2020 NEC Code Changes

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Welcome to the Bussmann 2020 NEC Changes

- We will start promptly at noon.
- Please keep your phone/computer muted (microphone on the bottom of the screen)
- While we wait tell me what you do to get a feel for our audience by going to www.menti.com and enter the code 76 09 89
- Test out the chat feature (looks like a balloon on the bottom of the screen) to communicate with me and other attendees

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Logistics

- All phones have been muted
- Please use chat window for questions during presentation.
- For PDHs – email request after presentation.
- NEC 2020 Code Changes can be downloaded at http://electricalsector.eaton.com/bussmannseries-2020-NEC
- Check out Tom Domitrovich's YouTube Channel for a more expanded series of 2020 NEC Changes (recorded)

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Agenda

- NEC Process
- Reconditioned Equipment
- Fault Current (Available)
- Interrupting Rating and Equipment SCCR
- Service Equipment
- Arc Energy Reduction
- Selective Coordination

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NEC Process

- Code Making Panels
  - 18 panels responsible for specific Articles
  - Manufacturers, User, Installer/Maintainer, Labor, Testing Laboratory, Enforcers, Insurance, Consumer, Special Expert and Utilities (where appropriate)
  - Respond to all public inputs and public comments, modify requirements (majority at meeting, 2/3rd at ballot), provide panel statement for first revisions (first Draft) and second revisions (second draft) – available on NFPA website
  - Correlating Committee reviews actions and comments where appropriate
- NITMAN and NFPA Technical Meeting
- Standards Council Appeals and Issuance of Standard

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Reconditioned Equipment

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Reconditioned Equipment – 2017 NEC

- Added Section 110.21(A), “Equipment Markings”.
  - Reconditioned equipment must be marked with the name, trademark, or other descriptive marking by which the organization responsible for reconditioning the electrical equipment can be identified, along with the date of reconditioning.
  - Reconditioned equipment be identified as “reconditioned”
  - Change drove public inputs and comments for 2020 NEC.
  - 2020 Code changes used NEMA guidelines on refurbished equipment

Reconditioned Equipment - Definition

Reconditioned.

Electromechanical systems, equipment, apparatus, or components that are restored to operating conditions. This process differs from normal servicing of equipment that remains within a facility, or replacement of listed equipment on a one-to-one basis. (CMP-10)

Informational Note: The term *reconditioned* is frequently referred to as *rebuilt*, *refurbished*, or *remanufactured*.

110.21(A)(2) Reconditioned Equipment

- Reconditioned equipment shall be marked with the name, trademark, or other descriptive marking by which the organization responsible for reconditioning the electrical equipment can be identified, along with the date of the reconditioning.
- Reconditioned equipment shall be identified as “reconditioned” and the original listing mark removed. Approval of the reconditioned equipment shall not be based solely on the equipment's original listing.
- Exception: In industrial occupancies, where conditions of maintenance and supervision ensure that only qualified persons service the equipment, the markings indicated in 110.21(A)(2) shall not be required for equipment that is reconditioned by the owner or operator as part of a regular equipment maintenance program.
- Informational Note No. 1: Industry standards are available for application of reconditioned and refurbished equipment.
- Informational Note No. 2: The term reconditioned may be interchangeable with the terms rebuilt, refurbished, or remanufactured.
- Informational Note No. 3: The original listing mark may include the mark of the certifying body and not the entire equipment label.

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New – Reconditioned Requirements

- Equipment permitted to be reconditioned:
  - Low- and medium-voltage power circuit breakers (240.88)
  - High-voltage circuit breakers (240.88)
  - Electromechanical protective relays and current transformers (240.88)
  - Switchboards and switchgear, or sections of switchboards or switchgear (408.8)
  - Switchgear, or sections of switchgear, within the scope of Article 490 (490.49)
  - Required to be listed (or field labeled) as “reconditioned”
  - If fire/water damage - evaluated by the manufacturer or testing laboratory

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New – Reconditioned Requirements

- Equipment NOT permitted to be reconditioned
  - Equipment that provides ground-fault circuit-interrupter protection for personnel (210.15)
  - Equipment that provides arc-fault circuit-interrupter protection (210.15)
  - Equipment that provides ground-fault protection of equipment (210.15)
  - Low-voltage nonrenewable fuses and fuseholders (240.62)
  - Molded-case circuit breakers (240.88)
  - Low-voltage power circuit breaker electronic trip units (240.88)
  - Medium-voltage nonrenewable fuses and fuseholders (240.102)
  - Receptacles (406.3)
  - Attachment plugs, cord connectors, and flanged surface devices (406.7)
  - Panelboards (other than replacement of panelboard within enclosure) (408.8)
  - Luminaires, lampholders, and retrofit kits (410.7)
  - Listed low-voltage lighting systems or a lighting system assembled from listed parts (411.4)
  - Fire pump controllers and transfer switches (695.10)
  - Automatic transfer switches (700.5, 701.5, 702.5, 708.24)

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Fault Current (Available), Interrupting Rating and Equipment SCCR

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New - Fault Current Definitions

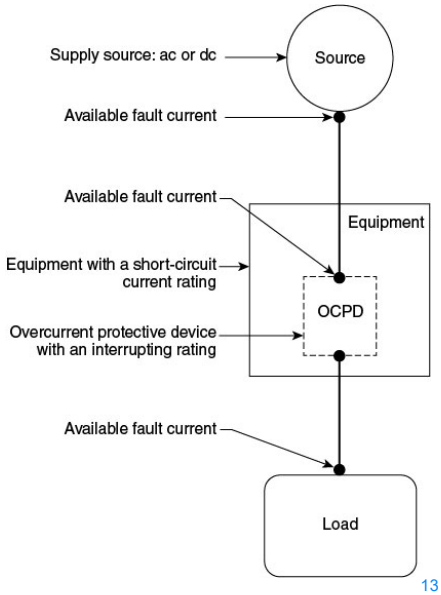
Fault Current

The current delivered at a point on the system during a short-circuit condition.

Fault Current, Available (Available Fault Current)

The largest amount of current capable of being delivered at a point on the system during a short-circuit condition.

Informational Note: A short-circuit can occur during abnormal conditions such as a fault between circuit conductors or a ground fault. See Informational Note Figure 100.1.



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SCCR is not interrupting rating

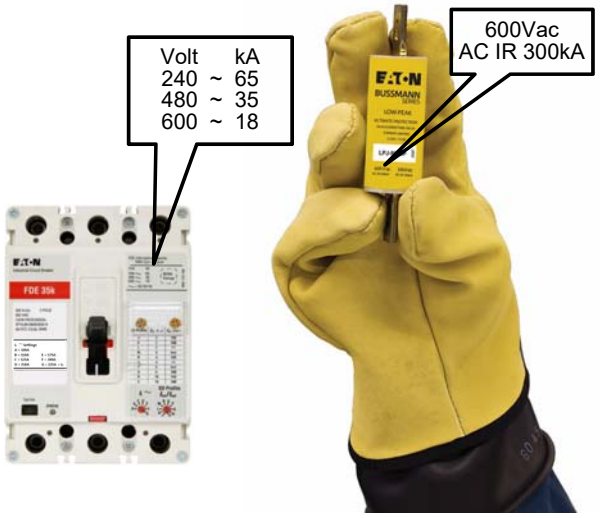
NEC Article 100 Definition

Interrupting Rating. The highest current at rated voltage that a device is identified to interrupt under standard test conditions.

