Chapter E 430

MOTORS, MOTOR CIRCUITS AND CONTROLLERS

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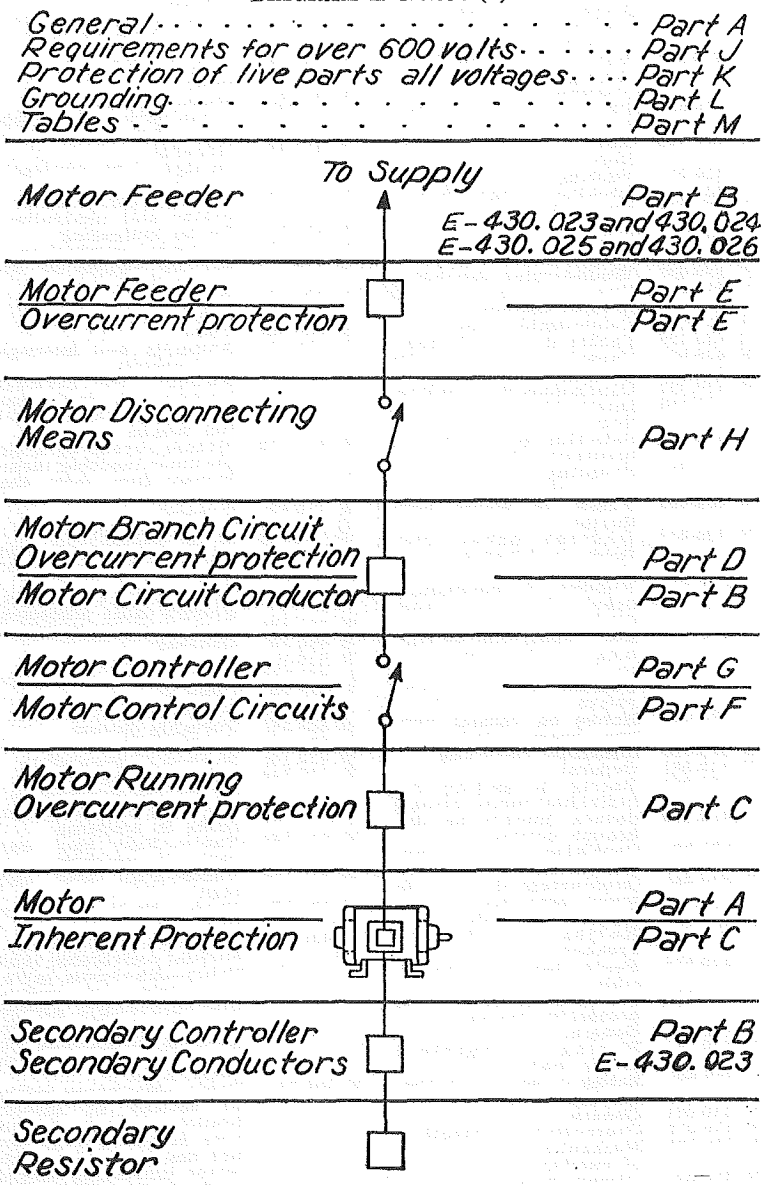
Note: See diagram next page for E 430.001

A. GENERAL

E 430.001 Motor feeder and branch circuits. (1) See diagram E 430.001 (1).

(2) GENERAL. The following general requirements cover provisions for motors, motor circuits and controllers which do not properly fall into other parts of this chapter.

DIAGRAM E 430.001 (1)



History: Cr. Register, January, 1968, No. 145, eff. 2-1-68.

E 430.002 Sealed (hermetic-type) refrigeration compressor. For the purposes of this chapter, a sealed (hermetic-type) refrigeration compressor is a mechanical compressor consisting of a compressor and a motor, both of which are enclosed in the same housing, with no external shaft nor shaft seals, the motor operating in the refrigerant atmosphere.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.003 Part winding motors. (1) A part-winding-start induction or synchronous motor is one arranged for starting by first energizing part of its primary (armature) winding and, subsequently, energizing the remainder of this winding in one or more steps. The purpose is to reduce the initial values of the starting current drawn on the starting torque developed by the motor. A standard part-winding-start induction motor is arranged so that one-half of its primary winding can be energized initially and, subsequently, the remaining half can be energized, both halves then carrying the same current. A sealed "hermetic-type" refrigeration compressor motor is not to be considered a standard part-winding-start induction motor.

(2) When separate overcurrent devices are used with a standard part-winding-start induction motor, each half of the motor winding shall be individually protected in accordance with sections E 430.032 and E 430.037 except that the trip current shall be one-half that specified.

(3) Each motor winding connection shall have short circuit and ground fault protection rated at not more than one-half that specified by section E 430.052 except that a single device having this half rating may be used for both windings if this will allow the motor to start.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.004 In sight from. Where in this chapter it is specified that some equipment shall be "in sight from" another equipment, it means that the equipment must be visible and not more than 50 feet distant.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.005 Other chapters. Motors and controllers shall also comply with the applicable provisions of the following:

Capacitors	Section E 460.09
Cranes and Hoists	Chapter E 610
Elevators, Dumbwaiters, Escalators, and Moving Walks	Chapter E 620
Garages, Aircraft Hangars, Gasoline Dispensing and Service Stations, Bulk Storage Plants, Finishing Processes and Flammable Anesthetics	Chapters E 511, E 513, E 514, E 515, E 516 and E 517
Hazardous Locations	Chapters E 500–E 503
Metal Working Machine Tools	Chapter E 670
Motion-picture Projectors	Sections E 540.12, E 540.17

Motion-picture Studios ---------- Chapter E 530
Organs ---------- Section E 650.03
Resistors and Reactors ---------- Chapter E 470
Theaters ---------- Section E 520.48

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.006 Ampacity determination. Ampacities shall be determined as follows:

(1) GENERAL MOTOR APPLICATIONS. Except as noted in subsection (2), whenever the current rating of a motor is used to determine the ampacity of conductors, switches, branch-circuit overcurrent devices, etc., the values given in tables E 430.147, E 430.148, E 430.149, and E 430.150, including notes, shall be used instead of actual current rating marked on the motor nameplate. Motor running overcurrent protection shall be based on the motor nameplate current rating. When a motor is marked in amperes, but not horsepower, the horsepower rating shall be assumed to be that corresponding to the value given in tables E 430.147, E 430.148, E 430.149, and E 430.150 interpolated if necessary.

(a) *Exception:* For multispeed motors, see subsection E 430.022 (1) and section E 430.052.

(2) SEALED (HERMETIC-TYPE) REFRIGERATION COMPRESSOR MOTORS. For sealed (hermetic-type) refrigeration compressor motors the full-load current marked on the nameplate for the compressor shall be used to determine the ampacity of the branch-circuit conductors (see sections E 430.022 and E 430.024), branch-circuit overcurrent protection, and motor-running overcurrent protection. For motor controllers and disconnecting means, see section E 430.083, exception No. 3, and section E 430.110.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.007 Marking on motors. (1) USUAL MOTOR APPLICATIONS. A motor shall be provided with a nameplate showing the maker's name, the rating in volts and amperes, including those of a secondary if a wound-rotor type of motor, the normal full-load speed and the interval during which it can operate at full load starting cold, before reaching its rated temperature. The time interval shall be 5, 15, 30, or 60 minutes, or continuous. A motor rated at ⅛ horsepower or larger shall have the horsepower rating marked on the nameplate except that the motors of arc welders may be marked in amperes. A multispeed motor, except a shaded pole or permanent split-capacitor motor, shall have the amperes and horsepower at each speed marked on the nameplate. A motor provided with a protective device integral with the motor, that complies with section E 430.032 (1) (b) or E 430.032 (3) (b) shall be permanently marked "Thermally Protected." An alternating-current motor rated at ½ horsepower or larger, unless it is a polyphase wound-rotor motor, shall have the nameplate marked with a code letter to show its input in kilovolt-amperes with locked rotor, selected from table E 430.007 (2). Motors complying with section E 430.032 (3) (d) shall be marked "Impedance-Protected."

(2) LOCKED ROTOR INDICATING CODE LETTERS. Code letters marked on motor nameplates to show motor input with locked rotor shall be in accordance with table E 430.007 (2).

TABLE E 430.007 (2)

LOCKED ROTOR INDICATING CODE LETTERS

Code Letter	Kilovolt-Amperes per Horsepower with Locked Rotor
A	0– 3.14
B	3.15– 3.54
C	3.55– 3.99
D	4.0 – 4.49
E	4.5 – 4.99
F	5.0 – 5.59
G	5.6 – 6.29
H	6.3 – 7.09
J	7.1 – 7.99
K	8.0 – 8.99
L	9.0 – 9.99
M	10.0 –11.19
N	11.2 –12.49
P	12.5 –13.99
R	14.0 –15.99
S	16.0 –17.99
T	18.0 –19.99
U	20.0 –22.39
V	22.4 –and up

Note 1. The above table is an adopted standard of the National Electrical Manufacturers Association.

Note 2. The code letter indicating motor input with locked rotor must be in an individual block on the nameplate, properly designated. This code letter is to be used for determining branch-circuit overcurrent protection by reference to table E 430.152, as provided in section E 430.052.

(a) Multi-speed motors shall be marked with the code letter designating the locked-rotor KVA per horsepower for the highest speed, except constant horsepower motors which shall be marked with the code letter giving the highest locked-rotor KVA per horsepower.

(b) Single-speed motors starting on Y connection and running on delta connections shall be marked with a code letter corresponding to the locked-rotor KVA per horsepower for the Y connection.

(c) Dual-voltage motors which have a different locked-rotor KVA per horsepower on the two voltages shall be marked with the code letter for the voltage giving the highest locked-rotor KVA per horsepower.

