

ARCO Electric Products
Installation and Maintenance Manual
Low Voltage Automatic Power Factor Correction Capacitor Systems
2013

READ CAREFULLY –

These instructions are intended to cover good practices in the receiving, inspection and maintenance of low voltage power factor capacitors, but are NOT intended to serve as an application guide or as a substitute for safe working procedures. Qualified personnel who have training in the operation and maintenance of electrical power systems must perform work on this equipment. Work on these devices requires training and experience with high capacity circuits and equipment and an understanding of the hazards involved.

NOTICE: Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate or maintain the automatic power factor correction capacitor. The following special messages may appear throughout this manual to warn of potential hazards or to call attention to that which clarifies or simplifies a procedure.

NOTE

Provides additional information to clarify or simplify a procedure.

WARNING: Hazard of electrical shock or burn.

Used where there is hazard of severe bodily injury or death. Failure to follow a “DANGER” instruction will result in severe bodily injury or death.

WARNING: Hazard of electrical shock or burn.

Used where there is hazard of bodily injury or death. Failure to follow a “WARNING” instruction may result in bodily injury or death.

CAUTION: Hazard of equipment damage.

Used where there is hazard of equipment damage. Failure to follow a “CAUTION” instruction may result in damage to equipment.

Electrical equipment should be serviced only by qualified electrical maintenance personnel. Although reasonable care has been taken to provide accurate information in this document, no responsibility is assumed for any consequences arising out of the use of this material.

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1. GENERAL

DANGER: Hazard of electrical shock or burn.

Equipment must be de-energized during all installation and maintenance operations. Failure to de-energize equipment will expose personnel to live parts which may result in electrical shock and/or burn.

DANGER: Hazard of electrical shock or burn.

Capacitors store potentially lethal voltage even when disconnected. Capacitor elements include integral discharge resistors to reduce terminal voltage to less than 50 VDC within 1 minute as outlined in the National Electric Code. Before handling equipment wait 1 minute after disconnecting from service, then short and ground each capacitor terminal with an insulated tool. Short between all capacitor terminals and ground.

1.1 Introduction

The operation of the Automatic Capacitor Bank is dependent upon handling, installation, operation and maintenance by qualified personnel. Failure to follow certain installation and maintenance requirements could lead to personal injury and the failure and loss of the Automatic Capacitor Bank as well as damage to other property. For the purpose of this guide, a qualified person is one who is familiar with the installation, construction and operation of the equipment and the hazards involved.

1.2 Description

Automatic Power Factor Correction Capacitor Banks are manufactured in freestanding structures. These free standing units house capacitors, contactors, optional reactors and common bus bar for distributing power to the Automatic Capacitor Bank and a network of control wiring.

1.3 Packaging

The Automatic Capacitor Banks are constructed in freestanding enclosures with removable lifting eyes. This allows for ease in handling during transportation and installation.

Before final packing for shipment from the factory, the Automatic Capacitor Bank is inspected visually, mechanically and electrically by our Quality Controlled Test Department using ISO-9001:2008 guidelines.

2. PRE-INSTALLATION

Inspect the Automatic Capacitor Bank for any damages as soon as it is received. Delivery of the equipment to a carrier or other shipping point constitutes delivery to the purchaser. Title and all risk of loss or damage in transit shall pass to the purchaser at that time, regardless of freight payment.

2.1 Taking Delivery

- Check that all packages and/or crates have been delivered and that the equipment has not been damaged in transit.
- Forward any claims to the carrier immediately.
- In the event of damage or missing items, quote the Bill of Lading number when making your claim to the carrier.
- Goods, whether sent freight pre-paid or not, are shipped at the consignee's risk.
- Damaged or missing items are the responsibility of the carrier and must be reported.
- Check that the information shown on the equipment nameplates corresponds with the order specifications.
- The packaging material should be replaced for protection until installation has begun.

