



# General Equipment Installation, Operation, and Maintenance Manual

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### **READ CAREFULLY**

These instructions are intended to cover good practices in the receiving, inspection and maintenance of APQ equipment. It is not intended as an application guide or as a substitute for safe working conditions. Work on this equipment must be performed by qualified personnel who have training in the operation and maintenance of electrical power systems. Work on this equipment requires training and experience with high capacity circuits and equipment with an understanding of the hazards and risks involved.

These instructions are intended as a supplement to other manuals, drawings and regulations or codes applicable.

# 1. Introduction

**THIS POWER QUALITY EQUIPMENT FROM APQ IS SELECTED FOR A SPECIFIC APPLICATION AT THE EXISTING CONDITION. ANY SIGNIFICANT CHANGES TO THE SYSTEM, SUCH AS ADDING LARGE NON-LINEAR LOADS, WILL IMPACT THE PERFORMANCE OF THIS EQUIPMENT.**

<p><b>WARNING</b></p> 	<p>Only qualified electricians with proper installation devices and protective clothing should handle the installation of this equipment. Always wear appropriate personal protective equipment (PPE) and follow all lock out tag out procedures.</p>
<p><b>WARNING</b></p> 	<p>Improper handling may cause improper operation and reduce the life of the equipment.</p>
<p><b>WARNING</b></p> 	<p>This Manual should be kept in a safe and accessible place during the service life of the equipment.</p>
<p><b>WARNING</b></p> 	<p>Disconnect all electrical feeders to this equipment. Extreme caution must be taken to prevent contact with energized components during the installation, operation and service of this equipment. Accidental contact with electricity may result in personal injury or death.</p>
<p><b>WARNING</b></p> 	<p>This equipment contains energy storing power capacitors. Always confirm that capacitor energy has been safely discharged before servicing the equipment. Use proper protective devices and clothing when servicing any electrical equipment.</p>
<p><b>WARNING</b></p> 	<p>Components and wiring are energized inside the enclosure when online. Properly disconnect all electrical feeders to the equipment circuit before installing or servicing. Accidental contact with energized parts may cause personal injury or death.</p>
<p><b>WARNING</b></p> 	<p>Observe torque requirements for all electrical connections as recommended by the lug manufacturer.</p>
<p><b>WARNING</b></p> 	<p>Install equipment in accordance with the National Electrical Code and any applicable local electrical standards. Failure to properly install the equipment in accordance with local electrical safety standards may cause electric shock, fire or service disruption.</p>
<p><b>WARNING</b></p> 	<p>Open type equipment should be installed in properly rated enclosure based on the location and environment.</p>
<p><b>WARNING</b></p> 	<p>After de-energizing the unit, wait 5 minutes before opening the enclosure for service or maintenance. This ensures that all stored energy component, such as capacitors, are discharged.</p>

## 2. Receiving, Handling and Storage

Every APQ product is carefully inspected and packaged at the factory before shipment. Construction of the equipment is checked both structurally and electrically for compliance with specifications, codes, and standards.

**RECEIVING.** Visually inspect equipment as soon as received. Make note of any damage that may have occurred during transportation and immediately report it to the proper carrier.

**UNPACKING.** Read this manual thoroughly before carefully unpacking the equipment. Remove plastic wrapping and protective pads used during transportation.

**HANDLING INSTRUCTIONS.** Always consult OSHA guidelines for lifting heavy equipment. Unsafe handling procedures can result in serious injury or death.

Wall mounted units are transported upright or on its back. Use proper lifting devices to set equipment upright and in place.

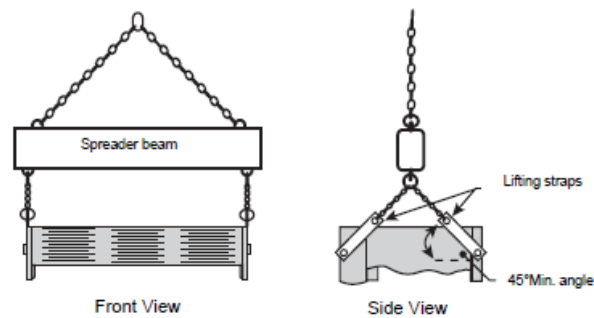


Figure 2.1 Overhead Lifting

Floor mounted units are transported upright on wooden crates. Use a forklift to transport the equipment and use a properly size overhead lifting mechanism to set in place.



### WARNING

#### TOP HEAVY LOAD

May tip resulting in death, severe personal injury, or equipment damage. Secure to forklift with safety strap.