(d) Motors with 60 and 50-cycle ratings shall be marked with a code letter designating the locked-rotor KVA per horsepower on 60 cycles.

(e) Part-winding-start motors shall be marked with a code letter designating the locked-rotor KVA per horsepower that is based upon the locked-rotor current for the full winding of the motor.

(3) SEALED (HERMETIC-TYPE) REFRIGERATION COMPRESSOR MOTORS. Sealed (hermetic-type) refrigeration compressors shall be provided with a nameplate which shall give the manufacturer's name; the phase, voltage, frequency, and the full load current in amperes of the motor (operating current when the compressor is delivering rated output). The locked-rotor current of single-phase motors having full load cur-

rents in amperes of more than 9 amperes at 115 volts and more than 4.5 amperes at 230 volts and all polyphase motors shall also be marked on the nameplate. When a protective device integral with a motor is used (see section E 430.032), the nameplate shall be marked with the words "Thermal Protection".

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.008 Marking on controllers. A controller shall be marked with the maker's name or identification, the voltage, the current or horsepower rating, and such other data as may be needed to properly indicate the motors for which it is suitable.

Note: Where a controller is built in as an integral part of a motor or of a motor-generator set, the controller need not be individually marked when the necessary data is on the motor nameplate.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.009 Marking at terminals. Terminals of motors and controllers shall be suitably marked or colored where necessary to indicate the proper connections.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.010 Wiring space in enclosures. Enclosures for controllers and disconnecting means for motors shall not be used as junction boxes, auxiliary gutters, or raceways for conductors feeding through or tapping off to other apparatus unless designs are employed which provide adequate space for this purpose.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.011 Protection against liquids. Suitable guards or enclosures shall be provided to protect exposed current-carrying parts of motors and the insulation of motor leads where installed directly under equipment, or in other locations where dripping or spraying oil, water, or other injurious liquid may occur, unless the motor is designed for the existing conditions.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.012 Motor terminal housings. Motor terminal housings shall be of ample size to properly make connections and shall be of substantial metal construction.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.013 Bushing. Where wires pass through an opening in an enclosure, conduit box or barrier, a bushing shall be used to protect the conductors from the edges of the openings having sharp edges. The bushing shall have smooth, well-rounded surfaces where it may be in contact with the conductors. If used where there may be a presence of oils, greases, or other contaminants, the bushing shall be made of material not deleteriously affected.

Note: For conductors, see Wis. Adm. Code section E 310.07.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.014 Location of motors. (1) VENTILATION AND MAINTENANCE. Motors shall be located so that adequate ventilation is provided and so that maintenance such as lubrication of bearings and replacing of brushes can be readily accomplished.

(2) OPEN MOTORS. Open motors having commutators or collector rings shall be located or protected so that sparks cannot reach adjacent combustible material. This does not prohibit the installation of these motors on wooden floors or supports.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.016 Overheating from dust accumulations. In locations where dust or flying material will collect on or in motors in such quantities as to seriously interfere with the ventilation or cooling of motors, and thereby cause dangerous temperatures, suitable types of enclosed motors which will not overheat under the prevailing conditions, shall be used. Especially severe conditions may require the use of enclosed pipe ventilated motors, or enclosure in separate dust-tight rooms, properly ventilated from a source of clean air.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

B. MOTOR CIRCUIT CONDUCTORS

E 430.021 General. The provisions of part B specify sizes of conductors capable of carrying the motor current without overheating under the conditions specified.

(1) The provisions of chapters E 250 and E 310 are not intended to apply to conductors which form an integral part of equipment, such as motors, motor controllers, and the like. See subsections E 300.01 (4) and E 310.01 (3).

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.022 Single motor. (1) Branch-circuit conductors supplying a single motor shall have an ampacity not less than 125% of the motor full-load current rating. In case of a multispeed motor, the selection of branch circuit conductors on the line side of the controller shall be based on the highest of the full load current ratings shown on the motor nameplate; selection of branch circuit conductors between the controller and the motor, which are energized for that particular speed, shall be based on the current rating for that speed.

(a) *Exception:* Conductors for a motor used for short-time, intermittent, periodic, or varying duty may have an ampacity not less than the percentage of the motor nameplate current rating as shown in table E 430.022 (1) Exception: Unless the administrative authority grants special permission for conductors of smaller size.

Note 1: Any motor application is considered to be for continuous duty unless the nature of the apparatus which it drives is such that the motor will not operate continuously with load under any condition of use.

Note 2: For long runs, it may be necessary in order to avoid excessive voltage drop, to use conductors of sizes larger than the minimum sizes selected from tables E 310.12 to E 310.15 inclusive.

Note 3: See diagram E 430.001, and example No. 8, chapter E 900.

(2) The conductors between a stationary motor rated one horsepower or less, and the separate terminal enclosures permitted in section E 430.145 (2) may be smaller than No. 14 but not smaller than No. 18, provided they have ampacity as specified above.

TABLE E 430.022 (1)
EXCEPTION

Classification of Service	Percentages of Nameplate Current Rating			
	5-Minute Rated Motor	15-Minute Rated Motor	30 & 60 Minute Rated Motor	Continuous Rated Motor
Short-Time Duty				
Operating valves, raising or lowering rolls, etc.	110	120	150	---
Intermittent Duty				
Freight and passenger elevators, tool heads, pumps, drawbridges, turntables, single-operator arc welders for manual welding, etc.	85	85	90*	140
Periodic Duty				
Rolls, ore and coal-handling machines, etc.	85	90	95	140
Varying Duty	110	120	150	200

*This figure also applies for conductors which supply a motor-generator single-operator arc welder which has a 60% duty cycle rating.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.023 Wound-rotor secondary. (1) For continuous duty the conductors connecting the secondary of a wound-rotor alternating-current motor to its controller shall have an ampacity which is not less than 125% of the full-load secondary current of the motor.

(2) For other than continuous duty, these conductors shall have an ampacity, in per cent of full load secondary current, not less than that specified in table E 430.022.

(3) Where the secondary resistor is separate from the controller, the ampacity of the conductors between controller and resistor shall be not less than that given in table E 430.023 (Exception).

TABLE E 430.023
EXCEPTION

Resistor Duty Classification	Carrying Capacity of Wire in Per Cent of Full-Load Secondary Current
Light starting duty	35
Heavy starting duty	45
Extra heavy starting duty	55
Light intermittent duty	65
Medium intermittent duty	75
Heavy intermittent duty	85
Continuous duty	110

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.024 Conductors supplying several motors. Conductors supplying two or more motors shall have an ampacity of not less than 125% of the full-load current rating of the highest rated motor in the group plus the sum of the full-load current ratings of the remainder of the motors in the group. Where one or more motors of a group are used on short time, intermittent, periodic, or varying duty, the conductors shall have an ampacity of not less than 125% of the name plate full load current of the highest rated continuous duty motor or the highest current obtained by multiplying the applicable percentage of table E 430.022 (1) Exception, by the name plate full

load current of any non-continuous duty motor, whichever is the larger, plus the name plate full load current of any non-continuous duty motor, whichever is the larger, plus the name plate full load currents of the other motors, each multiplied by 100% or the applicable percentage of the table, whichever is smaller.

(1) EXCEPTION: When the circuitry is so interlocked as to prevent the starting and running of a second motor or group of motors, the conductor size shall be determined from the larger motor or group of motors that are to be operated at a given time.

Note: See Example No. 8, Wis. Adm. Code chapter E 900.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.025 Combination load. Conductors supplying a motor load, and in addition a lighting or appliance load as computed from chapter E 220 and other applicable sections, shall have an ampacity sufficient for the lighting or appliance load plus the required capacity for the motor load determined in accordance with section E 430.024 or, for a single motor, in accordance with section E 430.022.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.026 Feeder demand-factor. Where a reduced heating of the conductors results from motors operating on duty-cycle, intermittently, or from all motors not operating at one time the administrative authority may grant permission for feeder conductors to be of a capacity less than specified in sections E 430.024 and E 430.025, provided the conductor is of sufficient ampacity for the maximum load determined by the sizes and number of motors supplied and the character of their loads and duties.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.027 Capacitors with motors. For provisions covering conductors where capacitors are installed on motor circuits, see sections E 460.07, E 460.08 and E 460.09.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

C. MOTOR RUNNING OVERCURRENT (OVERLOAD) PROTECTION

E 430.031 General. The provisions of part C specify overcurrent devices intended to protect the motors, the motor-control apparatus, and the branch-circuit conductors against excessive heating due to motor overloads.

(1) Overload in electrical apparatus is an operating overcurrent which, when it persists for a sufficient length of time, would cause damage or dangerous overheating of the apparatus. It does not include short-circuits or ground faults.

(2) These provisions shall not be interpreted as requiring overcurrent protection where it might introduce additional or increased hazards as in the case of fire pumps.

Note: See NFPA standard for centrifugal fire pumps (No. 20).

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.032 Continuous duty motors. (1) MORE THAN ONE HORSEPOWER. Each continuous duty motor rated more than one horsepower

shall be protected against running overcurrent by one of the following means:

(a) A separate overcurrent device which is responsive to motor current. This device shall be rated or selected to trip at not more than 125% of the motor full-load current rating for sealed (hermetic-type) refrigeration compressor motors and motors marked to have a temperature rise not over 40°C., and at not more than 115% for all other types of motors. This value may be modified as permitted by section E 430.034. For a multispeed motor, each winding connection shall be considered separately.