NEC Requirement

110.9 Interrupting Rating. Equipment intended to interrupt current at fault levels shall have an interrupting rating at nominal circuit voltage at least equal to the current that is available at the line terminals of the equipment.

- The highest current a fuse or breaker can *safely* interrupt – self protection rating
- Must be equal to or greater than the available fault current at the line terminals



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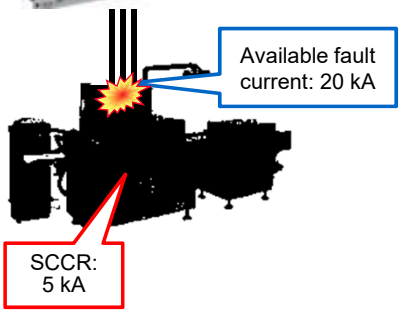
What is short-circuit current rating?

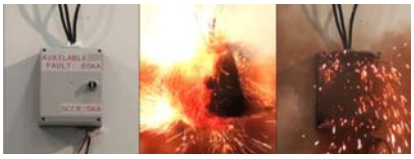


NEC Article 100 Definition

Short-Circuit Current Rating. The prospective symmetrical fault current at a nominal voltage to which an apparatus or system is able to be connected without sustaining damage exceeding defined acceptable criteria.

Hazards of insufficient SCCR

- *Shock:* Enclosure becomes energized from conductors pulling away from terminations
- *Fire:* Explosive power blows off door exposing flames and molten metal to exterior
- *Projectile (shrapnel):* Enclosure door explosively blows open emitting failing device debris

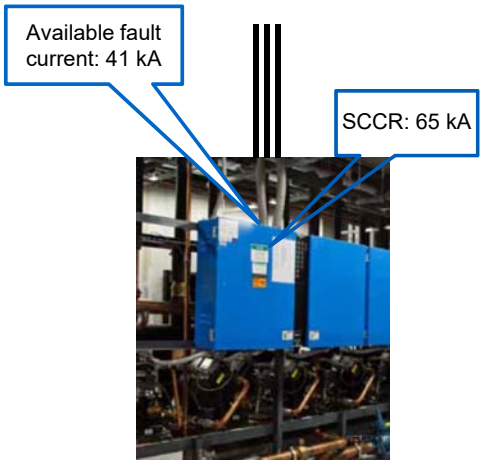


Key requirement for SCCR

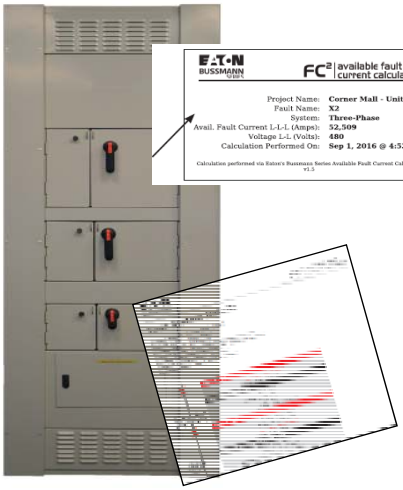
NEC Requirement

110.10 Circuit Impedance & Other Characteristics. The overcurrent protective devices, the total impedance, the component short-circuit current ratings, and other characteristics shall be selected and coordinated to permit the circuit-protective devices used to clear a fault to do so without extensive damage to the electrical components of the circuit.

- OCPDs and SCCR must be *"selected and coordinated"*
- OCPDs must clear fault without extensive damage
- SCCR applies to the device or equipment



110.24 Available Fault Current



(A) Field Marking.

Service equipment at other than dwelling units shall be legibly marked in the field with the ~~maximum~~ available fault current. The field marking(s) shall include the date the fault-current calculation was performed and be of sufficient durability to withstand the environment involved. The calculation shall be documented and made available to those authorized to design, install, inspect, maintain, or operate the system.

Informational Note No. 1: The available fault-current marking(s) addressed in 110.24 is related to required short-circuit current and interrupting ratings of equipment. NFPA 70E ~~2015~~2018, Standard for Electrical Safety in the Workplace, provides assistance in determining the severity of potential exposure, planning safe work practices, and selecting personal protective equipment.

Informational Note No. 2: Values of available fault current for use in determining appropriate minimum short-circuit current and interrupting ratings of service equipment are available from electric utilities in published or other forms.

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110.24 Available Fault Current

(B) Modifications.

When modifications to the electrical installation occur that affect the ~~maximum~~ available fault current at the service, the ~~maximum~~ available fault current shall be verified or recalculated as necessary to ensure the service equipment ratings are sufficient for the ~~maximum~~ available fault current at the line terminals of the equipment. The required field marking(s) in 110.24(A) shall be adjusted to reflect the new level of ~~maximum~~ available fault current.

Exception: The field marking requirements in 110.24(A) and 110.24(B) shall not be required in industrial installations where conditions of maintenance and supervision ensure that only qualified persons service the equipment.

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Determining available fault current

Method	Benefit	Result	Considerations
Utility published value	No calculations required	Worst case fault current	May require higher equipment ratings
As installed value (transformer nameplate)	Simple calculation (infinite primary)	Closer to actual fault current	Reduced equipment ratings but may not be adequate if system changes
SCCR of downstream equipment	Use tools to calculate	Closer to actual fault current	Actual value as installed may vary from estimated value at design stage

Bussmann series FC² Available Fault Calculator

- Makes point-to-point calculations easy
- Create labels and prints system one-lines
- Available for Apple or Android devices

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408.6 Short-Circuit Current Rating

408.6 Short-Circuit Current Rating.

Switchboards, switchgear, and panelboards shall have a short-circuit current rating not less than the available fault current. In other than one- and two-family dwelling units, the available fault current and the date the calculation was performed shall be field marked on the enclosure at the point of supply. The marking shall comply with 110.21(B)(3).