2.2 Storage

If for some reason the Automatic Capacitor Bank cannot be placed into service reasonably soon after it is received; it should be stored in a clean, dry and ventilated building free from temperature extremes. Storage temperatures from 0°C (32°) to 40°C (104°F) are accepted. If the storage area is cool and or damp, enough heat should be provided to prevent condensation that may be harmful to the Automatic Capacitor Bank. **NOTE: Outdoor storage is inadequate, even with the protection of a tarpaulin.**

- Store the equipment in a dry ventilated location sheltered from rain, water spray, splashes and chemicals.
- Effective covering to protect against dust, dirt, paint, etc should protect stored equipment.
- After prolonged storage or exposure to high humidity, the main terminals should be subjected to resistance-to-ground measurements. **NOTE: DO NOT use resistance-measuring devices for Terminal to Terminal measurements.** If this test shows less than 100 MΩ of resistance, steps must be taken to eliminate the moisture or contaminants causing low resistance to ground. Moisture levels may be reduced by blowing dry air into the enclosure or by the temporary installation of a heat source in the bottom of the enclosure. A recommended maximum of 100 watts per 24" width of the enclosure for 48 hours. If resistance to ground is still below 100 MΩ consult the factory.

2.3 Installation Location

Automatic Capacitor Banks are not designed to be placed in hazardous locations. The area chosen should be well ventilated, free from high humidity, dust and dirt. The temperature of the area should be no less than from -14°C (14°) and no greater than 40°C (104°F). For outdoor locations, protection from moisture or water entering the enclosure must be provided.

Automatic Capacitor Banks should be located in an area that allows a minimum of three feet of free space in front of the enclosure. A minimum of 1” space should be provided between the back of the Automatic Capacitor Banks and a wall (6” for damp locations).

When selecting a location for the installation of an Automatic Capacitor Bank, careful attention should be given to accessibility, overhead clearances and future expansions. Consideration of these factors will eliminate many difficulties during the installation of this and future units.

Automatic Capacitor Banks are assembled in the factory on a level surface to ensure that equipment and doors are properly aligned. The customer should provide a similar smooth and level surface for installation. An uneven foundation may cause misalignment of the enclosure doors. The surface under the Automatic Capacitor Bank must be of a non-combustible material.

2.4 Handling

Adequate equipment for handling of the Automatic Capacitor Bank such as overhead cranes, fork trucks, or pipe rollers must be available. Weights vary per enclosure and care should be taken to avoid injury and equipment damage while moving the Automatic Capacitor Bank.

- The Automatic Capacitor Bank is shipped on pallets designed for movement by forklift.
- Removable lifting eyes are provided for hoisting. On larger units a spreader bar is recommended.
- Equipment should be unpacked at the installation site.
- Handle carefully to avoid damage due to mechanical shock, which may cause equipment damage.
- Automatic Capacitor Banks must be installed on a level surface to prevent distortion of the enclosure, which can result in severe hazard due to damaged insulators, or misalignment of the enclosure doors.

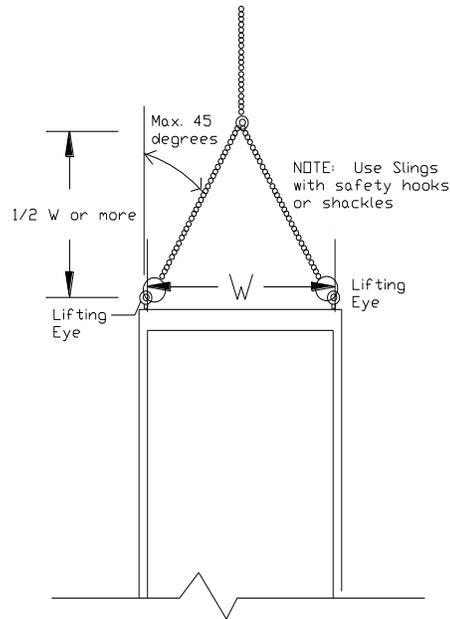
WARNING: Hazard of personal injury and equipment damage.

Use extreme caution when moving enclosures.