(b) A thermal protector integral with the motor, approved for use with the motor which it protects on the basis that it will prevent dangerous overheating of the motor due to overload or failure to start. If the motor current interrupting device is separate from the motor and its control circuit is operated by a protective device integral with the motor, it shall be so arranged that the opening of the control circuit will result in interruption of current to the motor.

(c) For motors larger than 1500 horsepower, a protective device employing embedded temperature detectors which cause current to the motor to be interrupted when the motor attains a temperature rise greater than marked on the nameplate in an ambient of 40° C.

Note: Standards for the application of embedded temperature detectors are given in the American Standards for Rotating Electrical Machinery, ASA C50-1 and C50-2.

(2) ONE HORSEPOWER OR LESS, MANUALLY STARTED. Each continuous duty motor rated at one horsepower or less which is not permanently installed, is manually started and is within sight from the controller location, shall be considered as protected against overcurrent by the overcurrent device protecting the conductors of the branch circuit. This branch circuit overcurrent device shall not be larger than that specified in table E 430.146, except that any such motor may be used at 125 volts or less on a branch circuit protected at 20 amperes. Any such motor which is not in sight from the controller location shall be protected as specified in subsection (3). Any motor rated at one horsepower or less which is permanently installed, shall be protected in accordance with subsection (3).

(3) ONE HORSEPOWER OR LESS, AUTOMATICALLY STARTED. Any motor of one horsepower or less which is started automatically shall be protected against overcurrent by the use of one of the following means:

(a) A separate overcurrent device which is responsive to motor current. This device shall be rated or selected to trip at not more than 125% of the motor full-load current rating for sealed (hermetic-type) refrigeration compressor motors and motors marked to have a temperature rise not over 40°C., and at not more than 115% for all other types of motors. This value may be modified as permitted by section E 430.034. For a multispeed motor each winding connection shall be considered separately.

(b) A thermal protector integral with the motor, approved for use with the motor which it protects on the basis that it will prevent dangerous overheating of the motor due to overload or failure to start. Where the motor current interrupting device is separate from the motor and its control circuit is operated by a protective device integral with the motor, it shall be so arranged that the opening of the control circuit will result in interruption of current to the motor.

(c) The motor shall be considered as being properly protected where it is part of an approved assembly which does not normally subject the motor to overloads and which is also equipped with other safety controls (such as the safety combustion controls of a domestic oil burner) which protect the motor against damage due to stalled rotor current. Where such protective equipment is used it shall be indicated on the nameplate of the assembly where it will be visible after installation.

(d) 1. In case the impedance of the motor windings is sufficient to prevent overheating due to failure to start, the motor may be protected as specified in subsection (2) for manually started motors.

2. Many alternating-current motors of less than 1/20 horsepower, such as clock motors, series motors, etc., and also some larger motors such as torque motors, come within this classification. It does not include split-phase motors having automatic switches to disconnect the starting windings.

(4) WOUND-ROTOR SECONDARIES. The secondary circuits of wound-rotor alternating-current motors, including conductors, controllers, resistors, etc., shall be considered as protected against overcurrent by the motor-running over-current device.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.033 Intermittent and similar duty. A motor used for a condition of service which is inherently short time, intermitent, periodic, or varying duty, as illustrated by table E 430.022 (1). Exception: Shall be considered as protected against overcurrent by the branch-circuit overcurrent device, provided the overcurrent protection does not exceed that specified in table E 430.152 and E 430.153.

Note: Any motor application shall be considered to be for continuous duty unless the nature of the apparatus which it drives shall be such that the motor cannot operate continuously with load under any condition of use.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.034 Selection or setting of protective device. (1) Where the values specified for motor-running overcurrent protection do not correspond to the standard sizes or ratings of fuses, non-adjustable circuit-breakers, thermal cut-outs, thermal relays, the heating elements of thermal trip motor switches, or possible settings of adjustable circuit-breakers adequate to carry the load, the next higher size, rating, or setting may be used, but not higher than 140% of the full-load current rating of sealed (hermetic-type) refrigeration compressor motors and motors marked to have a temperature rise not over 40° C., and not higher than 130% of the full-load current rating for all other motors.

(2) In case it is not shunted during the starting period of the motor (see section E 430.035), the protective device shall have sufficient time delay to permit the motor to start and accelerate its load.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.035 Shunting during starting period. (1) In the case of a motor that is manually started (including starting with a magnetic starter having push-button control), the running overcurrent protection may be shunted or cut out of circuit during the starting period of the motor, provided the device by which the overcurrent protection is shunted or cut out cannot be left in the starting position, and fuses

or time-delay circuit-breakers rated or set at not over 400% of the full-load current of the motor, are so located in the circuit as to be operative during the starting period of the motor.

(2) The motor-running overcurrent protection shall not be shunted or cut out during the starting period if the motor is automatically started.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.036 Fuses; in which conductor. Where fuses are used for motor-running protection, a fuse shall be inserted in each ungrounded conductor.

(1) EXCEPTION: A fuse shall also be inserted in a grounded conductor under the circumstances set forth in the note following table E 430.037.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.037 Devices other than fuses; in which conductor. Where devices other than fuses are used for motor-running overload protection, table E 430.037 shall govern the minimum allowable number and location of overcurrent units such as trip coils, relays, or thermal cutouts.

TABLE E 430.037

Kind of Motor	Supply System	Number and location of over-current units, such as trip coils, relays or thermal cutouts
1-phase A.C. or D.C.	2-wire, 1-phase A.C. or D.C. ungrounded	1 in either conductor
1-phase A.C. or D.C.	2-wire, 1-phase A.C. or D.C., one conductor grounded	1 in ungrounded conductor
1-phase A.C. or D.C.	3-wire, 1-phase A.C. or D.C., grounded-neutral	1 in either ungrounded conductor
2-phase A.C.	3-wire, 2-phase A.C., ungrounded	2, one in each phase
2-phase A.C.	3-wire, 2-phase A.C., one conductor grounded	2 in ungrounded conductors
2-phase A.C.	4-wire, 2-phase A.C. grounded or ungrounded	2, one per phase in ungrounded conductors
2-phase A.C.	5-wire, 2-phase A.C., grounded-neutral or ungrounded	2, one per phase in any ungrounded phase wire
3-phase A.C.	3-wire, 3-phase A.C., ungrounded	*2 in any 2 conductors
3-phase A.C.	3-wire, 3-phase A.C., one conductor grounded	*2 in ungrounded conductors
3-phase A.C.	3-wire, 3-phase A.C. grounded-neutral	*2 in any 2 conductors
3-phase A.C.	4-wire, 3-phase A.C. grounded-neutral or ungrounded	*2 in any 2 conductors except the neutral

Note 1: Three running overcurrent units shall be used where 3-phase motors are installed in isolated, inaccessible, or unattended locations unless the motor is protected by other approved means.

Note: Unattended (definition): Lacking the presence of a person capable of exercising responsible control of the motor under consideration.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.038 Number of conductors opened by overcurrent device. Motor-running protective devices, other than fuses, thermal cutouts, or thermal protectors, shall simultaneously open a sufficient number of ungrounded conductors to interrupt current flow to the motor.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.039 Motor controller as running overcurrent protection. A motor controller may also serve as the running overcurrent device

where the number of overcurrent units complies with section E 430.037 and where these overcurrent units are operative in both the starting and running position in the case of a direct-current motor, and in the running position in the case of an alternating-current motor. When a non-automatic motor controller serves as the running over-current device, it is recommended that all ungrounded conductors be opened.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.040 Thermal cutouts and relays. Thermal cutouts, thermal relays, and other devices for motor-running protection which are not capable of opening short-circuits, shall be protected by fuses or circuit-breakers with ratings or settings of not over 4 times the rating of the motor for which they are designed, unless approved for group installation, and marked to indicate the maximum size of fuse by which they must be protected.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.042 Motors on general purpose branch circuits. Overcurrent protection for motors used on general purpose branch circuits as permitted in Wis. Adm. Code chapter E 210, shall be provided as follows:

(1) One or more motors without individual running overcurrent protection may be connected to general purpose branch-circuits only where the limiting conditions specified for each of 2 or more motors in section E 430.053 (1) are complied with.

(2) Motors of larger ratings than specified in subsection E 430.053(1) may be connected to general purpose branch-circuits only in case each motor is protected by running overcurrent protection selected to protect the motor as specified in section E 430.032. Both the controller and the motor-running overcurrent device shall be approved for group installation with the protective device of the branch circuit to which the motor is connected. See section E 430.053.

(3) Where a motor is connected to a branch circuit by means of a plug and receptacle, and individual running overcurrent protection is omitted as provided in subsection (1), the rating of the plug and receptacle shall not exceed 15 amperes at 125 volts or 10 amperes at 250 volts. Where individual overcurrent protection is required as provided in subsection (2) for a motor or motor-operated appliance provided with an attachment plug for attaching to the branch circuit through a receptacle, the running overcurrent device shall be an integral part of the motor or of the appliance. The rating of the plug and receptacle shall be assumed to determine the rating of the circuit to which the motor may be connected, as provided in chapter E 210.

(4) The overcurrent device protecting a branch circuit to which a motor or motor-operated appliance is connected shall have sufficient time delay to permit the motor to start and accelerate its load.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.043 Automatic restarting. A motor-running protective device which can restart a motor automatically after overcurrent tripping shall not be installed unless approved for use with the motor which it protects. A motor which can restart automatically after shutdown shall not be installed so that its automatic restarting can result in injury to persons.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

D. MOTOR-BRANCH-CIRCUIT SHORT CIRCUIT AND GROUND FAULT PROTECTION

E 430.051 General. The provisions of part D specify overcurrent devices intended to protect the motor-branch-circuit conductors, the motor control apparatus, and the motors against overcurrent due to short-circuits or grounds. They are in addition to or amendatory of the provisions of chapter E 240.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.052 Rating or setting for individual motor circuit. (1) The motor-branch-circuit overcurrent device shall be capable of carrying the starting current of the motor. Overcurrent protection shall be considered as being obtained when this overcurrent device has a rating or setting not exceeding the values given in table E 430.152 or E 430.153; provided that where the overcurrent protection specified in the table is not sufficient for the starting current of the motor, it may be increased, but shall in no case exceed 225% of the motor full load current for sealed (hermetic-type) refrigeration compressor motors of 400 KVA locked rotor or less, nor more than 400% for other motors.

