	0.531
Bituminous Fiber	0.406	0.618	0.681
Asbestos Cement	0.560	0.561	0.675
Rigid (filled) PVC	0.347	0.516	0.525
Metal	0.355	0.546	0.596

For adequately lubricated cable, multiply the base frictional factor by 0.6

Table B
Maximum Allowable Conductor Pulling Stress

Conduit	S, Ib/MCM
Copper	8
Soft Drawn Aluminum	4
3/4 Hard Drawn Aluminum	8
Hard Drawn	8

Table C
Maximum Allowable Pulling Stress on Cable Jacket

Sheath or Jacket Material	K, Ibs/m²
Neoprene	1000
PE	1000
PVC	1000
Aluminum, smooth	6400
Aluminum, corrugated	3500
Arsenical Lead	2000
Pure Lead	1500

Table Bend Radii*
(Power Type Cable)

Cable Jacket Type	Cable O. D., inches 1.00 or less	1.00 to 2.00	2.001 & larger
	(Bending radius as a multible of cable O.D.)		
Aluminum sheath - corrugated	10	12	12
Aluminum sheath - smooth	12	15	18
Tape shielded.	12	12	12
Flat tape armoured	12	12	12
Wire armoured	12	12	12
Non-shielded	7	7	7
Wire shielded	7	7	7
Interlocked armour	7	7	7
Shielded and armoured	—	—	—
(a) Interlocked	7	7	7
(b) Flat tape or wire	12	12	12
Portable power cables 5KV or less	6	6	6
Portable power cables over 5KV	8	8	8

* These figures represent minimum values for the radii to which insulated power cables may be bent, but do not represent conduit bends or other curved surfaces around which cable may be pulled during installation while being installed; for these situations, greater bend radii are usually required. In each case, the minimum bend radii specified reference the inner surfaces and not the central axis of the cable.

Cable Installation - Cold Weather

Before installing cable in a cold climate, store the cable in a heated area for a 24 hour period.

The installed temperature (ambient) should not be lower than the following chart indicates:

Jacket	
PVC	-10 °C
Polyethlene	-40 °C
X Linked PE	-40 °C
TPR	-50 °C
Neopreneure	-20 °C
Polyurethane	-30 °C

Motors and Control Gear & Index of Protection Data

AC Motor Full Load Currents

Motor Rating		Full Load Current in Amperes						
		Three Phase 50-60 Hz						Single Phase
kW	h.p.	220V	380V	415V	440V	500V	660V	240V
0.37	0.50	1.9	1.2	1.05	1.0	0.9	0.6	3.6
0.55	0.75	2.8	1.6	1.44	1.3	1.2	0.9	4.8
0.75	1.0	3.6	2.0	1.90	1.7	1.5	1.1	6.1
1.10	1.50	4.6	2.8	2.50	2.3	2.0	1.5	8.8
1.50	2.00	6.4	3.7	3.45	3.1	2.6	2.0	11.7
2.20	3.00	9.1	5.0	4.70	4.4	3.8	2.8	17.1
3.00	4.00	12.1	6.6	6.20	5.8	5.0	3.6	22.2
4.00	5.50	15.3	8.5	8.10	7.6	6.5	4.9	27.1
5.50	7.50	20.0	11.5	10.90	10.4	9.0	6.6	38.7
7.50	10.00	27.0	15.5	14.80	13.7	12.0	8.9	50.0
11.00	15.00	39.0	22.0	20.50	20.1	17.0	12.7	
15.00	20.00	52.0	30.0	28.00	26.5	23.0	17.3	
18.50	25.00	66.0	37.0	34.50	32.8	28.5	21.3	
22.00	30.00	75.0	44.0	41.00	39.0	33.0	25.4	
30.00	40.00	103.0	60.0	55.00	51.5	45.0	34.6	
37.00	50.00	126.0	72.5	65.00	64.0	55.0	41.8	
45.00	60.00	147.0	85.0	79.0	76.3	65.0	49.0	
55.00	75.00	182.0	105.0	98.00	96.0	80.0	60.6	
75.00	100.00	239.0	138.0	133.00	125.0	105.0	79.6	
90.00	125.00	295.0	170.0	164.00	156.0	129.0	98.0	
110.00	150.00	356.0	205.0	188.00	186.0	156.0	118.0	
132.00	175.00	425.0	245.0	226.00	216.0	187.0	141.0	
160.00	220.00	520.0	300.0	268.00		228.0	173.0	
200.00	270.00	640.0	370.0	358.00		281.0	214.0	
220.00	300.00	710.0	408.0	385.00		310.0	235.0	
250.00	350.00	823.0	475.0	450.00		360.0	274.0	

Data is typical for 4-pole squirrel cage motors, and may vary depending on motor manufacturers.