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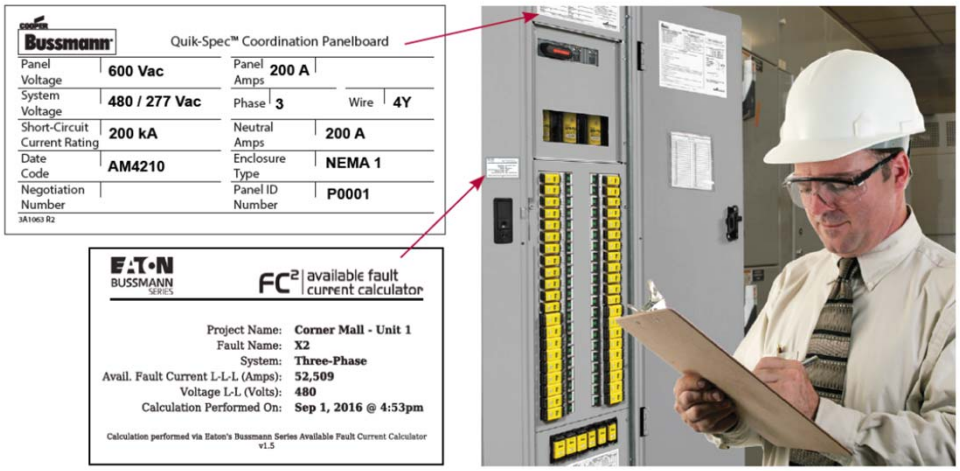
408.6 Short-Circuit Current Rating



408.6 Short-Circuit Current Rating

- SCCR not marked on nameplate
- May need to remove covers and deadfronts to identify circuit breaker interrupting rating
- SCCR equals lowest rated IR of CB installed (fully rated)
- May be series rated

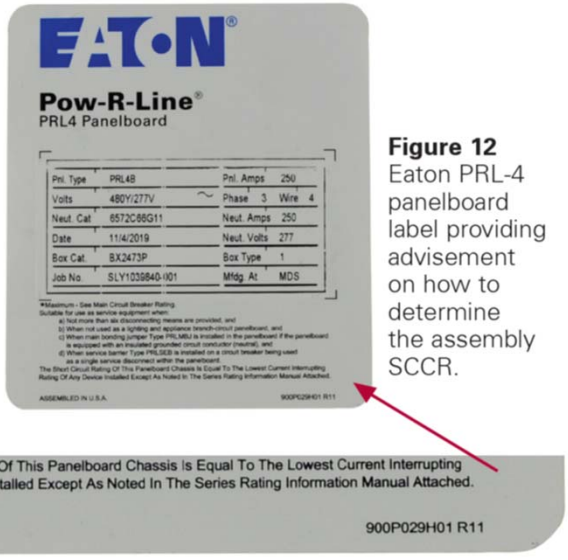


Figure 12 Eaton PRL-4 panelboard label providing advisement on how to determine the assembly SCCR.

240.86 Series Rating

240.86 Series Ratings Where a circuit breaker is used on a circuit having an available fault current higher than the marked interrupting rating by being connected on the load side of an ~~acceptable~~approved overcurrent protective device having a higher rating, the circuit breaker shall meet the requirements specified in 240.86(A) or (B), and (C).

(A) Selected Under Engineering Supervision of Existing Installation.

- Can not use up-over-down with molded case circuit breakers since they are not passive devices (unlatch within ½ cycle)

(B) Tested Combinations. The combination of line-side overcurrent device and load-side circuit breaker(s) is tested and marked on the end use equipment, such as switchboards and panelboards.

Informational Note: See 110.22 for marking of series combination systems.

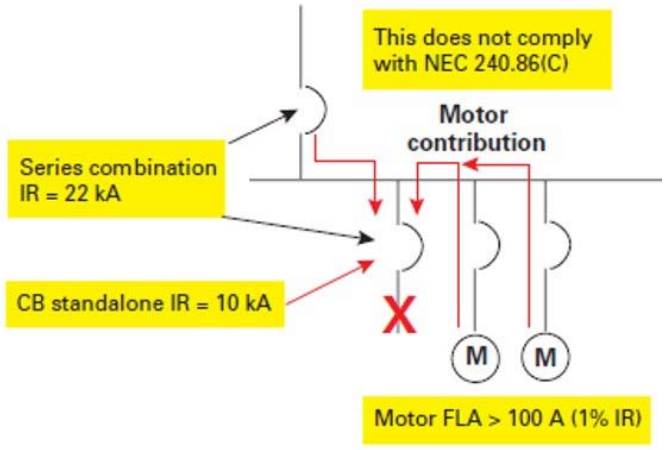
240.86 Series Rating

240.86 Series Ratings

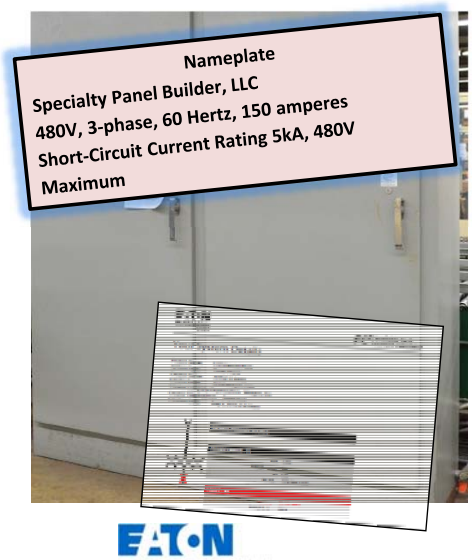
(C) Motor Contribution. Series ratings shall not be used where

(1) ~~Motors~~ Motor circuits are connected ~~on~~between the ~~load side of the~~ higher-rated overcurrent device of a series-rated combination and on the ~~line side of the~~ lower-rated ~~overcurrent device~~circuit breaker, and

(2) The sum of ~~the~~ these motor full-load currents exceeds one percent of the interrupting rating of the lower-rated circuit breaker.



409.22 Short-Circuit Current Rating



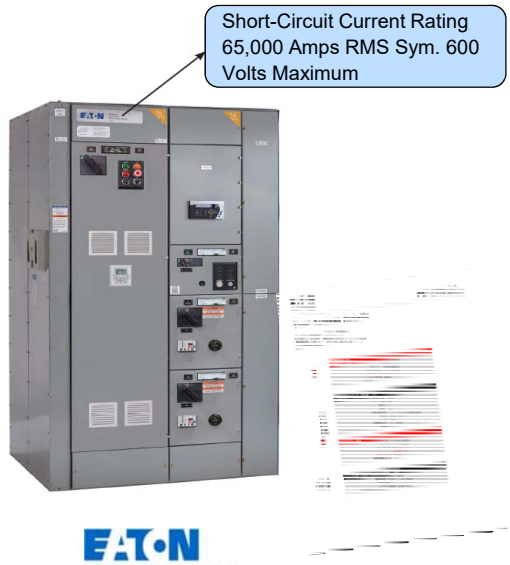
(A) Installation.

An industrial control panel shall not be installed where the available ~~short-circuit~~ fault current exceeds its short-circuit current rating as marked in accordance with 409.110(4).

(B) Documentation.

If an industrial control panel is required to be marked with a short-circuit current rating in accordance with 409.110(4), the available ~~short-circuit~~ fault current at the industrial control panel and the date the ~~short-circuit~~ available fault current calculation was performed shall be documented and made available to those authorized to inspect, install, or maintain the installation.

430.98/99 Motor Control Center



430.98 Marking

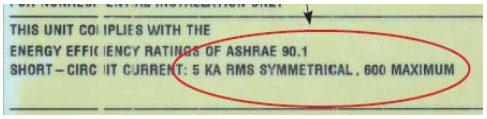
(A) Motor Control Centers.