(2) For a multispeed motor, a single short-circuit and ground fault protective device may be used for one or more windings of the motor provided the rating of the protective device does not exceed the above applicable percentage of the nameplate rating of the smallest winding protected.

(3) Where maximum protective device ratings shown on manufacturer's heater table for use with a motor controller are less than 15 amperes, the protective device rating shall not exceed the manufacturer's values marked on the equipment.

Note 1: Branch circuit protective device ratings calculated on this basis are given in columns 4, 5, 6, and 7, table E 430.146.

Note 2: See example No. 8, chapter E 900, and diagram in section E 430.001.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.053 Several motors on one branch circuit. Two or more motors may be connected to the same branch circuit under the following conditions:

(1) Two or more motors each not exceeding one horsepower in rating and each having a full-load rated capacity not exceeding 6 amperes, may be used on a branch circuit protected at not more than 20 amperes at 125 volts or less, or 15 amperes at 600 volts or less. Individual running overcurrent protection is unnecessary for such motors unless required by the provisions of section E 430.032.

(2) If the branch circuit protective device is selected not to exceed that allowed by section E 430.052 for the motor of the smallest rating, 2 or more motors each having individual running overcurrent protection may be connected to a branch circuit when it can be determined that branch circuit protective device will not open under the most severe normal conditions of service which might be encountered.

(3) Except as provided for in subsection (4), 2 or more motors of any rating, each having individual running overcurrent protection, may be connected to one branch circuit provided all of the following conditions are complied with:

(a) Each motor-running overcurrent device must be approved for group installation.

(b) Each motor controller must be approved for group installation.

(c) The branch circuit shall be protected by fuses having a rating not exceeding that specified in section E 430.052 for the largest motor connected to the branch circuit plus an amount equal to the sum of the full load current ratings of all other motors connected to the circuit.

(d) The branch circuit fuses must not be larger than allowed by section E 430.040 for the thermal cutout or relay protecting the smallest motor of the group.

(e) The conductors of any tap supplying a single motor need not have individual branch circuit protection, provided they comply with either of the following: 1. No conductor to the motor shall have an ampacity less than that of the branch circuit conductors, or 2. No conductor to the motor shall have an ampacity less than one-third that of the branch circuit conductors, with a minimum in accordance with section E 430.022; the conductors to the motor-running protective device being not more than 25 feet long and being protected from physical damage.

(4) The nameplate marking of a room air conditioner unit shall be used in determining the branch circuit requirements, and each unit shall be considered as a single-motor unit unless the nameplate is otherwise marked. For the purpose of this paragraph a room air conditioner is an alternating-current hermetic type air cooled window, console, or in-wall room air conditioner which is installed in the conditioned room. It covers equipment rated not greater than 250 volts, single phase. It also applies to such a room air conditioner, if it has provisions for heating.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.054 Combined overcurrent protection. Motor-branch-circuit overcurrent protection and motor-running overcurrent protection may be combined in a single overcurrent device when the rating or setting of the device provides the running overcurrent protection specified in section E 430.032.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.055 Overcurrent devices; in which conductor. Overcurrent devices shall comply with the provisions of section E 240.11.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.056 Size of fuseholder. Where fuses are used for motor-branch-circuit protection, the fuseholders shall not be of a smaller size than required to accommodate the fuses specified by table E 430.146.

(1) Exception. Where fuses having time delay appropriate for the starting characteristics of the motor are used, fuseholders of smaller size than specified in table E 430.146 may be used.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.057 Rating of circuit-breaker. A circuit-breaker for motor-branch circuit protection shall have a continuous current rating of not less than 115% of the full load current rating of the motor.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.058 Feeder taps in inaccessible location. If the location of the connection of a tap to the feeder conductors is not accessible, the motor-branch-circuit overcurrent device may be placed where it will be accessible, provided the conductors between the tap and the overcurrent device have the same ampacity as the feeder; or provided they have an ampacity of at least ⅓ that of the feeder and are not more than 25 feet long and are protected from physical damage. Where feeders are at a greater elevation than 25 feet, this distance may be increased to 50 feet.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.059 Selection or setting of protective device. In case the values for branch circuit protective devices determined by table E 430.152 or E 430.153 do not correspond to the standard sizes or ratings of fuses, non-adjustable circuit-breakers, or thermal devices, or possible settings of adjustable circuit-breakers adequate to carry the load, the next higher size, rating or setting may be used. (See sections E 240.06 and E 240.07 for standard ratings.)

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E. MOTOR-FEEDER SHORT-CIRCUIT AND GROUND FAULT PROTECTION

E 430.061 General. The provisions of part E specify overcurrent devices intended to protect feeder conductors supplying motors against overcurrents due to short-circuits or grounds.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.062 Rating or setting; motor load. (1) A feeder which supplies a specific fixed motor load and consisting of conductor sizes based on section E 430.024 shall be provided with overcurrent protection which shall not be greater than the largest rating or setting of the branch-circuit protective device, for any motor of the group (based on tables E 430.152 and E 430.153), plus the sum of the full-load currents of the other motors of the group.

Note 1. Where 2 or more motors of equal horsepower rating are the largest in the group, one of these motors should be considered as the largest for the above calculations.

Note 2. Where 2 or more motors of a group must be started simultaneously, it may be necessary to install larger feeder conductors and correspondingly larger ratings or settings of feeder overcurrent protection.

Note 3. See example 8, chapter E 900.

(2) For large capacity installations, where heavy capacity feeders are installed to provide for future additions or changes, the feeder overcurrent protection may be based on the rated current-carrying capacity of the feeder conductors.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.063 Rating or setting; power and light loads. Where a feeder supplies a motor load, and in addition a lighting or a lighting and appliance load, the feeder overcurrent protective device may have a rating or setting sufficient to carry the lighting or the lighting and appliance load as determined in accordance with chapters E 210 and

E 220 plus, for a single motor, the rating permitted by section E 430.052, and for 2 or more motors, the rating permitted by section E 430.062.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

F. MOTOR-CONTROL CIRCUITS

E 430.071 General. Part F contains modifications of the general requirements and applies to the particular conditions of motor control circuits.

Note: Control circuit (definition): The control circuit of a control apparatus or system is the circuit which carries the electric signals directing the performance of the controller, but does not carry the main power circuit.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.072 Overcurrent protection. Conductors of control circuits shall be protected against overcurrent in accordance with section E 240.05, Exception No. 5. Exception: Such conductors shall be considered as being properly protected by the branch-circuit overcurrent devices under any one of the following conditions:

(1) Where the rating or setting of the branch-circuit overcurrent device is not more than 500% of the ampacity of the control-circuit conductors.

(2) Where the controlled device and the point of control (start and stop buttons, pressure switch, thermostatic switch, etc.) are both located on the same machine and the control circuit does not extend beyond the machine.

(3) Where the opening of the control circuit would create a hazard; as for example, the control circuit of fire-pump motors, and the like.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.073 Mechanical protection of conductor. (1) Where damage to a control circuit would constitute a hazard, all conductors of such remote-control circuit shall be installed in a raceway or be otherwise suitably protected from physical damage outside the control device itself.

(2) Control circuits shall be so arranged that an accidental ground in the remote control devices will not start the motor.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.074 Disconnection. (1) Control circuits shall be so arranged that they will be disconnected from all sources of supply when the disconnecting means is in the open position. The disconnecting means may consist of 2 separate devices, one of which disconnects the motor and the controller from the source of power supply for the motor, and the other, the control circuit from its power supply. Where the 2 separate devices are used, they shall be located immediately adjacent one to the other.

(2) Where a transformer or other device is used to obtain a reduced voltage for the control circuit and is located in the controller, such transformer or other device shall be connected to the load side of the disconnecting means for the control circuit.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

G. MOTOR CONTROLLERS

E 430.081 General. The provisions of part G are intended to require suitable controllers for all motors.

(1) DEFINITION. For definition of "controller", see chapter E 100. For the purpose of this chapter, the term "controller" includes any switch or device normally used to start and stop the motor.

(2) STATIONARY MOTOR OF ⅛ HORSEPOWER OR LESS. For a stationary motor rated at ⅛ horsepower or less, that is normally left running and is so constructed that it cannot be damaged by overload or failure to start, such as clock motors and the like, the branch circuit overcurrent device may serve as the controller.

(3) PORTABLE MOTOR OF ⅛ HORSEPOWER OR LESS. For a portable motor rated at ⅛ horsepower or less, the controller may be an attachment plug and receptacle.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.082 Controller design. (1) CONTROLLER. Each controller shall be capable of starting and stopping the motor which it controls, and for an alternating-current motor shall be capable of interrupting the stalled-rotor current of the motor.

(2) AUTO-TRANSFORMER. An auto-transformer starter shall provide an off position, a running position, and at least one starting position. It shall be so designed that it cannot rest in the starting position, or in any position which will render inoperative the overcurrent protective device in the circuit.

(3) RHEOSTATS. Rheostats shall conform to the following: (a) *Internal connections.* Motor-starting rheostats shall be so designed that the contact arm cannot be left on intermediate segments. The point or plate on which the arm rests when in the starting position shall have no electrical connection with the resistor.