Recommended HRC Fuse Rating
For average starting conditions

Direct On Line Starting		Star-Delta Starting	
Motor FLC	**Fuse Rating**	**Motor FLC**	**Fuse Rating**
Amps	**Amps**	**Amps**	**Amps**
0.0 - 0.7	2	0.0 - 1.4	2
0.8 - 1.1	4	1.5 - 2.1	4
1.2 - 1.6	6	2.2 - 3.1	6
1.7 - 2.6	10	3.2 - 5.4	10
2.7 - 5.2	16	5.5 - 10.0	16
5.3 - 7.5	20	10.1 - 14.3	20
7.6 - 9.9	25	14.4 - 18.3	25
10.0 - 11.6	32	18.4 -22.6	32
11.7 - 15.7	35	22.7 - 29.2	35
15.8 - 19.3	40	29.3 - 35.0	40
19.4 - 22.9	50	35.1 - 42.8	50
23.0 - 28.6	63	42.9 - 55.0	63
28.7 - 41.4	80	55.1 - 74.2	80
41.5 - 54.3	100	74.3 - 97.3	100
54.4 - 71.5	125	97.4 - 125.0	125
71.6 - 94.4	160	125.1 -160.0	160
94.5 - 127.0	200	160.1 - 180.0	200
127.1 - 164.0	250	180.1 - 225.0	250
164.1 - 186.0	315	225.1 - 250.0	315
186.1 - 257.0	355	250.1 - 325.0	355
257.1 - 307.0	400	325.1 - 350.0	400
307.1 - 371.0	450	350.1 - 425.0	450
371.1 - 415.0	500	425.1 - 450.0	500
415.1 - 472.0	560	450.1 - 525.0	560
472.1 - 535.0	630	525.1 - 550.0	630

Index of Protection

Enclosed equipment applicable where voltages do not exceed 1000Vac, 1500 Vdc.

The index provides greater precision in defining protection capability than with common terms sush as within “dustproof”, “weatherproof”, “water-tight”, etc. It is based on the letters “IP”, followed by two or three digits as set out in the table below. Columns 2 and 3 conform to IEC 144 and 529, DIN 40050; column 4 is

IP No.	1st Digit Protection Against Solid Bodies	2nd Digit Protection Against Liquids	3rd Digit Mechanical Protection Impact Energy
0	No protection	No protection	No protection
1	Larger than 50mm	Falling drop of water, condensation	0.225 joules
2	Larger than 12mm	Falling drop of water, 15 degrees from vertical	0.375 joules
3	Larger than 2.5mm	Drop of rain up to 60 degrees from vertical	0.500 joules
4	Larger than 1mm	Protection against water from all directions	2.000 joules
5	Against dust	Protections against jets of water from all directions	20.000 joules
6	Completely protected Against dust	Protections against jets of water similar to heavy seas	—
7	—	Protected against immersion	—
8	—	Protected against immersion under pressure	—

Summary of Low Voltage Fuses
American Standards

Voltage	Fuse Type	Ampere Rating	Interrupting Rating, kA
A. UL Classifications			
125	Plug	0-30	10
250	Class H	0-600	10
	Class K	0-600	50, 100, 200
	Class RK1	0-600	200
	Class RK5	0-600	200
	Midget	0-30	10
300	Class G	0-60	100
	Class T	0-1200	200
600	Class H	0-600	10
	Class J	0-600	200
	Class K	0-600	50, 100, 200
	Class RK1	0-600	200
	Class RK5	0-600	200
	Class T	0-800	200
	Class CC	0-30	200
	Midget	0-30	10, 50, 100
	Class L	601-6000	200
B. Other types			
130-2500	Rectifier	0-2000	200
6-240	Glass	0-30	varies to 10
600	Cable	4/0-750MCM Cu or Al cables	200
600	Capacitor	25-225	200
250, 600	Welder	70-600	200

