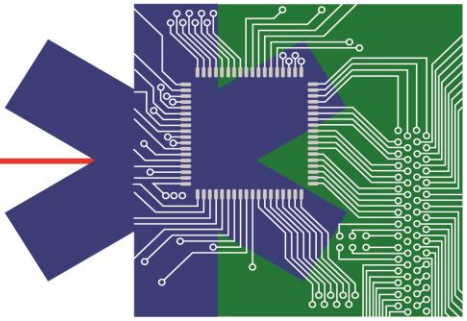
ELECTRO-MECHANICAL ER RECERTIFIERS INC.



24 HOUR RESPONSE 1-877-378-4183

STATE OF PENNNSYLVANIA EMERGENCY DIRECTIVE

Supplemental Document in Support of Disaster Recovery Plan for Critical Infrastructure: Assessment & Recovery of Electrical Power

Protocol for Handling Residential
and Multi-Residential Electrical System Assessments
Applicable to Office Buildings, Warehouses, Office Spaces,
Hotels, Schools, Hospitals and Multi-Purpose Buildings

Perils included:
Fire Damage Assessments
Power Damage Assessments
Water Damage Assessments

Prepared for distribution by Electro-Mechanical Recertifiers, Inc. March, 2011, Version 0.0

EMERGENCY DIRECTIVE
PROTOCOL FOR RECOVERY OF WATER DAMAGED CRITICAL ELECTRICAL INFRASTRUCTURE

HANDLING DIRECT WET, FLOODED OR INDIRECT (SECONDARY) MOISTURE CONDITIONS AFFECTING ELECTRICAL EQUIPMENT - GEAR AND POWER DISTRIBUTION SYSTEMS:

Electrical Equipment Protocol Covering:

- Main Switch Gear
- Main Distribution
- Sub Distribution Panels
- Lighting Panels
- Equipment Power Control Panels –Relay Logic or PLC
- Disconnects- Fused and Non Fused
- Transformers
- Rectifiers
- Power Inverter
- Current Transformers and Potential Transformers
- Peripheral Devices- Motion detectors, proximity switches, lasers, sensors
- Power Generating Equipment
- Automatic and Manual Transfer Switches
- Lighting Fixtures, Switches and Receptacles
- Internally Ground Circuits
- Charging Stations
- Lighting Suppression Systems
- Back Up Batteries and UPS systems
- Main Feeds, Distribution Feeds and Branch Circuit Wiring
- Other related Electrical Equipment

When any electrical equipment has been infiltrated by water whether by flash flood or long term flooding, or has been sprayed, splashed, hosed, extinguished or has standing water in, on or around it, or housed in high humidity conditions or is sweating and or at the dew point it must be professionally assessed. Water and the accompanying contaminates carried in through the roof rain water, firefighting suppression, rising flood waters and storm surge can cause immediate fire, explosion and shorting resulting in upstream and downstream damages to other system components, cabling and wiring as well as other equipment installed or electrically attached equipment. Left untreated and to dry slowly causes oxidation of the contaminates present resulting in corrosion of base metals,

According to NEMA – the National Electrical Manufactures Association Publication certain electrical gear can be restored/refurbished and certain components require replacement. Inspection and pre-testing can determine the conditions. UL and FM guldens also dictate how to approach these conditions. However specific mitigation and emergency services steps must be taken to preserve this equipment. Finally after proper emergency and restoration/refurbishment is components then final acceptance testing according to NETA standards allows an OEM to recertify their equipment. Electrical powered gear, components and distribution equipment can be deemed safe as of a specific point in time. Building wiring can also be tested using Insulation Resistance Testing to NETA standards ensuring the building compotes and combined systems are safe.

PRE-DISASTER PHASE:

What to do prior to an event or if you have time to prepare.