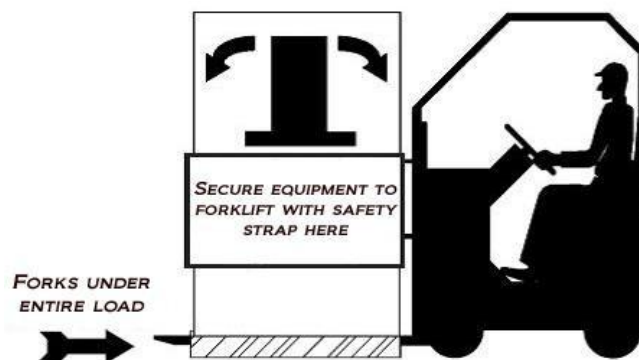


Figure 2.2 Fork Lift Base lifting

**STORAGE.** It is recommended that equipment is stored in an indoor, dry, and non-corrosive location. Equipment should be kept in its packing or shipping configuration. Outdoor rated equipment is not weather-resistant until completely and properly installed. Equipment should be stored upright or as received from shipment. Inspect the equipment before installing, if stored for a long period of time. The use of portable heaters may be needed to prevent humidity in the enclosure. When portable heaters are used, remove all loose packing materials to minimize the risk of fire.

### 3. General Installation and Wiring

**INTERIOR INSPECTION.** Inspect the unit for loose bolts, packing material or loose conductors. Bolts, screws and any mechanical restrictions may have loosened during the shipment. APQ may also use packing materials to minimize damage during shipment. Make sure those have been removed before proceeding.

Bolt Dimensions				Torque	
A	B	C (in.)	D (in.)	Lbs-in	N-m
¼"	7/16"	0.50	0.16	80	9.0
5/16"	½"	0.56	0.21	180	20.3
3/8"	9/16"	0.65	0.24	240	27.1
½"	¾"	0.87	0.32	480	54.2
5/8"	15/16"	1.08	0.40	660	75.5
¾"	1-1/8"	1.30	0.48	1050	118.6

Note: 1ft-lb = 12 in-lb

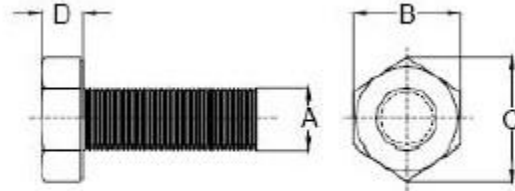


Figure 3.1 Recommended Torque for Mounting Bolts

Capacitors are bolted on to panels have a recommended Torque of 5 Nm.

**LOCATION.** The selected location for the installation must have sufficient space around the equipment for working clearance as prescribed by the National Electric Code Section 110-26 or local Authority Having Jurisdiction.

The selected location for the installation must also have sufficient space around the equipment for proper ventilation. Do not block the equipment airflow louvers.

**AMBIENT AND OPERATING TEMPERATURE.** APQ equipment is designed to operate at 60 deg C rise above 40 deg C ambient. Contact APQ for recommendations if install location is above 40 deg C.

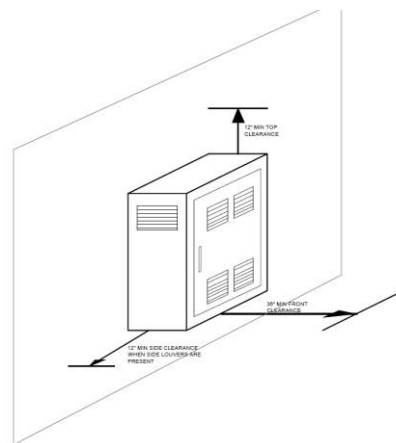


Fig 3.2 Clearance around equipment

**ANCHORING.** The foundation or the wall must be structurally sound to support the weight of the device. Foundation floor should be level and free of debris before moving the equipment into position.

Although an equipment is freestanding, it is recommended that the enclosure are anchored to the floor. This assures the equipment to withstand tipping and misalignment due to unintentional contact. For seismic requirements, contact the local experts for proper anchoring procedures.

**WIRING AND TERMINATION.** When connecting the unit to the power system, all applicable National Electric Codes must be followed.

Feeder conductor and cable, conduit and raceway must be sized according to the “National Electric Code Section 310” and/or subject to the local Authority Having Jurisdiction. NEC article 460 specifies that the ampacity of capacitor conductors to be rated at 135% of rated capacitor current. The ampacity should be derated as necessary for ambient temperature. Conductors must be terminated properly at the lug-manufacturer’s recommended torque range.

