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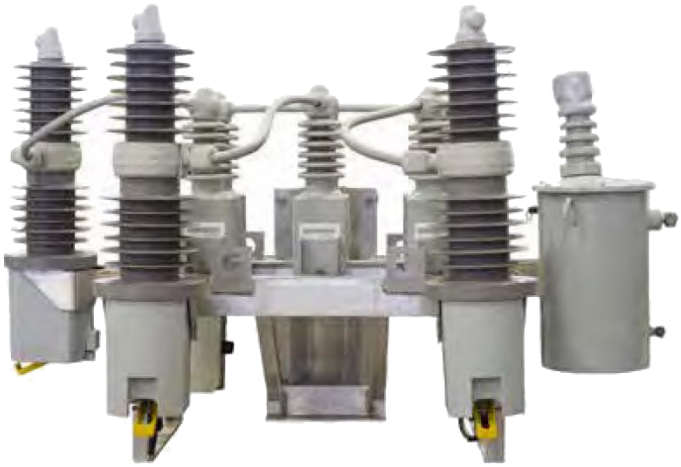
Seattle City Light
MATERIAL STANDARD

Capacitor Banks, Pole-Mounted



1. Scope

This standard covers the requirements for pole-mounted capacitor racks, switches, and single-phase capacitor units, also referred to as capacitor banks, and controllers.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock No.	Description
014374	Capacitor bank assembly (rack with switch and capacitor units, without control unit)
014375	Capacitor bank control unit
014376	Replacement single-phase capacitor unit

2. Application

Pole-mounted capacitor banks are intended for use on three-phase, 26.4 kV, 4-wire, solidly grounded, wye-connected, 60 Hz systems.

Capacitor banks are used to improve power factor (PF), improve voltage, and reduce line losses.

Engineers interested in learning more about this product are encouraged to review the catalog data sheets listed in Section 10.

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3. Industry Standards

Capacitor banks shall meet the applicable requirements of the following industry standards:

Capacitor units:

IEEE 18-2002; Standard for Shunt Power Capacitors

Switches:

IEEE C37.66-2005; Standard Requirements for Capacitor Switches for AC Systems (1 kV to 38 kV)

Control unit:

NEMA 250-2014; Enclosures for Electrical Equipment (1,000 V Maximum)

IEEE 802.3at-2009; Data Terminal Equipment (DTE) Power via the Media Dependent Interface (MDI) Enhancements

4. Requirements

4.1 General

Each capacitor bank and control unit shall be integrally designed and produced.

Capacitor banks and control units shall be of high quality design and construction providing safe and reliable operation with minimal maintenance over the life of the product.

Manufacturer shall be solely responsible for the performance of the capacitor bank and control unit components as well as the complete integrated assembly.

All components of the capacitor bank and control unit shall be fully assembled and pre-wired from the factory.

See Table 4.1.

Table 4.1. Electrical Ratings

Capacitor Bank	
Voltage, rms, (terminal-to-terminal), kV	15.24
Terminal-to-case (or ground) insulation class	125 kV BIL, crest
Reactive power	
Total, kvar	1200
Per capacitor unit, kvar	400
# of capacitor units	3
Number of phases	3
Frequency, Hz	60
Discharge time, maximum time limit, minutes	5
Control Power Transformer	
Primary voltage (kV, L-G)	15.24
kVA	1.0
Primary bushings	1
Control voltage, Vac	120

The capacitor bank operating temperature range shall be -40ºC to 55ºC.

Capacitor banks shall have voltage and current sensing capability.

Capacitor banks shall be connected grounded wye.

Capacitor banks shall have single-phase sensing, with provisions for three-phase sensing.

Pole mounting bolts shall be 18 inches on centers.

All high voltage wiring, accessories and terminal bushings shall be provided with wildlife protection.

An instruction manual covering installation, operation, and maintenance provided with each capacitor bank. The manual shall be securely attached to each capacitor bank in a waterproof, ultraviolet light resistant envelope.

4.2 Capacitor Bank Assembly Components

4.2.1. Rack

The rack frame shall be manufactured from high strength 6061-T6 aluminum alloy.

The rack shall be designed for three capacitor units.

Four eyes shall be provided on each rack for lifting purposes. The bearing surfaces of the lifting eyes shall be free from sharp edges and shall all lie in the same horizontal plane.

A rack ground connector shall be provided that accommodates .080–.355 diameter wire (#12 AWG solid–#1 AWG stranded).

4.2.2. Switch

The switch shall be a single-phase, solid dielectric vacuum-type.

Switch shall have manual trip capability

Switch tank shall be non-conductive.