1. Storm Harden using sand bag, raise equipment in lower elevations prone to flooding or standing water, build or modify with storm walls and/or concrete barriers or retaining walls with sump pumps and reinforce structural components wall, door, window, roof as well as roof and ell protrusions and ventilation opening. Storm harden any facilities housing Backup Generators, Transfer Switches, Back Up Batteries, Power Conditioning Equipment, Mina Switch Gear, Electrical Power Gear, and Electrical Distribution Systems including Transformers, Rectifiers, back Up Batteries, CT'S, PT'S and control systems including SCADA systems, relay logic and PLC controls for other electrical and mechanical systems or equipment. Primary focus should be to ensure these systems stay secure from high sustained winds, keep dry and operational as long as possible. Convert panel boxes to NEMA 4E configurations or to explosion proof configuration for critical applications where possible to minimize and water proof components, wiring and cables when possible.
2. When you determine a storm, flood or other event is inevitable shed loads, shut off sub-distribution breakers and fuses disconnects and open the main service breakers to Electrical Power Distribution Systems until event has passed.
3. When you have a fire, explosion or flood event isolate the power to the damaged areas of the finality and equipment ASAP or have the power company isolate the main power...

ASSESSMENT PHASE

After the storm or an event has occurred begin the assessment phase of the electrical equipment.

1. Determine that you are not at risk. Test that power is off. Ensure that there is no rogue power or utility power feeding into the area you desire to access. Make electrically safe.
2. Lock out and tag out mains and/or utility power according to OSHA standard.
3. Only then have electrically trained persons enter the facility wearing proper PPE and test again for current.
4. Inspect equipment for damage, note conditions of temperature, Rh% and moisture readings of structural items near the equipment you are assessing as well as electrical equipment in question.
5. Look for standing water, pockets of saturation and in check place conduit for standing water.
6. Look for oxidation, corrosion, pitting, burning, shorting and explosion.
7. Do not restore power until proper treatments and emergency services have taken place.
8. Document conditions and damaged components to the electrical systems. Take notes, make an inventory and record all pre-test results. Use photos or video.
9. Submit a step logic engineering best practices plan for emergency services.

EMERGENCY SERVICE PHASE:

Initiate emergency services to the damaged electrical equipment to preserve it and pre-test to determine conditions and replacement of items.

1. Determine that you are not at risk. Test that power is off. Ensure that there is no rogue power or utility power feeding into the area you desire to access. Make electrically safe.
2. Lock out a tag out mains and/or utility power.
3. Have electrically trained persons confirm before working on any equipment that it is safe and isolated form all energy sources according to OSHA standard.
4. Enter the facility wearing proper PPE and test again for current.
5. Continue to note conditions of temperature, Rh% and moisture readings of structural items near the equipment you are assessing as well as electrical equipment in question.
6. Inspect equipment for damage, note conditions of temperature, Rh% and moisture readings of structural items near the equipment you are assessing as well as electrical equipment in question.

7. Look for standing water, pockets of saturation and in check place conduit for standing water and remove this condition. Open pull boxes, junction boxes and troughs for proper drying. Remove panel covers for proper drying.
8. Do not restore power until proper until proper treatments and emergency services have taken place.
9. Employ desiccant drying equipment and air movement to dry the electrical system components.
10. Remove by pumping all standing water from conduits and use injectadry equipment to dry conduit and cabling or wiring.
11. Clean gross contamination with clean water by mechanical methods, hand clearing and pressure wading.
12. Final clean using de-ionized water and electrical conducive non-residual and non-acid based cleaners.
13. Treat all metallic contacts, wire end exposed, legs, terminals and all structural base metals and buss bars with corrosion inhibitors and moisture displacement agents.
14. Clean all insulators and insulating materials with compatible non-acidic and non-conductive cleaners.
15. Field preparation and treatment of any metals cabinets, troughs or conduits showing corrosion in clouding galvanized, epoxy coating or compatible primers to arrest coercion and breaching of paint or other finishes, prime to control corrosion.
16. Submit a cost effective, step logic engineering best practices plan for sound restoration including refurbishment and replacement as required for the shortest path to reverie of the electrical system.