Cable Size AWG or kcmil	Terminal Torque Requirements			
	Lbs-in	N-m	Lbs-in	N-m
18 - 10	35	4.0	80	9.0
8	40	4.5	80	9.0
6 - 4	45	5.1	165	18.6
3	50	5.6	275	31.1
2	50	5.6	275	31.1
1	50	5.6	275	31.1
1/0 - 2/0	50	5.6	385	43.5
3/0 - 4/0	50	5.6	500	58.5
250 - 350	50	5.6	650	73.4
400	50	5.6	825	93.2
500	50	5.6	825	93.2
600 - 700	50	5.6	1000	113.0

Note: 1 ft-lb = 12 in-lb

Figure 3.2 Recommended Torque for Cable Terminals

**OVERCURRENT AND PROTECTIVE DEVICE (OCPD) Sizing.** Short circuit and overload protection must be provided upstream of the power quality equipment. Fused disconnects should be sized no less than 135% of the rated capacitor current.

**EQUIPMENT GROUNDING.** Equipment must be grounded with properly sized grounding conductors in accordance to NEC Section 250-122.

Rating or Setting of Automatic Overcurrent Device in Circuit Ahead of Equipment, Conduit, etc., Not Exceeding (Amperes)	Size (AWG or kcmil)	
	Copper	Aluminum or Copper- Clad Aluminum*
15	14	12
20	12	10
30	10	8
40	10	8
60	10	8
100	8	6
200	6	4
300	4	2
400	3	1
500	2	1/0
600	1	2/0
800	1/0	3/0
1000	2/0	4/0
1200	3/0	250
1600	4/0	350
2000	250	400
2500	350	600
3000	400	600
4000	500	800
5000	700	1200
6000	800	1200

Note: Where necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor shall be sized larger than given in this table.

\*See installation restrictions in 250.120.

Figure 3.3 NEC Table 250.122 Minimum Size Equipment Grounding Conductor

#### 4. Energizing the equipment.

- a. It is important that all installation and operation manual has been read and clarified prior to energizing the equipment.
- b. Ensure that the equipment power feeder is disconnected or turned off while performing the final inspections.
- c. Verify all packing materials have been removed.
- d. Verify torque settings of wiring terminal lugs.
- e. Verify the wiring diagram and the orientation of current transformers, if equipped.
- f. Verify power and control fuse are installed.
- g. Verify torque settings of component mounting bolts.
- h. Verify wall or floor mount anchoring and clearance around the equipment.
- i. Verify general cleanliness and workmanship of the installation.

**WARNING!!**



**DO NOT USE EQUIPMENT THAT HAS BEEN  
SUBJECT TO A SHORT CIRCUIT SYSTEM FAULT.  
THOROUGH INSPECTION BY QUALIFIED  
PERSONNEL MUST BE PERFORMED BEFORE  
RETURNING TO SERVICE.**



**DO NOT USE EQUIPMENT THAT HAS BEEN  
EXPOSED TO LARGE VOLUMES OF WATER OR  
SUBMERGED AT ANY TIME. THOROUGH  
INSPECTION BY QUALIFIED PERSONNEL MUST BE  
PERFORMED BEFORE RETURNING TO SERVICE.**





## 5. Maintenance

**PERIODIC MAINTENANCE.** Periodic maintenance and inspection is recommended by APQ for proper long term operation of the equipment. The interval between maintenance and inspection vary depending on the amount of usage and environmental condition of the installation site. APQ recommends maintenance and inspection interval of one year at the longest.

- a. Clean and vacuum vent grills, louvers and filters.
- b. Check all accessible connections for tightness and torque.
- c. Check all factory and field installed lug terminations for tightness and torque.
- d. Check for enclosure dents
- e. Check for evidence of moisture and condensation. Look for visual cues such as, discoloration, paint peels and cracks.
- f. Check conduit entrances.
- g. Check for evidences of overheating. Look for visual cues such as discoloration, paint peels and cracks. If available, use an infrared thermographic camera and note any extreme temperatures during operation.
- h. Check capacitor cells for physical deformities.
- i. If equipped, manually exercise circuit breakers (local and/or remote)
- j. If equipped, check power and control fuse base and fuses.
- k. Verify all the safety locks and enclosure hasps are properly working.

### WARNING!!



**DO NOT ATTEMPT TO SERVICE ANY ORIGINAL EQUIPMENT DEVICES. THIS INCLUDES, BUT IS NOT LIMITED TO, COMPONENTS SUCH AS MOLDED CASE CIRCUIT BREAKERS, CAPACITOR CELLS, CONTACTORS, AND CONTROLLERS.**



**Failure to properly install, maintain and inspect the equipment may result in equipment damage, improper operation, shortened equipment life span and voided warranty.**