Switch terminals shall accommodate # 8AWG–2/0 copper or aluminum in horizontal or vertical position.

See Table 4.2.2.

Table 4.2.2. Switch Electrical Ratings

Switch rating, solidly grounded bank	26.4 kV
Continuous current rating	200 A
Line-to-ground rating (BIL)	125 kV
Control voltage	120 Vac
Frequency	60 Hz

4.2.3. Capacitor Unit

Capacitor units shall be assembled vertically mounted with the primary bushings located on the side opposite from the pole mounting bracket.

Manufacturer shall supply dielectric fluid for capacitors that is certified to less than 1PPM PCB.

Manufacturer shall affix a blue “NON PCB” label on the narrow end of the capacitor unit adjacent to the unit nameplate.

Each capacitor unit shall have two bushings.

Each capacitor unit bushing shall be rated at 125 kV BIL or greater

Each capacitor unit bushing shall be made of glazed, wet-processed porcelain.

Each capacitor unit bushing terminal shall be of the clamp connector type and shall accommodate #4 AWG stranded copper conductor.

See figures 4.2.3a and 4.2.3b.

Figure 4.2.3a. Capacitor Bank Assembly

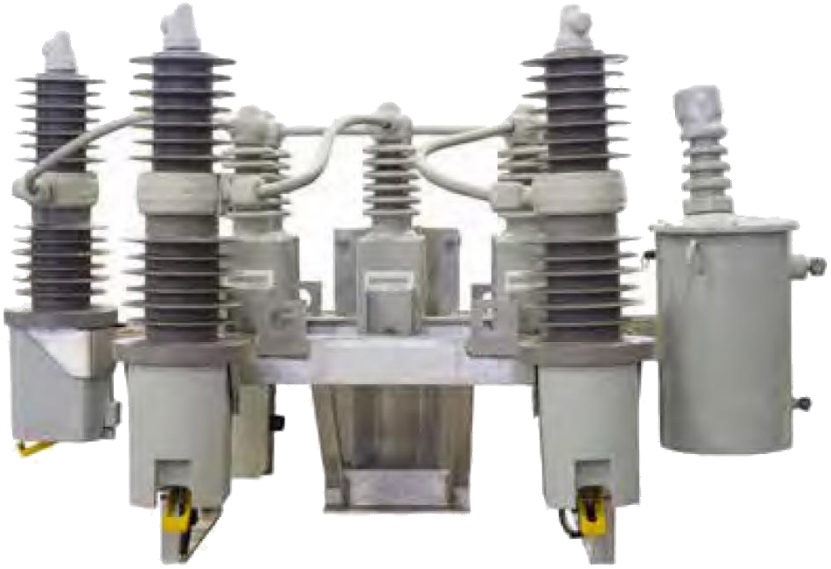

Figure 4.2.3b. Replacement Capacitor Unit

4.3 Control Unit

The control unit shall have electrical ratings as described in Table 4.3.

Table 4.3. Control Unit Electrical Ratings

Control voltage	120 Vac
Frequency	60 Hz
Temperature operating range	-30ºC–70ºC
Humidity operating range	3–95%

The control unit shall have a DC power supply module capable of supplying 6–28 Vdc for powering up peripherals such as a wireless radio communication module

The control unit shall include the following primary control modes:

- VAR
- Voltage
- Current
- Time
- Temperature control
- No Operations
- Seasonal control
- Thresholds from the sensor inputs
- Remote

The control unit shall include the following override control modes:

- Voltage
- Time

The control unit shall include the following protective functions:

- Overvoltage / undervoltage control
- Neutral current fault control
- Daily close count limit
- Alarming / alert setting
- Emergency voltage control
- Neutral current verification
- Communications loss control
- Adaptive voltage control

The control unit shall be able to record operations for the following:

- Date/Time Stamps
- Primary Operations
- Override Operations
- Manual Operations
- Power Up/Down
- Reverse Power
- KVAR Before and After each operation

The control unit shall include the following communication capabilities:

- Power Over Ethernet (POE) per IEEE 802.3AT.
- An Ethernet port
- A USB port for local application software tool connection.
- Support DNP3 protocol Level 2.

An instruction manual covering installation, operation, and maintenance shall be provided with each control unit. The manual shall be securely attached to each capacitor bank in a waterproof, ultraviolet light resistant envelope, or placed inside the control unit.

The enclosure shall meet the requirements of NEMA 250 for 4X, IP 45.

See Figure 4.3.

Figure 4.3. Control Unit

4.4 Certified Test Reports

Test data that establishes compliance with the requirements of this material standard shall be provided upon request.