RESTORATION – REFURBISHMENT and RECERTIFICATION PHASE

Begin restoration process which includes the refurbishment and replacement of items of the damaged electrical equipment:

1. At every phase establish that you or others are not at risk. Test that power is off. Ensure that there is no rogue power or utility power feeding into the area you desire to access. Make electrically safe.
2. Lock out a tag out mains and/or utility power bad sub-distribution power.
3. Have electrically trained persons confirm before working on any equipment that it is safe and isolated form all energy sources according to OSHA standard.
4. Enter the facility wearing proper PPE and test again for current.
5. Continue to note conditions of temperature, Rh% and moisture readings of structural items near the equipment you are assessing as well as electrical equipment in question.
6. Test the components, wiring and cabling using NETA and OEM guidelines. .Prepare witnessed test reports. Confirm electrical safety.
7. Restore and refurbish competes such as cabinets, busses, buckets, thoughts, conduits and blades. Test all electrical devices.
8. Dry in place wiring and cables and test.
9. Provide list of items for replacement and replace all required items such as case molded breakers, transformers, fuses, receptacles, switches.
10. Startup systems and monitor with IR camera and digital thermometers. Look for hot sports, nuisance trips and overheating conditions.
11. Final acceptance testing and power up building lighting controls and equipment.
12. Check phasing and confirm rotation of all motors on all systems and ensure voltages to all equipment. Final check loads, switching and breakers.
13. Certify test reports and provide to client in final acceptance testing format.
14. OEM recertification when possible and certified refurbishment and self-certification.

OTHER EQUIPMENT:

Other Related Electrical Powered Equipment Items Needing Further Evaluation:

A. Mechanical Systems- Heating or cooling.
B. Plumbing Systems.
C. Networked computers and IT systems.
D. Data storage and retrieval devices.
E. Communication systems including RF, cell equipment and telecommunications.
F. Phone interfaces, fiber optic and communication demark hubs.
G. Pumps, grinders, lift stations, controls, filtration systems, aeration systems for firefighting, water consumption, jockey pumps and waste treatment equipment.
H. Business machines- copiers, scanners, faxes.
I. Patient interactive equipment and medical equipment.
J. Food preparation and processing equipment.
K. Alarm Systems- Fire and burglar alarms.
L. Automated entry systems.
M. CCTV systems.
N. Other Systems

Table of Contents

Step Logic to Approaching Damaged Electrical Systems According to Loss Event by Type

Supporting Reference Materials:

NEMA- Guidelines For Handling Water-Damaged Electrical Equipment

Flood Damaged Electrical Requirements CNI-027 by Sonoma County, CA

ANSI/NETA ATS-2009 Page 11, Section 3 - Qualifications of Testing Organizations and Personnel
Page 12, Section 4 - Division of Responsibility
Page 13,14,15 Section 5 - General
Page 38, 39 Section 7 - Inspection and Test Procedures

DATA BULLETIN 0110DB0401R9/05- Water Damaged Electrical Distribution and Control Equipment Class 0110

Technical Restoration Step Logic submitted by Electro-Mechanical Recertifiers, Inc. 2011

Step Logic Residential or Multi-Residential Electrical System Assessments for Fire Damage