CONVERSION TABLES

TO CONVERT	MULTIPLY BY	TO OBTAIN		TO CONVERT	MULTIPLY BY	TO OBTAIN
acres	4047	sq. meters		degrees(angles)	1.111×10^{-2}	quadrants
acres	1.562×10^{-3}	sq. miles		degrees(angles)	1.745×10^{-2}	radians
acres	4840	sq. yards				
				ergs	2.389×10^{-11}	kilogram-calories
amperes/sq.cm	6.452	amperes/sq.in.		ergs	2.773×10^{-11}	watt-hours
amperes/sq.in.	0.155	amperes/sq.cm.				
ampere-hours	3600	coulombs		faradays	26.8	ampere-hours
ampere-hours	3.731×10^{-2}	faradays				
				feet	30.48	centimeters
barrels(U.S. liquid)	31.5	gallons		feet	0.3048	meters
barrels(oil)	42	gallons(oils)		feet	1.645×10^{-4}	miles(nautical)
				feet/min	0.508	centimeters/sec
btu	10.409	liter atmosphere		feet/min	1.667×10^{-2}	feet/sec
btu	1.055×10^{10}	ergs		feet/sec	0.5921	knots
btu	778.16	foot-pounds		feet/sec	18.29	meters/min
btu	1055	joules		feet/sec	0.6818	miles/hour
btu	2.928×10^{-4}	kilowatt-hours		feet/sec	1.136×10^{-2}	miles/min
btu/hour	0.2162	foot-pounds/sec		foot-candle	10.764	lumen/sq. meter
btu/hour	3.929×10^{-4}	horsepower		foot-candle	10.764	lux
btu/hour	0.2931	watts				
btu/min	12.96	foot-pounds/sec		foot-pounds	1.286×10^{-3}	btu
btu/min	2.356×10^{-2}	horsepower		foot-pounds	1.356×10^{-7}	ergs
btu/min	17.57	watts		foot-pounds	1.356	joules
				foot-pounds	3.766×10^{-7}	kilowatt-hours
°C	(°C x 9/5)+32	°F		foot-pounds/min	3.03×10^{-5}	horsepower
				foot-pounds/min	2.26×10^{-5}	kilowatts
centimeter	0.3937	inches				
				gallons	3785	cubic centimeters
circular mils	5.067×10^{-6}	sq. centimeters		gallons	0.1337	cubic feet
circular mils	7.854×10^{-7}	sq. inches		gallons	3.785×10^{-3}	cubic meters
				gallons	3.785	liters
cubic centimeters	3.531×10^{-5}	cubic feet		gallons (U.S.)	0.83267	gallons (imperial)
cubic centimeters	1×10^{-3}	liters				
				hectares	2.471	acres
cubic feet	28320	cubic centimeters				
cubic feet	1728	cubic inches		horsepower	42.44	btu/min
cubic feet	2.832×10^{-2}	cubic meters		horsepower	550	foot-pound/sec
cubic feet	7.48052	gallons (U.S. liq.)		horsepower	0.7457	kilowatts
cubic feet	28.32	liters				
				inches	2.54	centimeters
cubic inches	16.39	cubic centimeters				
cubic inches	5.787×10^{-4}	cubic feet		joules	9.486×10^{-4}	btu
cubic inches	1.639×10^{-5}	cubic meters		joules	1×10^{-7}	ergs
cubic inches	4.329×10^{-3}	gallons(U.S. liq.)		joules	0.7736	foot-pounds
cubic inches	1.639×10^{-2}	liters		joules	2.778×10^{-4}	watt-hours
cubic meters	35.31	cubic feet		kilograms	2.2046	pounds
cubic meters	61023	cubic inches		kilograms	9.842×10^{-4}	tons (long)
cubic meters	1.308	cubic yards		kilograms/meter	0.672	pounds/foot
cubic meters	264.2	gallons (U.S. liq.)				
cubic meters	1000	liters				