4.5 Nameplates

4.5.1. Capacitor Bank

Each capacitor bank nameplate shall include, but not be limited to, the following:

- Manufacturer name
- Unique serial number
- Manufacturer type, model, style, or catalog number
- Rated voltage, rms
- Rated reactive power
- Rated frequency
- Rated BIL

4.5.2. Capacitor Unit

Each capacitor unit nameplate shall include, but not be limited to, the following:

- Manufacturer name
- Unique serial number
- Manufacturer type, model, style, or catalog number
- Year of manufacture
- Rated reactive power
- Rated voltage, rms
- Number of phases,
- Rated frequency
- BIL
- Flammability classification and volume of insulating fluid
- Statement that capacitor contains an internal discharge device.

4.5.3. Capacitor Switch

The capacitor switch nameplate shall include, but not be limited to, the following:

- Manufacturer name
- Manufacturer type or identification number to indicate the design or construction
- Rated maximum voltage
- Rated capacitive switching current
- Rated lightning impulse withstand voltage
- Rated control voltage
- Month and year of manufacture designation
- Serial number designation
- Rated short-time (symmetrical) current
- Rated high-frequency transient-making current
- Probability of restrike classification

4.5.4. Control Unit

The control unit nameplate shall include, but not be limited to, the following:

- Manufacturer name
- Manufacturer type or identification number to indicate the design or construction
- Month and year of manufacture designation
- Serial number designation

5. Design Changes

Manufacturer shall inform Seattle City Light in writing of all design changes that could affect the product's understood or published capabilities.

6. Packaging

6.1 General

Pallets shall be designed for movement by either pallet jack or forklift.

The two openings for the pallet jack or forklift shall have a minimum width of 21 in and height of 4 in.

Crates and pallets, including slats, blocking, and wedges, shall be unpainted wood.

6.2 Capacitor Bank

Each capacitor bank shall be packaged in its own crate and delivered on its own pallet.

The outside of each crate shall be permanently and clearly marked with the following:

- Manufacturer name or symbol
- SCL purchase order number
- SCL stock number, and manufacturer
- Manufacturer equipment serial number, if applicable

Each capacitor unit shall be shipped with terminals shorted.

6.3 Control Unit

The control unit shall be packaged separately from other components.

Each control unit shall be packaged in its own crate and delivered on a pallet.

The outside of each control unit crate shall be permanently and clearly marked with the following:

- Manufacturer name or symbol
- SCL purchase order number
- SCL stock number, and manufacturer
- Manufacturer equipment serial number, if applicable

6.4 Replacement Capacitor Unit

Each capacitor unit shall be packaged in its own crate and delivered on its own pallet.

The outside of each crate shall be permanently and clearly marked with the following:

- Manufacturer name or symbol
- SCL purchase order number
- SCL stock number, and manufacturer
- Manufacturer equipment serial number, if applicable

Each capacitor unit shall be shipped with terminals shorted.

7. Shipping

Product may be delivered on enclosed, covered, or flatbed trucks. If capacitor bans, control units, or replacement capacitor units are delivered on a flatbed truck, product shall be side-loaded.

Because Washington State law requires a 10-in minimum side board when driving a forklift or pallet jack onto the bed of a truck or trailer. Most flatbed trucks or trailers must be side-loaded to ease off loading.

8. Issuance

Unit: EA

9. Approved Manufacturer

Stock No.	Description	Eaton Cooper Power Series Catalog No.
014374	Capacitor bank assembly (rack, switch, and capacitor units)	CER1178M0303E2
014375	Control unit	C8020900
014376	Replacement single-phase capacitor unit	CEP133M16

10. Sources

ANSI C63.16-2016; American National Standard Guide for Electrostatic Discharge Test Methodologies and Acceptance Criteria for Electronic Equipment

CA230001EN; Cooper Power Series Catalog Data Sheet for Pole-Mounted Capacitor Racks with Single-Phase Capacitor Units, effective date October 2016

CA230002EN; Cooper Power Series Catalog Data Sheet for Edison Single-Phase Capacitor Switch, effective date January 2017

CA230003EN; Cooper Power Series Catalog Data Sheet for Medium Voltage Standard-Duty, Heavy-Duty, and Extreme-Duty Single-Phase Unfused Capacitor Units and Accessories, effective date February 2017

CA916001EN; Cooper Power Series Catalog Data Sheet for CBC-8000 Capacitor Bank Control, effective date October 2016

IEEE 1036-1992; IEEE Guide for the Application of Shunt Power Capacitors

IEEE C62.41; IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

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