2.5 Equipment Placement

1. Use Caution when moving heavy equipment.
2. Verify that the equipment used to move the unit is capable of handling the weight.
3. Fork trucks provide a quick and convenient method of moving the Automatic Capacitor Bank.
4. Lifting eyes are provided on each shipping block for handling Automatic Capacitor Banks by overhead cranes. Use the following precautions when using an overhead crane.
 - Handle enclosures in the upright position only.
 - Select proper rigging lengths to compensate for any unequal weight distribution within the enclosure.
 - Do not exceed the 45° maximum between the vertical and lifting cables.
 - Use only slings with safety hooks or shackles. Do not pass cables or ropes through the lifting eyes.

5. After the enclosure is in place, the lifting eyes may be removed and discarded. If the lifting eye is removed, to prevent entrance of foreign material into the enclosure, fill the hole with a good quality silicone. The silicone can be easily removed in the future if the lifting eyes are returned to the unit.



2.6 EQUIPMENT DESCRIPTION

The Automatic Power Factor Correction system consists of capacitors controlled by contactors, which in turn are activated by a power factor controller. The power factor controller continually monitors the system load power factor and automatically adjusts the number of capacitors connected to the line to regulate the power factor.

The Automatic Power Factor Correction Capacitor may have an optional Main Circuit Breaker or Fused Disconnect Switch.

For Non-Linear applications a detuned capacitor bank is used protecting the capacitors and the system from resonance.

Enclosure front can include fans and exhaust, power factor controller, capacitor fuse blown indicator lights in rows of three representing each fuse in each phase of each capacitor followed by two fuses that control the small control transformer. Below these lights you will find a blue “Power On” light

that shows that 120 volt control power is available from the transformer. Under this light you will find a single row of blown fuse indicator lights that indicate the control circuit to each contactor in the automatic system followed by fuses for the 120 VAC capacitor controller.

2.7 INSTALLATION

Take time to read all installation instructions and recommendations. This will minimize time wasted later locating faults. Each unit is fully inspected and tested before leaving the factory.

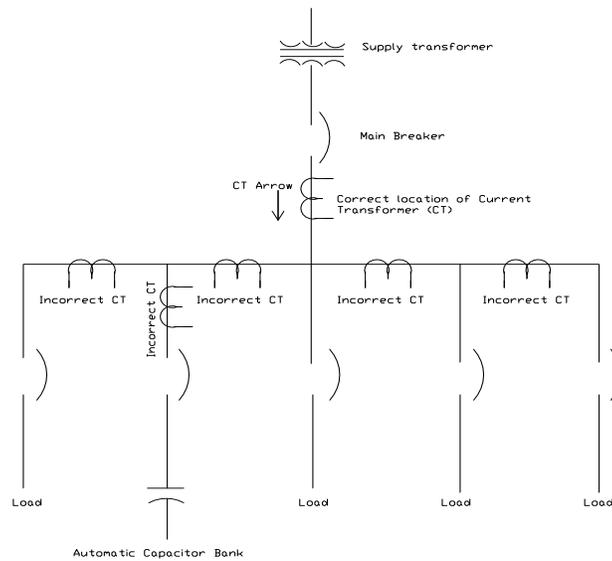
Since the equipment is factory wired, on-site installation is limited to:

1. Secure the enclosure to its final installation point.
2. Install properly sized feeder circuits to the buss bar, circuit breaker or fused disconnect switch.
3. Installation of the current transformer(s) (CT's) to supply the signal required by the power factor controller.
4. Connect the CT(s) secondary wires to the CT Terminal Block.
5. Adjust power factor controller to customer requirements.

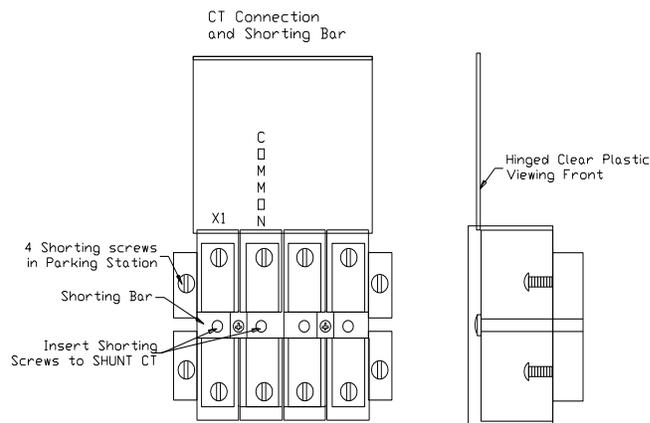
2.8 Current Transformer

The CT(s) provides a signal required for the operation of the power factor controller. The current transformer is usually supplied inside the enclosure sized for the customer's service unless other arrangements were previously made.