(b) *Under-voltage release, direct-current motors.* Motor-starting rheostats for direct-current motors operated from a constant voltage supply shall be equipped with automatic devices which will interrupt the supply before the speed of the motor has fallen to less than one-third its normal value.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.083 Rating. The controller shall have a horsepower rating, which shall not be lower than the horsepower rating of the motor, except as follows:

(1) EXCEPTION NO. 1. STATIONARY MOTOR OF 2 HORSEPOWER OR LESS. For a stationary motor rated at 2 horsepower or less, and 300 volts or less, the controller may be a general-use switch having an ampere rating at least twice the full-load current rating of the motor. On AC circuits, general use snap switches suitable only for use on AC (not general use AC–DC snap switches) may be used to control a motor rated at 2 horsepower or less and 300 volts or less having a full-load current rating not exceeding 80% of the ampere rating of the switch.

(2) EXCEPTION NO. 2. CIRCUIT-BREAKER AS CONTROLLER. A branch-circuit circuit-breaker, rated in amperes only, may be used as a con-

troller. Where this circuit-breaker is also used for overcurrent protection, it shall conform to the appropriate provisions of this chapter governing overcurrent protection.

(3) EXCEPTION NO. 3. SEALED (HERMETIC-TYPE) REFRIGERATION COMPRESSOR MOTORS. The motor controller shall have both a continuous duty full-load current rating, and a locked-rotor current rating, not less than the nameplate full-load current and locked-rotor current, respectively, of the compressor. In case the motor controller is rated in horsepower, but is without one or both of the foregoing current ratings, equivalent currents shall be determined from the rating as follows: Use table E 430.148, E 430.149, or E 430.150 to determine the equivalent full-load current rating. Use table E 430.151 to determine the equivalent locked-rotor current rating.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.084 Need not open all conductors. Except when it serves also as a disconnecting means (see section E 430.111), the controller need not open all conductors to the motor.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.085 In grounded conductors. One pole of the controller may be placed in a permanently grounded conductor provided the controller is so designed that the pole in the grounded conductor cannot be opened without simultaneously opening all conductors of the circuit.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.086 Motor not in sight from controller. Where a motor and the driven machinery are not in sight from the controller location, the installation shall comply with one of the following conditions:

(1) The controller disconnecting means is capable of being locked in the open position.

(2) A manually-operable switch which will disconnect the motor from its source of supply is placed within sight from the motor location.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.087 Number of motors served by each controller. Each motor shall be provided with an individual controller. Exception: For motors of 600 volts or less a single controller may serve a group of motors under any one of the following conditions:

(1) Where a number of motors drive several parts of a single machine or piece of apparatus such as metal and wood-working machines, cranes, hoists, and similar apparatus.

(2) Where a group of motors is under the protection of one overcurrent device as permitted in subsection E 430.053 (1).

(3) Where a group of motors is located in a single room within sight from the controller location.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.088 Adjustable-speed motors. Adjustable-speed motors that are controlled by means of field regulation shall be so equipped and connected that they cannot be started under weakened field, unless the motor is designed for such starting.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.089 Speed limitation. Machines of the following types shall be provided with speed limiting devices.

(1) Separately-excited direct-current motors.

(2) Series motors.

(3) Motor-generators and converters which can be driven at excessive speed from the direct-current end, as by a reversal of current or decrease in load.

(a) *Exception No. 1.* Unless the inherent characteristics of the machines, the system, or the load and the mechanical connection thereto, are such as to safely limit the speed.

(b) *Exception No. 2.* Unless the machine is always under the manual control of a qualified operator.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.090 Combination fuseholder and switch as controller. The rating of a combination fuseholder and switch used as a motor-controller shall be such that the fuseholder will accommodate the size of fuse specified in table E 430.146, for motor-running overcurrent protection.

(1) EXCEPTION. Where fuses having time delay appropriate for the starting characteristics of the motor are used, fuseholders of smaller size than specified in table E 430.146 may be used.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

H. DISCONNECTING MEANS

E 430.101 General. The provisions of part H are intended to require disconnecting means capable of disconnecting motors and controllers from the circuit.

Note: See diagram E 430.001.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.102 In sight from controller location. A disconnecting means shall be located in sight from the controller location, except as recognized in section E 422.26.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.103 To disconnect both motor and controller. The disconnecting means shall disconnect both the motor and the controller from all ungrounded supply conductors. The disconnecting means may be in the same enclosure with the controller. See section E 430.113.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.104 To be indicating. The disconnecting means shall plainly indicate whether it is in the open or closed position.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.105 Grounded conductors. One pole of the disconnecting means may disconnect a permanently grounded conductor, provided the disconnecting means is so designed that the pole in the grounded conductor cannot be opened without simultaneously disconnecting all conductors of the circuit.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.106 Service switch as disconnecting means. Where an installation consists of a single motor, the service switch may serve as the disconnecting means, provided it conforms to the requirements of this chapter, and is within sight from the controller location, except as recognized in section E 422.26.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.107 Readily accessible. One of the disconnecting means shall be readily accessible.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.108 Every switch. Every switch in the motor branch circuit within sight from the controller location shall comply with the requirements of part H.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.109 Type. The disconnecting means shall be a motor-circuit switch, rated in horsepower, or a circuit-breaker, except as permitted in section E 430.109 (1), (2), (3), (4), or (5).

(1) ONE-EIGHTH HORSEPOWER OR LESS. For stationary motors of ⅛ horsepower or less, the branch-circuit overcurrent device may serve as the disconnecting means.

(2) TWO HORSEPOWER OR LESS. For stationary motors rated at 2 horsepower or less and 300 volts or less, the disconnecting means may be a general-use switch having an ampere rating not less than twice the full-load current rating of the motor. On AC circuits, general use snap switches suitable only for use on AC (not general use AC–DC snap switches) may be used to disconnect a motor having a full-load current rating not exceeding 80% of the ampere rating of the switch.

(3) OVER 2 HORSEPOWER TO AND INCLUDING 50 HORSEPOWER. The separate disconnecting means required for a motor with an autotransformer type of controller may be a general-use switch where all of the following provisions are complied with:

(a) The motor drives a generator which is provided with overcurrent protection.

(b) The controller 1. is capable of interrupting the stalled-rotor current of the motor, 2. is provided with a no-voltage release, and 3. is provided with running-overcurrent protection not exceeding 125% of the motor full-load current rating.

(c) Separate fuses or a circuit-breaker, rated or set at not more than 150% of the motor full-load current, are provided in the motor branch circuit.

(4) EXCEEDING 50 HORSEPOWER. (a) For stationary motors rated at more than 50 horsepower, the disconnecting means may be a motor-circuit switch also rated in amperes, a general-use switch, or an isolating switch.

(b) Isolation switches for motors exceeding 50 horsepower, not capable of interrupting stalled-rotor currents, shall be plainly marked "Do not open under load."

(5) PORTABLE MOTORS. For portable motors an attachment plug and receptacle may serve as the disconnecting means.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.110 Ampacity and interrupting capacity. (1) The disconnecting means shall have an ampacity of at least 115% of the full-load current rating of the motor.

(2) The disconnecting means for sealed (hermetic-type) refrigeration compressors shall be selected on the basis of the nameplate full-load current and locked-rotor current respectively of the compressor motor as follows:

(a) The ampacity shall be at least 115% of the nameplate full-load current.

(b) To determine the equivalent horsepower in complying with the requirements of section E 430.109, select the horsepower rating from tables E 430.148, E 430.149, and E 430.150 corresponding to the full-load current, and also the horsepower rating from table E 430.151 corresponding to the locked-rotor current. In case the nameplate full-load current and locked-rotor current do not correspond to the currents shown in tables E 430.148, E 430.149, and E 430.150, respectively, the horsepower rating corresponding to the next higher value shall be selected. In case 2 different horsepower ratings are obtained when applying tables E 430.148, E 430.149, E 430.150 and E 430.151, a horsepower rating at least equal to the larger of the 2 values obtained shall be selected.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.111 Switch or circuit-breaker as both controller and disconnecting means. (1) A switch or circuit-breaker complying with the provisions of section E 430.083 may serve as both controller and disconnecting means provided it opens all ungrounded conductors to the motor, is protected by an overcurrent device (which may be the branch circuit fuses) which opens all ungrounded conductors to the switch or circuit-breaker, and is of one of the following types:

(a) An air-break switch, operable directly by applying the hand to a lever or handle.

(b) A circuit-breaker operable directly by applying the hand to a lever or handle.

(c) An oil switch used on a circuit whose rating does not exceed 600 volts or 100 amperes, or by special permission on a circuit exceeding this capacity where under expert supervision.

(2) The oil switch or circuit-breaker specified above may be both power and manually operable. If power operable, provision should be made to lock it in the open position.

(3) The overcurrent device protecting the controller may be part of the controller assembly or may be separate.

(4) An auto-transformer type of controller is not included above and will require a separate disconnecting means.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.112 Motors served by a single disconnecting means. (1) Each motor shall be provided with individual disconnecting means. Exception: For motors of 600 volts or less a single disconnecting means may serve a group of motors under any one of the following conditions:

(a) Where a number of motors drive several parts of a single machine or piece of apparatus such as metal and woodworking machines, cranes, and hoists.

(b) Where a group of motors is under the protection of one set of overcurrent devices as permitted by subsection E 430.053 (1).

(c) Where a group of motors is in a single room within sight from the location of the disconnecting means.