Motor control centers shall be marked according to 110.21, and the marking shall be plainly visible after installation. Marking shall also include common power bus current rating and motor control center short-circuit current rating.

430.99 Available Fault Current

The available ~~short-circuit~~ fault current at the motor control center and the date the ~~short-circuit~~ available fault current calculation was performed shall be documented and made available to those authorized to inspect, install, or maintain the installation.

440.10 Short-Circuit Current Rating



Summary of Short-Circuit Current Study for Ernest Operations, Inc.
January, 23, 2017
By Fred Byrd
The calculations are on the pages following this summary table

Equipment Designation	Available Short-Circuit Current amps rms sym.
Service Equipment	45,340
Motor Control Center 1	30,600
HVAC Rooftop — North	13,700
HVAC Rooftop — South	9,980

(A) Installation.

Motor controllers or industrial control panels of multimotor and combination-load equipment shall not be installed where the available ~~short-circuit~~fault current exceeds its short-circuit current rating as marked in accordance with 440.4(B).

(B) Documentation.

When motor controllers or industrial control panels of multimotor and combination-load equipment are required to be marked with a short circuit current rating, the available ~~short-circuit~~fault current and the date the ~~short-circuit~~available fault current calculation was performed shall be documented and made available to those authorized to inspect, install, or maintain the installation.

620.16 Short-Circuit Current Rating

620.16(A) Marking.

Where an elevator control panel is installed, it shall be marked with its short-circuit current rating, based on one of the following:

(1) Short-circuit current rating of a listed assembly

(2) Short-circuit current rating established utilizing an approved method

Informational Note: UL 508A-2013, *Standard for Industrial Control Panels*, Supplement SB, is an example of an approved method.

620.16(B) Installation.

The elevator control panel shall not be installed where the available ~~short-circuit~~ fault current exceeds its short-circuit current rating, as marked in accordance with 620.16(A).

Equipment and nameplate photos courtesy of MCE

620.51 Disconnecting Means

(D) Identification and Signs (2) Available ~~Short-Circuit~~ Fault Current Field Marking. Where an elevator control panel is used, it shall be legibly marked in the field with the ~~maximum~~ available ~~short-circuit~~ fault current at its line terminals. The field marking(s) shall include the date the ~~short-circuit~~ available fault current calculation was performed and be of sufficient durability to withstand the environment involved. When modifications to the electrical installation occur that affect the ~~maximum~~ available ~~short-circuit~~fault current at the elevator control panel, the ~~maximum~~ available ~~short-circuit~~ fault current shall be verified or recalculated as necessary to ensure the elevator control panel's short-circuit current rating is sufficient for the ~~maximum~~ available ~~short-circuit~~ fault current at the line terminals of the equipment. The required field marking(s) shall be adjusted to reflect the new level of ~~maximum~~ available ~~short-circuit~~ fault current.

Equipment and nameplate photos courtesy of MCE

620.51 Disconnecting Means

(A) Type The disconnecting means shall be an enclosed externally operable fused motor circuit switch or circuit breaker that is lockable only in the open position in accordance with 110.25.

The disconnecting means shall be a listed device.

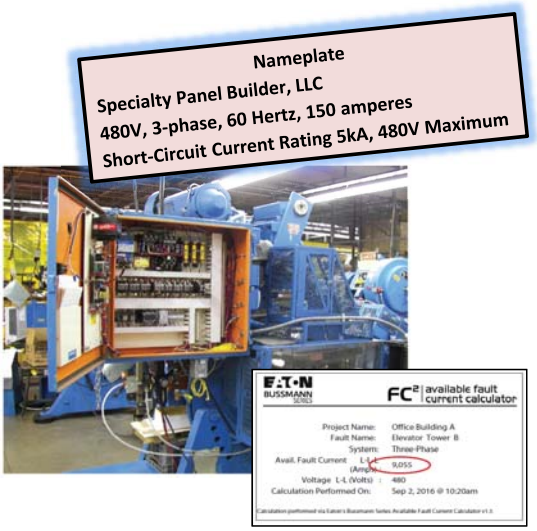
Informational Note: For additional information, see ASME A17.1-~~2013~~2016/CSA B44-~~13~~16, Safety Code for Elevators and Escalators.

Exception No. 1: ...

Exception No. 2: ...

(E) Surge Protection. Where any of the disconnecting means in 620.51 has been designated as supplying an emergency system load, a legally required system load, or a critical operation power system load, listed surge protection shall be provided.

670.5 Short-Circuit Current Rating.



(1) Industrial machinery shall not be installed where the available ~~short-circuit~~ fault current exceeds its short-circuit current rating as marked in accordance with 670.3(A)(4).

(2) Industrial machinery shall be legibly marked in the field with the ~~maximum~~ available ~~short-circuit~~ fault current. The field marking(s) shall include the date the ~~short-circuit~~ available fault current calculation was performed and be of sufficient durability to withstand the environment involved.

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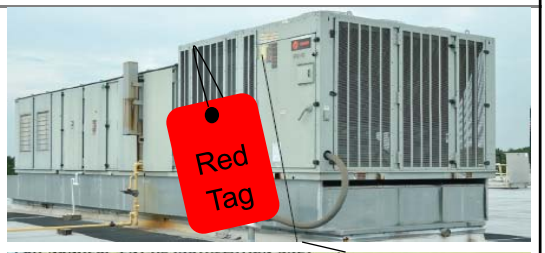
Field issues after installation

- Install transformer
- Increase conductor length
- Field evaluation and equipment modification
- Install current-limiting fuses where permitted per the AHJ. In this application, if overcurrent devices are present, they must have an interrupting rating equal or great to the calculated available fault current.



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Service Equipment

230.62(C) Barriers

- **230.62(C) Barriers** Barriers shall be placed in service equipment such that no uninsulated, ungrounded service busbar or service terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations.
- For the 2017 NEC, 408.3(A)(2) added the barrier requirement for service panelboards, switchboards, switchgear.
- For the 2020 NEC, the 408.3(A) requirement is relocated and revised to 230.63(C) and now applies to all service equipment.

230.71 Maximum Number of Disconnects

230.71(B) Two to Six Service Disconnecting Means.

Two to six service disconnects shall be permitted for each service permitted by 230.2 or for each set of service-entrance conductors permitted by 230.40, Exception No. 1, 3, 4, or 5. The two to six service disconnecting means shall be permitted to consist of a combination of any of the following:

(1) Separate enclosures with a main service disconnecting means in each enclosure

(2) Panelboards with a main service disconnecting means in each panelboard enclosure

(3) Switchboard(s) where there is only one service disconnect in each separate vertical section where there are barriers separating each vertical section

(4) Service disconnects in switchgear or metering centers where each disconnect is located in a separate compartment

Informational Note No. 1: Metering centers are addressed in UL 67, *Standard for Panelboards*.