Loss Event	General Conditions	Meter Socket & Service Feeder	Electrical Panel Conditions	Branch Circuit Wiring	Devices	Recommended Testing on items to determine replacement, or proof for items not being replaced
Fire & Explosion	Heavy residue, some chemical or hydrocarbon residues, hard to remove and some debris and soot. Maybe be chemically based	If residue has affected the meter or feeder cable and adhering to the meter or the feeder cable jacket clean the meter and cable jacket or replace accordingly. Certain contaminates may continue to be highly corrosive and may need replacement.	If the residue is adhered covering the panel and breakers, disassemble, clean the soot, reassemble, make sure to remove all soot using proper methods. Exterior clean/restore the box, conductor and cover or replace. Certain contaminates may continue to be highly corrosive and may need replacement.	If no wire is burnt and no electrical work to be done may be ok. If wire is exposed or stained, replace sections affected. May need to cut back wires and strip to remove residue to metal wire. Certain contaminates may continue to be highly corrosive and may need replacement. Knob & Tube and Aluminum wire may need to be upgraded to meet current code requirements.	Check light sockets, switches and receptacles: if discolored, replace. Certain contaminates may continue to be highly corrosive residue and devices may need replacement.	Megohmmeter Testing to Feeder and Branch Circuit Wiring to confirm condition. Voltage Testing to Breakers and Devices to confirm condition.
Fire Damage	Low Heat - No heat line, no melted plastic, minimal soot and fall out	If fire is in the area of the meter or feeder cable, check for thermal damage to feeder jacket, replace/repair/restore accordingly	If fire is in the direct area of the panel, check for thermal damage to breakers and wire jacket, replace/repair/restore accordingly	If no wire is burnt and no electrical work to be done may be ok. If wire is exposed and burnt replace sections affected. Knob and Tube and Aluminum wire may need to be upgraded to meet current code requirements.	Check light sockets, switches and receptacles if melted replace	Megohmmeter Testing to Feeder and Branch Circuit Wiring to confirm condition. Voltage Testing to Breakers and Devices to confirm condition.
Fire Damage	High Heat- A mix of organics and made items burnt at a high rate with a lot of oxygen. Less soot a lot of heat or can be a lot of soot in some smoldering fires	If the heat line has affected the meter or feeder cable, check for thermal damage to feeder jacket, replace/repair/restore accordingly	If the heat line has affected the panel and breakers, check for thermal damage to breakers and wire jacket and replace/repair/restore accordingly	If no wire is burnt and no electrical work to be done may be ok. If wire is exposed or burnt replace sections affected. Knob and Tube and Aluminum wire may need to be upgraded to meet current code requirements.	Check light sockets, switches and receptacles if melted replace	Megohmmeter Testing to Feeder and Branch Circuit Wiring to confirm condition. Voltage Testing to Breakers and Devices to confirm condition.
Fire Damage	Fallout- Light soot, paper, cotton or even wood based fires usually organic in nature.	If light soot has affected the meter or feeder cable like a dusting and has landed on the feeder cable jacket clean the meter and cable jacket or replace accordingly	If the soot is light and in the panel and breakers, clean the soot, make sure to remove all soot using proper methods. Exterior clean the breakers. Clean the box, conductors and cover.	If no wire is burnt and no electrical work to be done may be ok. If wire is exposed or stained replace sections affected. May need to cut back wires and strip to remove corrosion to metal wire. Knob and Tube and Aluminum wire may need to be upgraded to meet current code requirements. Knob and Tube and Aluminum wire may need to be upgraded to meet current code requirements.	Check light sockets, switches and receptacles if discolored replace	Megohmmeter Testing to Feeder and Branch Circuit Wiring to confirm condition. Voltage Testing to Breakers and Devices to confirm condition.

Step Logic Residential or Multi-Residential Electrical System Assessments for Fire Damage

Loss Event	General Conditions	Meter Socket & Service Feeder	Electrical Panel Conditions	Branch Circuit Wiring	Devices	Recommended Testing on items to determine replacement, or proof for items not being replaced
Fire Damage	Soot covered- usually a mixed fire of organics and made materials. Can be slightly corrosive.	If soot has affected the meter or feeder cable like a dusting and has landed on the meter or feeder cable jacket clean the meter and cable jacket or replace accordingly	If the soot is adhering to the surfaces and covering the panel and breakers, disassemble, clean the soot, reassemble, make sure to remove all soot using proper methods. Exterior clean the box, conductor and cover.	If no wire is burnt and no electrical work to be done may be ok. If wire is exposed or stained replace sections affected. Knob and Tube and Aluminum wire may need to be upgraded to meet current code requirements.	Check light sockets, switches and receptacles if discolored replace	Megohmmeter Testing to Feeder and Branch Circuit Wiring to confirm condition. Voltage Testing to Breakers and Devices to confirm condition.
Fire Damage	Heavy sticky soot- Food or protein based fire can have metallic residues if a pan or appliance burnt without plastics melting	If sticky soot has affected the meter or feeder cable and adhering to the meter or the feeder cable jacket clean the meter and cable jacket or replace accordingly	If the soot is sticky and covering the panel and breakers, dissemble, clean the soot, reassemble, make sure to remove all soot using proper methods. Exterior clean the box, conductor and cover.	If no wire is burnt and no electrical work to be done may be ok. If wire is exposed or stained replace sections affected. May need to cut back wires and strip to remove corrosion to metal wire. Knob and Tube and Aluminum wire may need to be upgraded to meet current code requirements.	Check light sockets, switches and receptacles if discolored replace	Megohmmeter Testing to Feeder and Branch Circuit Wiring to confirm condition. Voltage Testing to Breakers and Devices to confirm condition.
Fire Damage	Heavy corrosive soot- man made materials, PVC, ABS, Nylon etc... burnt and give off high chlorides, sulfates and bromides which are very corrosive to plastic and base metals	If corrosive soot has affected the meter or feeder cable and adhering to the meter or the feeder cable jacket clean the meter and cable jacket or replace accordingly	If the soot is adhered residue covering the panel and breakers, disassemble, clean the soot, reassemble, make sure to remove all soot using proper methods. Exterior clean/restore the box, conductor and cover or replace.	If no wire is burnt and no electrical work to be done may be ok. If wire is exposed or stained replace sections affected. May need to cut back wires and strip to remove corrosion to metal wire. Knob and Tube and Aluminum wire may need to be upgraded to meet current code requirements.	Check light sockets, switches and receptacles if discolored replace	Megohmmeter Testing to Feeder and Branch Circuit Wiring to confirm condition. Voltage Testing to Breakers and Devices to confirm condition.