(2) The disconnecting means shall have a rating not less than is required by section E 430.109 for a single motor, the rating of which equals the sum of the horsepowers or currents of all the motors of the group.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.113 Energy from more than one source. Equipment receiving electrical energy from more than one source shall be provided with disconnecting means from each source of electrical energy adjacent to the equipment served.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

J. REQUIREMENTS FOR OVER 600 VOLTS

E 430.121 General. The provisions of part J recognize the additional hazard due to the use of high voltage. They are in addition to or amendatory of the other provisions of this chapter. Other requirements for circuits and equipment operating at more than 600 volts are in Wis. Adm. Code chapter E 710.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.122 More than 7500 volts. Motors operating at more than 7500 volts between conductors shall be installed in fire-resistant motor rooms.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.123 Motor running overcurrent (overload) protection. Running overcurrent protection for a motor of over 600 volts shall consist either of a circuit-breaker, or of overcurrent units integral with the controller which shall simultaneously open all ungrounded conductors to the motor. The overcurrent device shall have a setting as specified elsewhere in this chapter for motor-running overcurrent (overload) protection.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.124 Short-circuit and ground fault protection. Each motor branch circuit and feeder of more than 600 volts shall be protected against overcurrent by one of the following means:

(1) A circuit-breaker of suitable rating so arranged that it can be serviced without hazard.

(2) Fuses of the oil-filled or other suitable type. Fuses shall be used with suitable disconnecting means or they shall be of a type which can also serve as the disconnecting means. They shall be so arranged that they cannot be re-fused or replaced while they are energized.

(3) Differential protection may be employed to protect an alternating-current motor, the motor control apparatus, and the branch-circuit conductors against over-current due to short circuits or grounds. When all these elements are included within the protected zone of a differential protective system, the ratings or settings specified in section E 430.052 do not apply.

Note 1. A differential protective system is a combination of 2 or more sets of current transformers and a relay or relays energized from their interconnected secondaries. The primaries of the current transformers

are connected on both sides of the equipment to be protected, both ends of the motor phase windings being brought out for this purpose. All of the apparatus and circuits included between the sets of current transformer primaries constitute the protected zone. The current transformer secondaries and the relay elements are so interconnected that the relay elements respond only to a predetermined difference between the currents entering and leaving the protected zone. When actuated, the relay or relays serve to trip the branch-circuit circuit-breaker, thus disconnecting the motor, control apparatus in the motor circuit and the branch-circuit conductors from the source of power and, in the case of a synchronous motor, de-energizing its field circuit.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.126 Disconnecting means. The circuit-breaker or the fuses specified in section E 430.124 may constitute the disconnecting means if they conform to the other applicable requirements of this chapter.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

K. PROTECTION OF LIVE PARTS—ALL VOLTAGES

E 430.131 General. The provisions of part K specify that live parts shall be protected in a manner judged adequate to the hazard involved.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.132 Where required. Exposed live parts of motors and controllers operating at 50 volts or more between terminals, shall be guarded against accidental contact by enclosure, or by location as follows:

(1) By installation in a room or enclosure which is accessible only to qualified persons;

(2) By installation on a suitable balcony, gallery or platform, so elevated and arranged as to exclude unqualified persons;

(3) By elevation 8 feet or more above the floor;

(4) So that it will be protected by a guard rail when the motor operates at 600 volts or less.

Exception. Stationary motors having commutators, collectors and brush rigging located inside of motor end brackets and not conductively connected to supply circuits operating at more than 150 volts to ground.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.133 Guards for attendants. Where the live parts of motors or controllers operating at more than 150 volts to ground are guarded against accidental contact only by location as specified in section E 430.132, and where adjustment or other attendance may be necessary during the operation of the apparatus, suitable insulating mats or platforms shall be provided so that the attendant cannot readily touch live parts unless standing on the mats or platforms. Where necessary, steps and handrails should be installed on or about large machines to afford safe access to parts which must be examined or adjusted during operation.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

L. GROUNDING

E 430.141 General. The provisions of part L specify the grounding of motor and controller frames to prevent a potential above ground in the event of accidental contact between live parts and frames. Insula-

tion, isolation, or guarding are suitable alternatives to grounding of motors under certain conditions.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.142 Stationary motors. (1) The frames of stationary motors shall be grounded where any of the following conditions exist:

(a) Supplied by means of metal-enclosed wiring.

(b) Located in a wet place and not isolated nor guarded.

(c) In a hazardous location. (See Wis. Adm. Code chapters E 500 to E 517 inclusive.)

(d) The motor operates with any terminal at more than 150 volts to ground.

(2) Grounding of the motor frame is preferable, but where the frame of the motor is not grounded, it shall be permanently and effectively insulated from the ground.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.143 Portable motors. The frames of portable motors which operate at more than 150 volts to ground shall be guarded or grounded. See section E 250.045 (4) on grounding of portable appliances in other than residential occupancies.

Note 1. It is recommended that the frames of motors which operate at less than 150 volts to ground be grounded where this can be readily accomplished.

Note 2: See section E 250.059 (2) for color of grunding conductor.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.144 Controllers. Controller cases, except those attached to ungrounded portable equipment and except the lined covers of snap switches, shall be grounded regardless of voltage.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 430.145 Method of grounding. Grounding where required shall be done in the manner specified in Wis. Adm. Code chapter E 250.

(1) GROUNDING THROUGH TERMINAL HOUSINGS. Where the wiring to fixed motors is in type AC metal-clad cable or metal raceways, junction boxes to house motor terminals shall be provided, and the armor of the cable or the metal raceways shall be connected to them in the manner specified in chapter E 250.

(2) SEPARATION OF JUNCTION BOX FROM MOTOR. The junction box required by subsection (1) may be separated from the motor not more than 6 feet provided the leads to the motor are type AC metal-clad cable or armored cord or are stranded leads enclosed in flexible or rigid conduit or electrical metallic tubing not smaller than ⅜ inch electrical trade size, the armor or raceway being connected both to the motor and to the box. Where stranded leads are used, protected as specified above, they shall not be larger than No. 10, and shall comply with other requirements of the code for conductors to be used in raceways.

(3) GROUNDING OF CONTROLLER MOUNTED DEVICES. Instrument transformer secondaries, and exposed noncurrent-carrying metal or other conductive parts or cases of instrument transformers, motors, instruments, and relays shall be grounded as specified in Wis. Adm. Code sections E 250.121 through E 250.125.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

TABLE E 430.146
OVERCURRENT PROTECTION FOR MOTORS
(See tables E 430.152 and E 430.153)

These values are in accordance with sections E 430.006, E 430.022, E 430.032, E 430.034, E 430.052, E 430.059, except as follows: The current values in column 1 are to be taken from tables E 430.147 through E 430.150, including footnotes, but the values shown for running protection in columns 2 and 3 must be modified if nameplate full load current values are different, as provided in section E 430.006. The current values shown in columns 2 and 3 must be reduced by 8% for all motors other than open type motors marked to have a temperature rise of not over 40° C. as required by section E 430.032. For certain exceptions to the values in columns 4, 5, 6, and 7, see sections E 430.052 and E 430.059. See section E 430.053 for values to be used for several motors on one branch circuit. For running protection of motors, see section E 430.032. For setting of motor-branch-circuit protective devices, see tables in sections E 430.152 and E 430.153. For grouping of small motors under the protection of a single set of fuses, see section E 430.053.

Col. No. 1	2	3	4		5		6		7	
			Maximum Allowable Rating or Setting of Branch Circuit Protective Devices							
	For Running Protection of Motors		WITH CODE LETTERS Single phase, squirrel cage and synchronous. Full voltage, resistor or reactor starting, Code letters F to V inclusive.		WITH CODE LETTERS Single phase, squirrel cage and synchronous. Full voltage, resistor or reactor start, Code letters B to E inclusive. Auto-transformer start, Code letters F to V inclusive.		WITH CODE LETTERS Squirrel cage and synchronous auto-transformer start, Code letters B to E inclusive.		WITH CODE LETTERS All motors Code letter A.	
Full load current rating of motor amperes	Maximum rating of nonadjustable protective devices.	Maximum setting of adjustable protective devices.	WITHOUT CODE LETTERS Same as above.		WITHOUT CODE LETTERS (Not more than 30 Amperes) squirrel cage and synchronous, auto-transformer start, high reactance squirrel cage.*		WITHOUT CODE LETTERS (More than 30 amperes) squirrel cage and synchronous auto-transformer start, high reactance squirrel cage.*		WITHOUT CODE LETTERS DC and wound rotor motors.	
	Amperes	Amperes	Fuses	Circuit Breakers (Non-adjustable Over-load Trip)	Fuses	Circuit Breakers (Non-adjustable Over-load Trip)	Fuses	Circuit Breakers (Non-adjustable Over-load Trip)	Fuses	Circuit Breakers (Non-adjustable Over-load Trip)
1	2	1.25	15	15	15	15	15	15	15	15
2	3	2.50	15	15	15	15	15	15	15	15
3	4	3.75	15	15	15	15	15	15	15	15
4	6	5.0	15	15	15	15	15	15	15	15
5	8	6.25	15	15	15	15	15	15	15	15
6	8	7.50	20	15	15	15	15	15	15	15
7	10	8.75	25	20	20	15	15	15	15	15
8	10	10.0	25	20	20	20	20	20	15	15
*See note at end of table.										
9	12	11.25	30	30	25	20	20	20	15	15
10	15	12.50	30	30	25	20	20	20	15	15
11	15	13.75	35	30	30	30	25	30	20	20
12	15	15.00	40	30	30	30	25	30	20	20
13	20	16.25	40	40	35	30	30	30	20	20
14	20	17.50	45	40	35	30	30	30	25	30
15	20	18.75	45	40	40	30	30	30	25	30
16	20	20.00	50	40	40	40	35	40	25	30