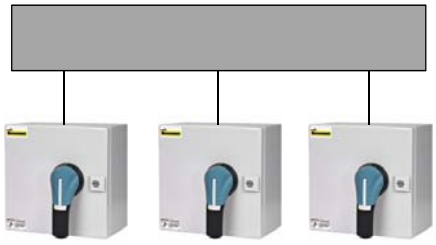
Informational Note No. 2: Examples of separate enclosures with a main service disconnecting means in each enclosure include but are not limited to motor control centers, fused disconnects, circuit breaker enclosures, and transfer switches that are suitable for use as service equipment.

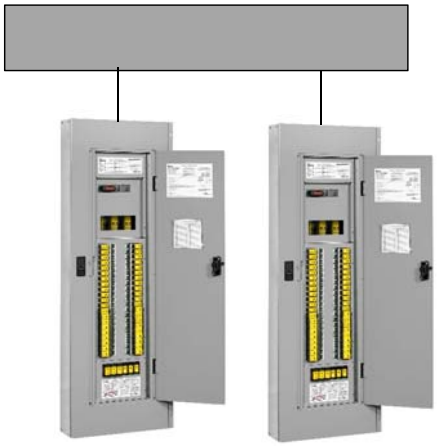
230.71 Maximum Number of Disconnects

- Multiple disconnects no longer permitted in single enclosure.

230.71 Maximum Number of Disconnects

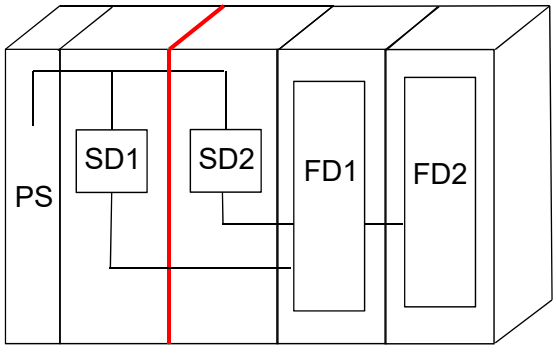
- Examples (1) & (2)

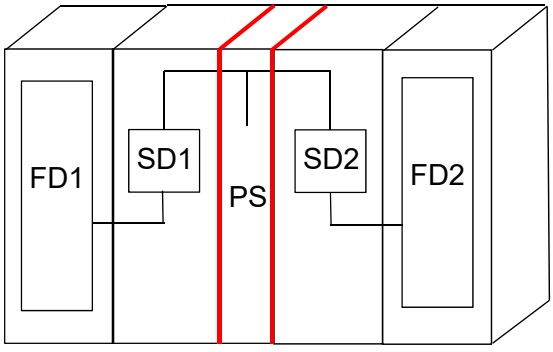




230.71 Maximum Number of Disconnects

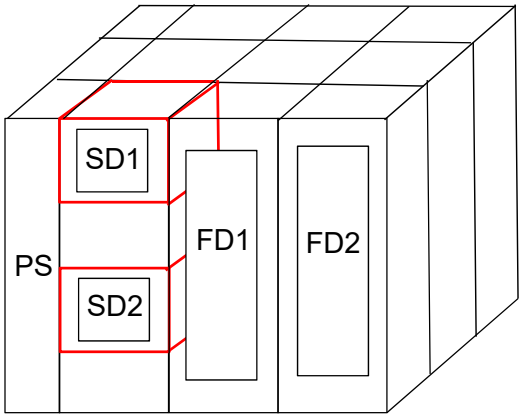
- Examples (3)



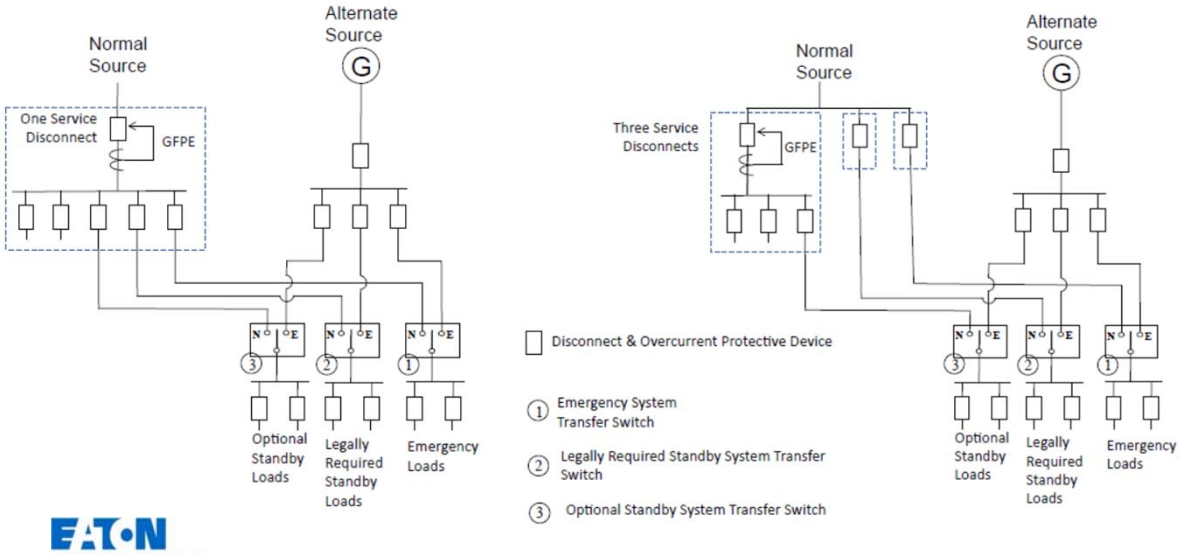


230.71 Maximum Number of Disconnects

- Example (4)



230.71 Maximum Number of Disconnects



Arc Energy Reduction

240.67 Arc Energy Reduction

240.67 Arc Energy Reduction.

Where fuses rated 1200 A or higher are installed, 240.67(A) and (B) shall apply. This requirement shall become effective January 1, 2020.

(A) Documentation.

Documentation shall be available to those authorized to design, install, operate, or inspect the installation as to the location of the fuses. Documentation shall also be provided to demonstrate that the method chosen to reduce clearing time is set to operate at a value below the available arcing current.

(B) Method to Reduce Clearing Time.