Step Logic for Residential or Multi-Residential Electrical System Assessments for Power Damage

Loss Event	General Conditions	Meter Socket & Service Feeder	Electrical Panel Conditions	Branch Circuit Wiring	Devices	Recommended Testing on items to determine replacement, or proof for items not being replaced
Power Surge/Line Voltage Damage	Overcurrent, spikes or surges transmitted through the feeder line from the power provider causing damage to the home's electrical system, appliances and electronics.	Inspect, test and replace if fails	Inspect, test and replace if fails	If wire is dry, not burnt then further visual inspect; test and replace if fails. Knob and Tube and Aluminum wire may need to be upgraded to meet current code requirements.	Inspect, test and replace if fails	Megohmmeter Testing to Feeder and Branch Circuit Wiring to confirm condition. Voltage Testing to Breakers and Devices to confirm condition.
Lightning Damage	Lightning and thunder storm related event. Either direct to a structure or usually through the electrical power lines but can travel through, cable lines, phone lines, data lines, water lines, speaker lines or metal ductwork causing damage to the homes electrical system, appliances and electronics.	Inspect, test and replace if fails	Inspect, test and replace if fails	If wire is dry, not burnt then further visual inspect; test and replace if fails. Knob and Tube and Aluminum wire may need to be upgraded to meet current code requirements.	Inspect, test and replace if fails	Megohmmeter Testing to Feeder and Branch Circuit Wiring to confirm condition. Voltage Testing to Breakers and Devices to confirm condition.
Power Condition Damage	Certain devices are affected by erratic power, i.e. computers will not safely run direct on a generator without conditioned power. Electronics, appliances and equipment running on generators can be damaged. Also undercurrent conditions can cause serious problems and easily ruin motors and controls in HVAC systems, refrigerators, and other appliances with motors. This condition may be due to bad line transformer, bad wiring, loose connection, or undercurrent condition.	Inspect, test and replace if fails	Inspect, test and replace if fails	If wire is dry, not burnt then further visual inspect; test and replace if fails. Knob and Tube and Aluminum wire may need to be upgraded to meet current code requirements.	Inspect, test and replace if fails	Megohmmeter Testing to Feeder and Branch Circuit Wiring to confirm condition. Voltage Testing to Breakers and Devices to confirm condition.
Power Outage Damage	When line power is out or a blackout condition occurs, the electrical systems and electronics can be affected due to improper shut-down or undercurrent conditions. Real damage occurs from the spike when power turns back on.	Inspect, test and replace if fails	Inspect, test and replace if fails	If wire is dry, not burnt then further visual inspect; test and replace if fails. Knob and Tube and Aluminum wire may need to be upgraded to meet current code requirements.	Inspect, test and replace if fails	Megohmmeter Testing to Feeder and Branch Circuit Wiring to confirm condition. Voltage Testing to Breakers and Devices to confirm condition.

Step Logic for Residential or Multi-Residential Electrical System Assessments for Water Damage