Col. No. 1	2	3	4		5		6		7	
			Maximum Allowable Rating or Setting of Branch Circuit Protective Devices							
	For Running Protection of Motors		WITH CODE LETTERS Single phase, squirrel cage and synchronous. Full voltage, resistor or reactor starting, Code letters F to V inclusive. WITHOUT CODE LETTERS Same as above.		WITH CODE LETTERS Single phase, squirrel cage and synchronous. Full voltage, resistor or reactor start, Code letters B to E inclusive. Auto-transformer start, Code letters F to V inclusive. WITHOUT CODE LETTERS (Not more than 30 Amperes) squirrel cage and synchronous, auto-transformer start, high reactance squirrel cage.*		WITH CODE LETTERS Squirrel cage and synchronous auto-transformer start, Code letters B to E inclusive. WITHOUT CODE LETTERS (More than 30 amperes) squirrel cage and synchronous auto-transformer start, high reactance squirrel cage.*		WITH CODE LETTERS All motors Code letter A. WITHOUT CODE LETTERS DC and wound rotor motors.	
Full load current rating of motor amperes	Maximum rating of nonadjustable protective devices.	Maximum setting of adjustable protective devices.	Fuses	Circuit Breakers (Non-adjustable Over-load Trip)	Fuses	Circuit Breakers (Non-adjustable Over-load Trip)	Fuses	Circuit Breakers (Non-adjustable Over-load Trip)	Fuses	Circuit Breakers (Non-adjustable Over-load Trip)
	Amperes	Amperes								
17	25	21.25	60	50	45	40	35	40	30	30
18	25	22.50	60	50	45	40	40	40	30	30
19	25	23.75	60	50	50	40	40	40	30	30
20	25	25.00	60	50	50	40	40	40	30	30
22	30	27.50	70	70	60	50	45	50	35	40
24	30	30.00	80	70	60	50	50	50	40	40
26	35	32.50	80	70	70	70	60	70	40	40
28	35	35.00	90	70	70	70	60	70	45	50
30	40	37.50	90	100	80	70	60	70	45	50
32	40	40.00	100	100	80	70	70	70	50	50
34	45	42.50	110	100	90	70	70	70	60	70
36	45	45.00	110	100	90	100	80	100	60	70
38	50	47.50	125	100	100	100	80	100	60	70
40	50	50.00	125	100	100	100	80	100	60	70
42	50	52.50	125	125	110	100	90	100	70	70
44	60	55.00	125	125	110	100	90	100	70	70
46	60	57.50	150	125	125	100	100	100	70	70
48	60	60.00	150	125	125	100	100	100	80	100
50	60	62.50	150	125	125	100	100	100	80	100
52	70	65.00	175	150	150	125	110	125	80	100
54	70	67.50	175	150	150	125	110	125	90	100
56	70	70.00	175	150	150	125	125	125	90	100
58	70	72.50	175	150	150	125	125	125	90	100
60	80	75.00	200	150	150	125	125	125	90	100
62	80	77.50	200	175	175	125	125	125	100	100
64	80	80.00	200	175	175	150	150	150	100	100
66	80	82.50	200	175	175	150	150	150	100	100
68	90	85.00	225	175	175	150	150	150	110	125
70	90	87.50	225	175	175	150	150	150	110	125
72	90	90.00	225	200	200	150	150	150	110	125
74	90	92.50	225	200	200	150	150	150	125	125
76	100	95.00	250	200	200	175	175	175	125	125
78	100	97.50	250	200	200	175	175	175	125	125
80	100	100.00	250	200	200	175	175	175	125	125
82	110	102.50	250	225	225	175	175	175	125	125
84	110	105.00	250	225	225	175	175	175	150	150

Col. No. 1	2	3	4		5		6		7	
			Maximum Allowable Rating or Setting of Branch Circuit Protective Devices							
	For Running Protection of Motors		WITH CODE LETTERS Single phase, squirrel cage and synchronous. Full voltage, resistor or reactor starting, Code letters F to V inclusive.		WITH CODE LETTERS Single phase, squirrel cage and synchronous. Full voltage, resistor or reactor start, Code letters B to E inclusive. Auto-transformer start, Code letters F to V inclusive.		WITH CODE LETTERS Squirrel cage and synchronous auto-transformer start, Code letters B to E inclusive.		WITH CODE LETTERS All motors Code letter A.	
Full load current rating of motor amperes	Maximum rating of nonadjustable protective devices.	Maximum setting of adjustable protective devices.	WITHOUT CODE LETTERS Same as above.		WITHOUT CODE LETTERS (Not more than 30 Amperes) squirrel cage and synchronous, auto-transformer start, high reactance squirrel cage.*		WITHOUT CODE LETTERS (More than 30 amperes) squirrel cage and synchronous auto-transformer start, high reactance squirrel cage.*		WITHOUT CODE LETTERS DC and wound rotor motors.	
	Amperes	Amperes	Fuses	Circuit Breakers (Non-adjustable Over-load Trip)	Fuses	Circuit Breakers (Non-adjustable Over-load Trip)	Fuses	Circuit Breakers (Non-adjustable Over-load Trip)	Fuses	Circuit Breakers (Non-adjustable Over-load Trip)
86	110	107.50	300	225	225	175	175	175	150	150
88	110	110.00	300	225	225	200	200	200	150	150
90	110	112.50	300	225	225	200	200	200	150	150
92	125	115.00	300	250	250	200	200	200	150	150
94	125	117.50	300	250	250	200	200	200	150	150
96	125	120.00	300	250	250	200	200	200	150	150
98	125	122.50	300	250	250	200	200	200	150	150
100	125	125.00	300	250	250	200	200	200	150	150
105	150	131.50	350	300	300	225	225	225	175	175
110	150	137.50	350	300	300	225	225	225	175	175
115	150	144.00	350	300	300	250	250	250	175	175
120	150	150.00	400	300	300	250	250	250	200	200
125	175	156.50	400	350	350	250	250	250	200	200
130	175	162.50	400	350	350	300	300	300	200	200
135	175	169.00	450	350	350	300	300	300	225	225
140	175	175.00	450	350	350	300	300	300	225	225
145	200	181.50	450	400	400	300	300	300	225	225
150	200	187.50	450	400	400	300	300	300	225	225
155	200	194.00	500	400	400	350	350	350	250	250
160	200	200.00	500	400	400	350	350	350	250	250
165	225	206.00	500	500	450	350	350	350	250	250
170	225	213.00	500	500	450	350	350	350	300	300
175	225	219.00	600	500	450	350	350	350	300	300
180	225	225.00	600	500	450	400	400	400	300	300
185	250	231.00	600	500	500	400	400	400	300	300
190	250	238.00	600	500	500	400	400	400	300	300
195	250	244.00	600	500	500	400	400	400	300	300
200	250	250.00	600	500	500	400	400	400	300	300
210	250	263.00	800	600	600	500	450	500	350	350
220	300	275.00	800	600	600	500	450	500	350	350
230	300	288.00	800	600	600	500	500	500	350	350
240	300	300.00	800	600	600	500	500	500	400	400

Col. No. 1	2	3	4		5		6		7	
			Maximum Allowable Rating or Setting of Branch Circuit Protective Devices							
Full load current rating of motor amperes	For Running Protection of Motors		WITH CODE LETTERS Single phase, squirrel cage and synchronous. Full voltage, resistor or reactor starting, Code letters F to V inclusive.		WITH CODE LETTERS Single phase, squirrel cage and synchronous. Full voltage, resistor or reactor start, Code letters B to E inclusive. Auto-transformer start, Code letters F to V inclusive.		WITH CODE LETTERS Squirrel cage and synchronous auto-transformer start, Code letters B to E inclusive.		WITH CODE LETTERS All motors Code letter A.	
	Maximum rating of nonadjustable protective devices.	Maximum setting of adjustable protective devices.	WITHOUT CODE LETTERS Same as above.		WITHOUT CODE LETTERS (Not more than 30 Amperes) squirrel cage and synchronous, auto-transformer start, high reactance squirrel cage.*		WITHOUT CODE LETTERS (More than 30 amperes) squirrel cage and synchronous auto-transformer start, high reactance squirrel cage.*		WITHOUT CODE LETTERS DC and wound rotor motors.	
	Amperes	Amperes	Fuses	Circuit Breakers (Non-adjustable Over-load Trip)	Fuses	Circuit Breakers (Non-adjustable Over-load Trip)	Fuses	Circuit Breakers (Non-adjustable Over-load Trip)	Fuses	Circuit Breakers (Non-adjustable Over-load Trip)
250	300	313.00	800	700	800	500	500	500	400	400
260	350	325.00	800	700	800	600	600	600	400	400
270	350	338.00	1000	700	800	600	600	600	450	500
280	350	350.00	1000	700	800	600	600	600	450	500
290	350	363.00	1000	800	800	600	600	600	450	500
300	400	375.00	1000	800	800	600	600	600	450	500
320	400	400.00	1000	800	800	700	800	700	500	500
340	450	425.00	1200	---	1000	700	800	700	600	600
360	450	450.00	1200	---	1000	800	800	800	600	600
380	500	475.00	1200	---	1000	800	800	800	600	600
400	500	500.00	1200	---	1000	800	800	800	600	600
420	600	525.00	1600	---	1200	---	1000	---	800	700
440	600	550.00	1600	---	1200	---	1000	---	800	700
460	600	575.00	1600	---	1200	---	1000	---	800	700
480	600	600.00	1600	---	1200	---	1000	---	800	800
500	---	625.00	1600	---	1600	---	1000	---	800	800

*High-reactance squirrel-cage motors are those designed to limit the starting current by means of deep slot secondaries or double-wound secondaries and are generally started on full voltage.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

TABLE E 430.147
FULL LOAD CURRENTS IN AMPERES
Direct Current Motors

The following values of full-load currents are for motors running at base speed.