A fuse shall have a clearing time of 0.07 seconds or less at the available arcing current, or one of the following means shall be provided and shall be set to operate at less than the available arcing current:

(1) Differential relaying

(2) Energy-reducing maintenance switching with local status indicator

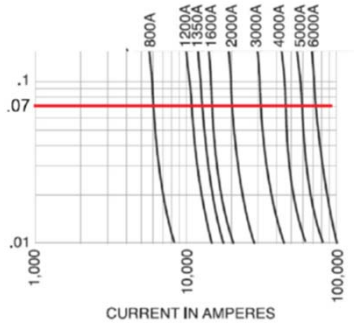
(3) Energy-reducing active arc-flash mitigation system

(4) Current-limiting, electronically actuated fuses

(5) An approved equivalent means

240.67 Arc Energy Reduction

- Document the location of the fuses (one-line)
- Calculate available fault current, then arcing current (IEEE 1584) and compare to total clearing time



- Example of minimum arcing current for 0.07 sec clearing

Fuse	Ampere rating (A)	Arcing curent (kA)
KTU	1200	11.02
KTU	1400	13.54
KTU	1500	14.7
KTU	1600	15.7
KTU	1800	18.6
KTU	2000	21.23
KTU	2500	26.65
KTU	3000	32.58
KTU	3500	40.05
KTU	4000	51.08

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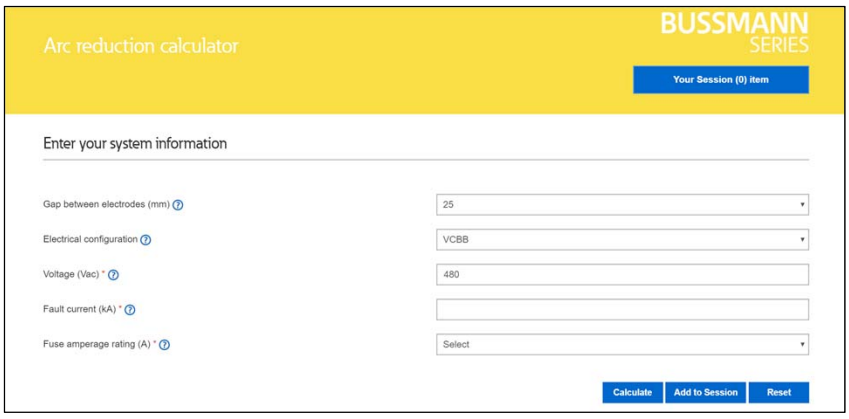
240.67 Arc Energy Reduction

- Resources: Arc Reduction Calculator
- https://arc.bussmann.com/



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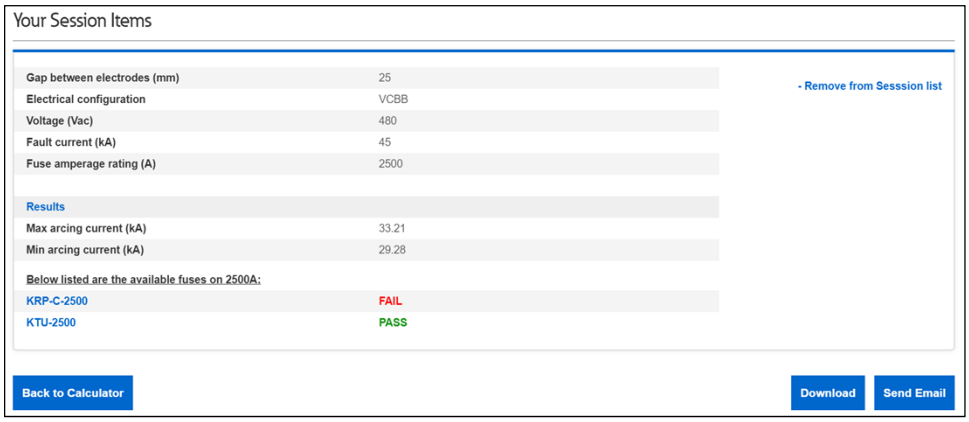
240.67 Arc Energy Reduction

- Resources: Arc Reduction Calculator
- https://arc.bussmann.com/



240.67 Arc Energy Reduction

- If arcing current is less than threshold arc energy reduction technology is needed.

240.67 Arc Energy Reduction

(C) Performance Testing.

~~Where a method to reduce clearing time is required in 240.67(B), the~~The arc energy reduction protection system shall be performance tested by primary current injection testing or another approved method when first installed on site. This testing shall be conducted by a qualified person(s) in accordance with the manufacturer's instructions.

~~Performance testing of an instantaneous element of the protective device shall be conducted by a qualified person(s) using a test process of primary current injection and the manufacturer's recommended test procedures.~~

A written record of this testing shall be made and shall be available to the authority having jurisdiction.

Informational Note: Some energy reduction protection systems cannot be tested using a test process of primary current injection due to either the protection method being damaged such as with the use of fuse technology or because current is not the primary method of arc detection.

NEC 240.87 Arc Energy Reduction

240.87 Arc Energy Reduction Where the highest continuous current trip setting for which the actual overcurrent device installed in a circuit breaker is rated or can be adjusted is 1200 A or higher, 240.87(A) and (B) shall apply.

(A) Documentation. Documentation shall be available to those authorized to design, install, operate, or inspect the installation as to the location of the circuit breaker(s). Documentation shall also be provided to demonstrate that the method chosen to reduce clearing time is set to operate at a value below the available arcing current.

(B) Method to Reduce Clearing Time. One of the following means shall be provided and shall be set to operate at less than the available arcing current:

(1) Zone-selective interlocking

(2) Differential relaying

(3) Energy-reducing maintenance switching with local status indicator

(4) Energy-reducing active arc flash mitigation system

(5) An instantaneous trip setting ~~that is less than the available arcing current~~. Temporary adjustment of the instantaneous trip setting to achieve arc energy reduction shall not be permitted.

(6) An instantaneous override ~~that is less than the available arcing current~~

(7) An approved equivalent means

NEC 240.87 Arc Energy Reduction

(C) Performance Testing.

The arc energy reduction protection system shall be performance tested by primary current injection testing or another approved method when first installed on site. This testing shall be conducted by a qualified person(s) in accordance with the manufacturer's instructions.

~~Performance testing of an instantaneous element of the protective device shall be conducted by a qualified person(s) using a test process of primary current injection and the manufacturer's recommended test procedures.~~

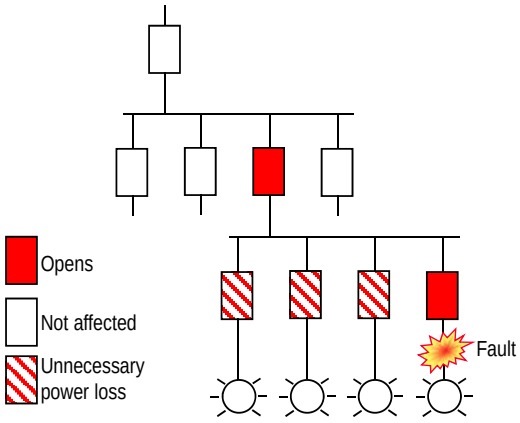
A written record of this testing shall be made and shall be available to the authority having jurisdiction.

Informational Note: Some energy reduction protection systems cannot be tested using a test process of primary current injection due to either the protection method being damaged such as with the use of fuse technology or because current is not the primary method of arc detection.

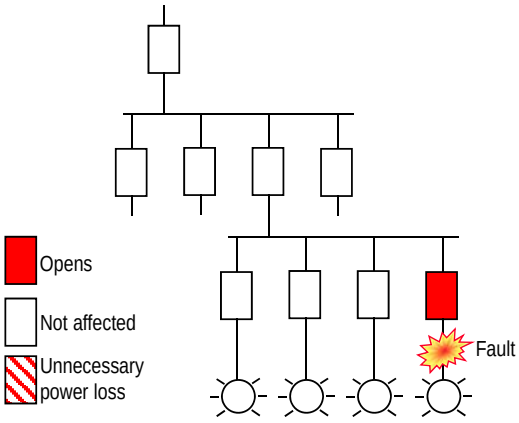
Selective coordination

What is selective coordination?