Loss Event	General Conditions	Meter Socket & Service Feeder	Electrical Panel Conditions	Branch Circuit Wiring	Devices	Recommended Testing on items to determine replacement, or proof for items not being replaced
Water Damage	Clean Class I- the problem is that even "clean water" left untreated will corrode base metals, as it contains chlorine and other chemicals as well as a certain level of oxides. When the water dries, the oxidation can allow mild corrosion to begin.	If clean water has affected the meter or feeder cable and no visible corrosion to the meter or the feeder cable dry and clean as needed. Any wire that is not type W or water resistant must be replaced	If there is no corrosion or evidence of water covering the panel and breakers, disassemble, dry, reassemble, make sure to remove all salt or chlorine residues using proper methods. Interior/Exterior clean/restore the box, conductor and cover or replace.	If wire is dry and no electrical work to be done may be ok. If wire is wet dry and replace sections affected. May need to cut back wires and strip to remove corrosion to metal wire. Any wire that is not type W or water resistant must be replaced. Knob and Tube and Aluminum wire may need to be upgraded to meet current code requirements.	Check light sockets, switches and receptacles if corroded or discolored replace.	Megohmmeter Testing to Feeder and Branch Circuit Wiring to confirm condition. Voltage Testing to Breakers and Devices to confirm condition.
Water Damage	Gray Class II- Same as Class I except this water has chlorine, possible metals and chemicals, plus cleaning solutions, sink drain water, and bio-hazards that can easily cause untreated water to become Class III in a matter of days.	If gray water has affected the meter or feeder cable and no visible corrosion to the meter or the feeder cable dry and clean as needed. Gray water untreated and left without drying can become black water meaning it can contain bio-contaminates and affected the metals and plastics. Any wire that is not type W or water resistant must be replaced	If there is no corrosion or evidence of water covering the panel and breakers, disassemble, dry, reassemble, make sure to remove all salt or chlorine residues using proper methods. Interior/Exterior clean/restore the box, conductor and cover or replace.	If wire is dry and no electrical work to be done may be ok. If wire is wet dry and replace sections affected. May need to cut back wires and strip to remove corrosion to metal wire. Any wire that is not type W or water resistant must be replaced. Knob and Tube and Aluminum wire may need to be upgraded to meet current code requirements.	Check light sockets, switches and receptacles if corroded or discolored replace.	Megohmmeter Testing to Feeder and Branch Circuit Wiring to confirm condition. Voltage Testing to Breakers and Devices to confirm condition.
Water Damage	Black (Sewage) Class III - This is the dirtiest of the waters that can be in a home or business. These waters are very similar to outside flood water and have pesticides, bio-cedes, heavy metals, chemicals and raw sewage. This condition is always hazardous, with bio-hazards and heavy silt, and has high corrosion potential.	If black water has affected the meter or feeder cable and no visible corrosion to the meter or the feeder cable dry and clean as needed. Black water contains bio-contaminates and affected the metals and plastics. Any wire that is not type W or water resistant must be replaced	If there is no corrosion or evidence of water covering the panel and breakers, disassemble, dry, reassemble, make sure to remove all salt or chlorine residues using proper methods. Interior/Exterior clean/restore the box, conductor and cover or replace.	If wire is dry and no electrical work to be done may be ok. If wire is wet dry and replace sections affected. May need to cut back wires and strip to remove corrosion to metal wire. Any wire that is not type W or water resistant must be replaced. Knob and tube and Aluminum wire may need to be upgraded to meet current code requirements.	Check light sockets, switches and receptacles if corroded or discolored replace.	Megohmmeter Testing to Feeder and Branch Circuit Wiring to confirm condition. Voltage Testing to Breakers and Devices to confirm condition.

Step Logic for Residential or Multi-Residential Electrical System Assessments for Water Damage