HP	120 V	240 V
¼	2.9	1.5
⅓	3.6	1.8
½	5.2	2.6
¾	7.4	3.7
1	9.4	4.7
1½	13.2	6.6
2	17	8.5
3	25	12.2
5	40	20
7½	58	29
10	76	38
15	----------	55
20	----------	72
25	----------	89
30	----------	106
40	----------	140
50	----------	173
60	----------	206
75	----------	255
100	----------	341
125	----------	425
150	----------	506
200	----------	675

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

TABLE E 430.148
FULL LOAD CURRENTS IN AMPERES
Single Phase Alternating Current Motors

The following values of full-load currents are for motors running at usual speeds and motors with normal torque characteristics. Motors built for especially low speeds or high torques may have higher full-load currents, and multispeed motors will have full load current varying with speed, in which the nameplate current ratings shall be used.

To obtain full-load currents of 208 and 200-volt motors, increase corresponding 230-volt motor full-load currents by 10 and 15%, respectively.

The voltages listed are rated motor voltages. Corresponding nominal system voltages are 110 to 120, 220 to 240, 440 to 480.

HP	115 V	230 V	440 V
1/6	4.4	2.2	----------
¼	5.8	2.9	----------
⅓	7.2	3.6	----------
½	9.8	4.9	----------
¾	13.8	6.9	----------
1	16	8	----------
1½	20	10	----------
2	24	12	----------
3	34	17	----------
5	56	28	----------
7½	80	40	21
10	100	50	26

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

TABLE E 430.149

FULL-LOAD CURRENT

Two-Phase A. C. Motors (4-wire)

The following values of full-load current are for motors running at speeds usual for belted motors and motors with normal torque characteristics. Motors built for especially low speeds or high torques may require more running current, and multispeed motors will have full load current varying with speed, in which case the nameplate current rating shall be used. Current in common conductor of 2-phase, 3-wire system will be 1.41 times value given.

The voltages listed are rated motor voltages. Corresponding nominal system voltages are 110 to 120, 220 to 240, 440 to 480 and 550 to 600 volts.

	Induction Type Squirrel-Cage and Wound Rotor Amperes					Synchronous Type *Unity Power Factor Amperes			
HP	110V	220V	440V	550V	2300V	220V	440V	550V	2300V
½	4	2	1	.8					
¾	4.8	2.4	1.2	1.0					
1	6.4	3.2	1.6	1.3					
1½	8.8	4.4	2.2	1.8					
2	11.2	5.6	2.8	2.2					
3		8	4	3.2					
5		13	7	6					
7½		19	9	8					
10		24	12	10					
15		34	17	14					
20		45	23	18					
25		55	28	22	6	47	24	19	4.7
30		67	34	27	7.5	56	29	23	5.7
40		88	44	35	9	75	37	31	7
50		108	54	43	11	94	47	38	9
60		129	65	52	13	111	56	44	11
75		158	79	63	16	140	70	57	13
100		212	106	85	21	182	93	74	17
125		268	134	108	26	228	114	93	22
150		311	155	124	31		137	110	26
200		415	208	166	41		182	145	35

*For 90 and 80% P.F. the above figures should be multiplied by 1.1 and 1.25 respectively.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

TABLE E 430.150

FULL-LOAD CURRENT*

Three-Phase A. C. Motors

	Induction Type Squirrel-Cage and Wound Rotor Amperes					Synchronous Type **Unity Power Factor Amperes			
HP	110V	220V	440V	550V	2300V	220V	440V	550V	2300V
½	4	2	1	.8					
¾	5.6	2.8	1.4	1.1					
1	7	3.5	1.8	1.4					
1½	10	5	2.5	2.0					
2	13	6.5	3.3	2.6					
3		9	4.5	4					
5		15	7.5	6					
7½		22	11	9					
10		27	14	11					
15		40	20	16					
20		52	26	21					
25		64	32	26	7	54	27	22	5.4
30		78	39	31	8.5	65	33	26	6.5
40		104	52	41	10.5	86	43	35	8
50		125	63	50	13	108	54	44	10
60		150	75	60	16	128	64	51	12
75		185	93	74	19	161	81	65	15
100		246	123	98	25	211	106	85	20
125		310	155	124	31	264	132	106	25
150		360	180	144	37		158	127	30
200		480	240	192	48		210	168	40

For full-load currents of 208 and 200 volt motors, increase the corresponding 220-volt motor full-load current by 6 and 10%, respectively.

*These values of full-load current are for motors running at speeds usual for belted motors and motors with normal torque characteristics. Motors built for especially low speeds or high torques may require more running current, and multispeed motors will have full load current varying with speed, in which case the nameplate current rating shall be used.

**For 90 and 80% P.F. the above figures should be multiplied by 1.1 and 1.25 respectively.

The voltages listed are rated motor voltages. Corresponding nominal system voltages are 110 to 120, 220 to 240, 440 to 480 and 550 to 600 volts.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

TABLE E 430.151

LOCKED-ROTOR CURRENT CONVERSION TABLE

As Determined from Horsepower and Voltage Rating
For Use Only with section E 430.083, exception No. 3, and section E 430.110 (2)
Conversion Table

Max. HP Rating	Maximum Motor Locked-Rotor Amperes					
	Single Phase		Two or Three Phase			
	115 V	230 V	110 V	220 V	440 V	550 V
½	58.8	29.4	24	12	6	4.8
¾	82.8	41.4	33.6	16.8	8.4	6.6
1	96	48	42	21	10.8	8.4
1½	120	60	60	30	15	12
2	144	72	78	39	19.8	15.6
3	204	102	----------	54	27	24
5	336	168	----------	90	45	36
7½	480	240	----------	132	66	54
10	600	300	----------	162	84	66
15	----------	----------	----------	240	120	96
20	----------	----------	----------	312	156	126
25	----------	----------	----------	384	192	156
30	----------	----------	----------	468	234	186
40	----------	----------	----------	624	312	246
50	----------	----------	----------	750	378	300
60	----------	----------	----------	900	450	360
75	----------	----------	----------	1110	558	444
100	----------	----------	----------	1476	738	588
125	----------	----------	----------	1860	930	744
150	----------	----------	----------	2160	1080	864
200	----------	----------	----------	2880	1440	1152

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

TABLE E 430.152

MAXIMUM RATING OR SETTING OF MOTOR-BRANCH-CIRCUIT PROTECTIVE DEVICES FOR MOTORS MARKED WITH A CODE LETTER INDICATING LOCKED ROTOR KVA

Type of Motor	Per Cent of Full-Load Current		
	Fuse Rating See also Table E 430.146, Columns 4, 5, 6, 7	Circuit Breaker Setting	
		Instantaneous Type	Time Limit Type
All AC single-phase and polyphase squirrel cage and synchronous motors with full-voltage, resistor or reactor starting:			
Code Letter A	150	----------	150
Code Letter B to E	250	----------	200
Code Letter F to V	300	----------	250
All AC squirrel cage and synchronous motors with auto-transformer starting:			
Code Letter A	150	----------	150
Code Letter B to E	200	----------	200
Code Letter F to V	250	----------	200

Note 1. For certain exceptions to the values specified see sections E 430.052 and E 430.054. The values given in the last column also cover the ratings of non-adjustable, time-limit types of circuit-breakers which may also be modified as in section E 430.052.

Note 2. Synchronous motors of the low-torque, low-speed type (usually 450 RPM or lower), such as are used to drive reciprocating compressors, pumps, etc., which start up unloaded, do not require a fuse rating or circuit-breaker setting in excess of 200% of full-load current.

Note 3. For motors not marked with a code letter, see table E 430.153.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

TABLE E 430.153

MAXIMUM RATING OR SETTING OF MOTOR-BRANCH-CIRCUIT PROTECTIVE DEVICES FOR MOTORS NOT MARKED WITH A CODE LETTER INDICATING LOCKED ROTOR KVA

Type of Motor	Per Cent of Full-Load Current		
	Fuse Rating See also Table E 430.146, Columns 4, 5, 6, 7	Circuit-Breaker Setting	
		Instantaneous Type	Time Limit Type
Single-phase, all types	300	----------	250
Squirrel-cage and synchronous (full-voltage, resistor and reactor starting)	300	----------	250
Squirrel-cage and synchronous (auto-transformer starting)			
Not more than 30 amperes	250	----------	200
More than 30 amperes	200	----------	200
High-reactance squirrel-cage			
Not more than 30 amperes	250	----------	250
More than 30 amperes	200	----------	200
Wound-rotor	150	----------	150
Direct-current			
Not more than 50 H.P.	150	250	150
More than 50 H.P.	150	175	150
Sealed (Hermetic Type) Refrigeration Compressor* 400 KVA locked-rotor or less	**175	----------	**175

*The locked rotor KVA is the product of the motor voltage and the motor-locked rotor current (LRA) given on the motor nameplate divided by 1,000 for single-phase motors or divided by 580 for 3-phase motors.

**This value may be increased to 225% if necessary to permit starting.

Note 1. For certain exceptions to the values specified see sections E 430.052 and E 430.059. The values given in the last column also cover the ratings of non-adjustable, time-limit types of circuit-breakers which may also be modified as in section E 430.052.

Note 2. Synchronous motors of the low-torque, low-speed type (usually 450 RPM or lower), such as are used to drive reciprocating compressors, pumps, etc., which start up unloaded, do not require a fuse rating or circuit-breaker setting in excess of 200% of full-load current.

Note 3. For motors marked with a code letter, see table E 430.152.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.