Without selective coordination



With selective coordination



Selective Coordination Definition

Coordination, Selective (Selective Coordination).

Localization of an overcurrent condition to restrict outages to the circuit or equipment affected, accomplished by the selection and installation of overcurrent protective devices and their ratings or settings for the full range of available overcurrents, from overload to the ~~maximum~~ available fault current, and for the full range of overcurrent protective device opening times associated with those overcurrents.

Selective coordination: All currents, all times

- All Currents
  - Overloads and short-circuits (ground faults, arcing faults and bolted faults)
  - Up to the available fault current
- All Times
  - Not 0.1 seconds
  - Not 0.01 seconds

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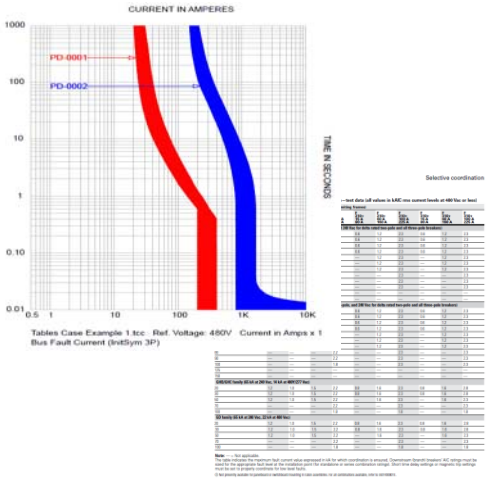
Selective coordination with circuit breakers

1. Complete fault current study
2. Complete coordination study
   1. Compare TCCs to available fault current
   2. Utilize manufacturer's tables where fault current is in upstream circuit breaker instantaneous trip
   3. Identify correct ratings and settings of circuit breakers to selectively coordinate



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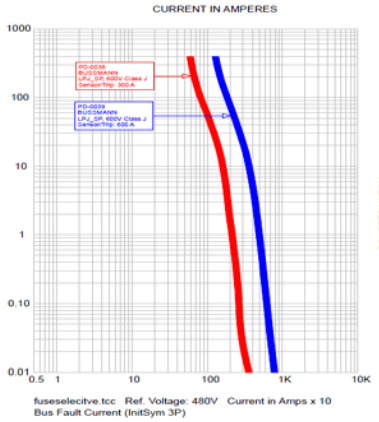
Selective coordination with fuses

- Use fuse selective coordination tables to assure selective coordination up to 200kA

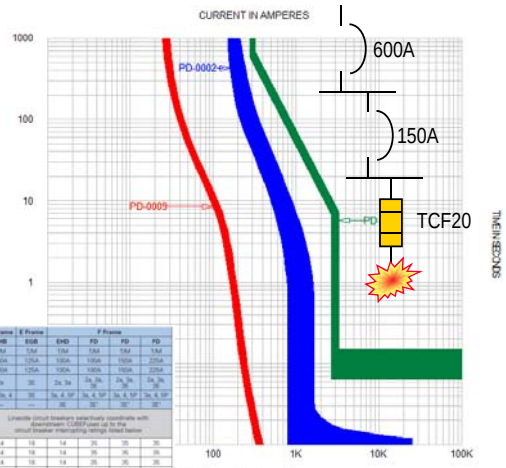


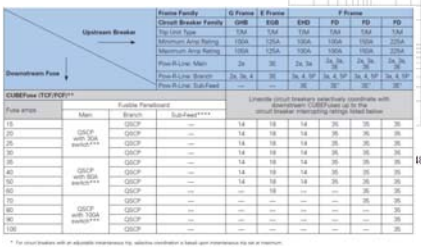
Bussmann series fuse selectivity ratios

Circuit				Downstream / loadside fuse											
Amp rating range				601-6000 A	601-4000 A	1-100 A	0-600 A			601-6000 A	0-600 A	0-1200 A	0-600 A	0-60 A	0-30 A
Fuse type				Time-delay	Time-delay	Time-delay	Dual-element, time-delay			Fast-acting	Fast-acting	Fast-acting	Fast-acting	Time-delay	
Trade name (fuse class)				Low-Peak (L)	Limitron (L)	CUBEFuse (CF)	Low-Peak (J)	Low-Peak (RK1)	Fusetron (RK5)	Limitron (L)	Limitron (RK1)	Limitron (T)	Limitron (J)	SC (G)	(CC)
			Bussmann fuse symbol	KRP-C_SP	KLU	TCF	LPJ-SP	LPN-RK-SP LPS-RK-SP	FRN-R FRS-R	KTU	KTN-R KTS-R	JJN JJS	JKS	SC	LP-CC FNQ-R KTK-R
Upstream / inside fuse	601 to 6000 A	Time-delay	Low-Peak (L)	KRP-C-SP	2:1	2.5:1	2:1	2:1	2:1	4:1	2:1	2:1	2:1	2:1	2:1
	601 to 4000 A	Time-delay	Limitron (L)	KLU	2:1	2:1	2:1	2:1	2:1	4:1	2:1	2:1	2:1	2:1	2:1
	0 to 600 A	Dual-element	Low-Peak (RK1)	LPN-RK-SP LPS-RK-SP	—	—	2:1	2:1	2:1	8:1	—	3:1	3:1	3:1	4:1	2:1
	0 to 600 A	Dual-element	Low-Peak (J)	LPJ-SP	—	—	2:1	2:1	2:1	8:1	—	3:1	3:1	3:1	4:1	2:1
	0 to 100 A	Dual-element	CUBEFuse (CF)	TCF	—	—	2:1	2:1	2:1	8:1	—	3:1	3:1	3:1	4:1	2:1
	0 to 600 A	Dual-element	Fusetron (RK5)	FRN-R FRS-R	—	—	1.5:1	1.5:1	1.5:1	2:1	—	1.5:1	1.5:1	1.5:1	1.5:1	2:1
	601 to 6000 A	Fast-acting	Limitron (L)	KTU	2:1	2.5:1	3:1	3:1	3:1	6:1	2:1	2:1	2:1	2:1	2:1	2:1
	0 to 600 A	Fast-acting	Limitron (RK1)	KTN-R KTS-R	—	—	3:1	3:1	3:1	8:1	—	3:1	3:1	3:1	4:1	—
	0 to 1200 A	Fast-acting	Limitron (T)	JJN JJS	—	—	3:1	3:1	3:1	8:1	—	3:1	3:1	3:1	4:1	—
	0 to 600 A	Fast-acting	Limitron (J)	JKS	—	—	3:1	3:1	3:1	8:1	—	3:1	3:1	3:1	4:1	—
	0 to 60 A	Time-delay	SC (G)	SC	—	—	3:1	3:1	3:1	4:1	—	2:1	2:1	2:1	2:1	—

Selective coordination with fuses and CBs

- Plot curves and calculate fault current
- Consult tables and tested combinations
- Analyze instantaneous pick up of upstream breakers – adjust settings
- Downstream branch fuses provide flexibility in designs





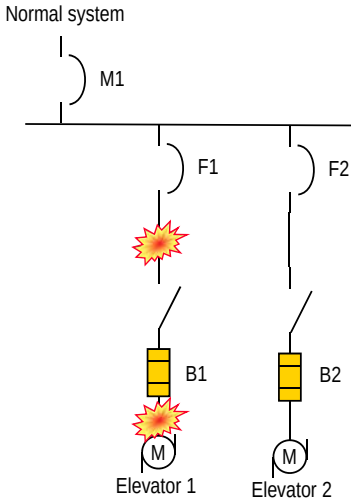
620.62 Selective Coordination.