CT's provided are sized to the customer's service based on amperage with the secondary amperage always being 5 amps. Example: 2000 amp main service would require a 2000/5 split core CT. The Split Core design allows the CT to be installed without the removal of feeder circuits or buss bars. Positioning the CT is important in proper operation of the Automatic Capacitor controller. Every CT has an arrow on the side pointing in one direction. On installation, the arrow should point towards the load, **not the transformer** or supply side. Location of the CT(s) is also important for proper operation. The CT(s) should be installed on the feeder circuits ahead of all loads within the facility.



The CT terminal block in the Automatic Capacitor Bank has a CT shorting bar. By removing the shorting screws from their parking station and inserting them into the screw holes provided on the terminal block, the CT will be safely shorted. NOTE: The CT shorting bar screws must be removed and returned to their parking station before the Capacitor Bank will operate as designed. If the CT has been installed backwards, use the shorting screws and reverse the secondary side of the terminal block connection. Then remove the shorting screws and replace in the parking station.



2.9 Sizing Overcurrent Protective Devices

Short circuit and overload protection must be provided upstream from the Automatic Capacitor Bank to protect the feeder cables. The table below gives the rating of the short circuit and over current devices that will adequately protect the feeder cables.

NOTE: ARCO Electric Products recommends that all local state and federal electric codes and regulations be checked to ensure compliance.

Fused Disconnect Switch	165% of capacitor nominal amperage rating
Molded Case Circuit Breaker	150% of capacitor nominal amperage rating
Air Circuit Breaker	135% of capacitor nominal amperage rating

On standard Automatic Power Factor Correction Capacitors for applications with minimal harmonic distortion capacitors without reactors would be used. On applications with harmonic content requiring tuned reactors in series with the capacitors the amperage is generally 7 to 10% higher than nominal. Always use the nameplate kVAR rating to calculate protective device ratings.

Calculations to determine Automatic Capacitor Bank current rating:

$$\frac{\text{kVAR} \times 1000}{\text{Voltage} \times 1.732} = \text{Nominal Amperage}$$

- For 208 VAC, 60 HZ, multiply NAMEPLATE kVAR by 2.78 = Nominal Amperage
- For 240 VAC, 60 HZ, multiply NAMEPLATE kVAR by 2.41 = Nominal Amperage
- For 480 VAC, 60 HZ, multiply NAMEPLATE kVAR by 1.20 = Nominal Amperage
- For 600 VAC, 60 HZ, multiply NAMEPLATE kVAR by .096 = Nominal Amperage

3.0 Sizing Feeder Cables

The feeder cables to the Automatic Capacitor Bank must be sized as follows, 135% of Nominal Amperage. Refer to 1999 National Electric Code section 460-8.

3.1 Automatic Controller Setup

Refer to controller manual included in envelope package located on inside of door.

4.0 Maintenance

All automatic capacitor banks come equipped with forced air circulation. Some fans contain a removable washable aluminum or foam filter that requires periodic maintenance. The filter is friction fit and can be removed by pulling straight out. Once removed, use clean soap and water and/or compressed air to blow the filter clean. Once cleaned, replace the filter to eliminate build of foreign material within the enclosure.

It is recommended on an annual basis, component connections are checked for tightness and confirmed torque values are still at the value as when shipped from the factory. A torque-tightening outline is posted on the interior wall of each automatic power factor capacitor. It is also recommended that a thermal scan be performed a few days after initial installation and maintained for baseline data. On an annual basis another thermal scan can be performed and compared to the original data.