Where more than one driving machine disconnecting means is supplied by ~~a single feeder~~the same source, the overcurrent protective devices in each disconnecting means shall be selectively coordinated with any other supply side overcurrent protective devices.

Selective coordination shall be selected by a licensed professional engineer or other qualified person engaged primarily in the design, installation, or maintenance of electrical systems. The selection and device settings shall be documented and made available to those authorized to design, install, inspect, maintain, and operate the system.

Exception No. 1 Selective Coordination shall not be required between transformer primary and secondary overcurrent protective devices where only one overcurrent device or set of overcurrent devices exists on the transformer secondary.

Exception No.2 Selective coordination shall not be required between overcurrent protective devices of the same rating located in series where no loads are connected in parallel with the downstream device.



New 620.65 Signage.

Equipment enclosures containing selectively coordinated overcurrent devices shall be legibly marked in the field to indicate that the overcurrent devices are selectively coordinated. The marking shall meet the requirements of Article 110.21(B), shall be readily visible and shall state the following: CAUTION: OVERCURRENT DEVICES IN THIS ENCLOSURE ARE SELECTIVELY COORDINATED. EQUIVALENT REPLACEMENTS AND TRIP SETTINGS ARE REQUIRED.

645.27 Selective Coordination

Critical operations data system(s) overcurrent protective devices shall be selectively coordinated with all supply-side overcurrent protective devices.

Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, inspect, maintain, and operate the system.

695.3(C) Multibuilding Campus-Style Complexes

(C) Multibuilding Campus-Style Complexes If the sources in 695.3(A) are not practicable and the installation is part of a multibuilding campus-style complex, feeder sources shall be permitted if approved by the authority having jurisdiction and installed in accordance with either 695.3(C)(1) and (C)(3) or (C)(2) and (C)(3).

(1) Feeder Sources Two or more feeders shall be permitted as more than one power…

(2) Feeder and Alternate Source A feeder shall be permitted as a normal source of power…

(3) Selective Coordination ~~The overcurrent~~ Overcurrent protective device(s) ~~in each disconnecting means~~ shall be selectively coordinated with ~~any other~~ all supply-side overcurrent protective device(s).

Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, maintain, and operate the system.

Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.

700.32 Selective Coordination

700.32 Selective Coordination Emergency system(s) overcurrent devices shall be selectively coordinated with all supply-side overcurrent protective devices. Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, inspect, maintain, and operate the system.

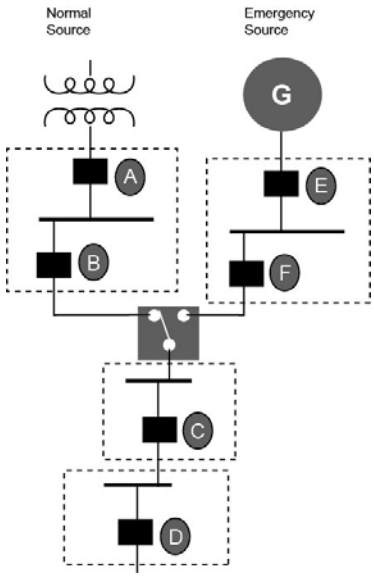
Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.

Informational Note: See Informational Note Figure 700.32 for an example of how emergency system overcurrent protective devices (OCPDs) selectively coordinate with all supply-side OCPDs.

Note: Also added to 701.32 (previously 701.27) and 708.54

700.32 Selective Coordination

- OCPD D selectively coordinates with OCPDs C, F, E, B, and A.
- OCPD C selectively coordinates with OCPDs F, E, B, and A.
- OCPD F selectively coordinates with OCPD E.
- OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD.



Selective coordination compliance

- Design phase
  - Calculate available fault current at each overcurrent protective device
  - Choose basis of design that selectively coordinates for all times and all currents
- Approval phase
  - Verify any changes meet same the performance as BOD
  - Review third party power systems studies meet selective coordination requirements
- Construction phase
  - Verify proper installation, settings and ratings on all OCPDs

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Selective coordination enforcement

- AHJ communicate requirements when selective coordination is required.
- Assures manufacturers will be quoting compliant systems.
- Example check-list can be used by AHJ.

Selective Coordination Verification

This completed form is required to ensure compliance with the requirements for selective coordination for critical systems per the 2017 NFPA 70, National Electrical Code®.

PERMIT #: _____

PROJECT NAME: _____

PROJECT LOCATION: _____

ELECTRICAL CONTRACTOR: _____

DESIGN ENGINEER: _____

COMPLIANCE CHECKLIST

1. Does the project contain any of the following critical systems?

Multiple elevators (NEC 620.62)	YES ☐	NO ☐
Emergency System (NEC 700.32)	YES ☐	NO ☐
Legally Required Standby System (NEC 701.27)	YES ☐	NO ☐
Critical Operations Power System: (NEC 708.54)	YES ☐	NO ☐

2. Critical systems shall comply with the definition of selective coordination:

"**Coordination (Selective)**. The localization of an overcurrent condition to restrict outages to the circuit or equipment affected, accomplished by the selection and installation of overcurrent protective devices and their ratings or settings for the full range of available overcurrents, from overload to the maximum available fault current, and for the full range of overcurrent protective device opening times associated with those overcurrents."

3. Critical systems shall have a study performed and documented per the NEC:

Selective coordination is required to be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection must be documented and made available to those authorized to design, install, inspect, maintain, and operate the system.

4. Required documentation for the selective coordination study shall include:

- One-line diagram and available fault current study
- Analysis of critical system overcurrent devices with upstream normal system and critical system overcurrent protective devices including:
  - Time-current characteristic curves
  - Manufacturer specific selective coordination tables or ratio charts where required for verification of selective coordination for all currents and times
  - Overcurrent protective device type, manufacturer, ratings and settings
- Signature by professional engineer or other qualified person. Qualifications of person other than professional engineer must be submitted with documentation.

Signature: _____ Date: _____

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Additional resources and tools

- 2020 NEC Code changes
- 2017 SCCR Code changes
- Fault current calculator – FC2
  - Available in the app store or play store
- Fuseology Technical Guide
- SPD – Electrical Protection Handbook

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