Loss Event	General Conditions	Meter Socket & Service Feeder	Electrical Panel Conditions	Branch Circuit Wiring	Devices	Recommended Testing on items to determine replacement, or proof for items not being replaced
Water Damage	Chemical Laden - Chemical spill, overflow or other industrial accident. This water needs to be handled with vacuum trucks and the waste stream needs to be disposed of properly. Some chemicals may be toxic, flammable, combustible or even have risk of flash fire/explosion.	If chemical-laden water has affected the meter or feeder cable and no visible corrosion to the meter or the feeder cable dry and clean as needed. This might be from medical equipment, drug paraphnilla or other processes using into he homes water treatment, hobbies, garage or other activities that may have a hazardous by product. These chemicals may be highly corrosive and the contamination level may warrant replacement. Any wire that is not type W or water resistant must be replaced	If the soot is light and in the panel and breakers, clean the soot, make sure to remove all soot using proper methods. Exterior clean the breakers. Clean the box, conductors and cover.	If wire is dry and no electrical work to be done may be ok. If wire is wet dry and replace sections affected. May need to cut back wires and strip to remove corrosion to metal wire. Any wire that is not type W or water resistant must be replaced. Knob and tube and Aluminum wire may need to be upgraded to meet current code requirements.	Check light sockets, switches and receptacles if discolored replace	Megohmmeter Testing to Feeder and Branch Circuit Wiring to confirm condition. Voltage Testing to Breakers and Devices to confirm condition.
Water Damage	Outside Flood Waters - These waters are very similar to Class III Black Water and have pesticides, bio-cedes, heavy metals, chemicals, raw sewage, bio-hazards and heavy silts. This condition is always hazardous and has high corrosion potential.	If outside flood water has affected the meter or feeder cable and no visible corrosion to the meter or the feeder cable dry and clean as needed. Outside flood water has all types of contaminates and bio-hazards. Medical, dental , industrial and sewage are all heavy. These chemicals may be highly corrosive, toxic and the contamination level and may warrant replacement	If the soot is adhering to the surfaces and covering the panel and breakers, disassemble, clean the soot, reassemble, make sure to remove all soot using proper methods. Exterior clean the box, conductor and cover.	If wire is dry and no electrical work to be done may be ok. If wire is wet dry and replace sections affected. May need to cut back wires and strip to remove corrosion to metal wire. Any wire that is not type W or water resistant must be replaced. Knob and tube and Aluminum wire may need to be upgraded to meet current code requirements.	Check light sockets, switches and receptacles if discolored replace	Megohmmeter Testing to Feeder and Branch Circuit Wiring to confirm condition. Voltage Testing to Breakers and Devices to confirm condition.

Sectional Divider- Supporting Materials:

NEMA- Guidelines For Handling Water-Damaged Electrical Equipment

GUIDELINES FOR HANDLING WATER-DAMAGED ELECTRICAL EQUIPMENT

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
1300 NORTH 17TH STREET, SUITE 1752
ROSSLYN, VIRGINIA 22209

703 841-3200
703 841-5900 FAX

WWW.NEMA.ORG

Guidelines for Handling Water-damaged Electrical Equipment

NOTICE AND DISCLAIMER – Please see the last page of this document.

Use of this Publication

This publication provides guidelines on how to handle electrical equipment that has been exposed to water through flooding, fire fighting activities, hurricanes, etc. It is designed for use by suppliers, installers, inspectors, and users of electrical products.

Electrical equipment exposed to water can be extremely dangerous if reenergized without proper reconditioning or replacement. Reductions in integrity of electrical insulation due to moisture, debris lodged in the equipment components, and other factors, can damage electrical equipment by affecting the ability of the equipment to perform its intended function. Damage to electrical equipment can also result from flood waters contaminated with chemicals, sewage, oil, and other debris that will affect the integrity and performance of the equipment. Ocean water and salt spray can be particularly damaging due to the corrosive and conductive nature of the salt water residue.

Distributors of electrical equipment should not use any inventory that has been subjected to water damage. Damaged inventory should not be sold to resellers that will place the equipment back into the market. This can lead to damaged equipment still being used and creating a hazard to individuals or property.

To Contact the Manufacturer

Working knowledge of electrical systems and of the equipment in question is required to evaluate damage due to contact with water. The original manufacturer of the equipment should be contacted if any questions arise or specific recommendations are needed. In many cases, replacement will be necessary.

After consultation with the manufacturer, some larger types of electrical equipment may be reconditioned by properly trained personnel. The ability to recondition the equipment may vary with the nature of the electrical function, the degree of flooding, the age of the equipment, and the length of time the equipment was exposed to water.

Attempts to recondition equipment without consulting the manufacturer can result in additional hazards due to the use of improper cleaning agents, which can further damage the equipment (see National Electrical Code® Section 110-11 FPN No.2) or due to improper reconditioning techniques.

NEMA member companies are committed to safety. For specific contacts within these manufacturing firms, call or write:

National Electrical Manufacturers Association
1300 North 17th Street, Suite 1752
Rosslyn, Virginia 22209
Telephone: (703) 841-3236
Fax: (703) 841-3336
ATTN: Vince Baclawski
email: vin_baclawski@nema.org

Electrical Distribution Equipment

Electrical distribution equipment usually involves switches and low-voltage protective components such as molded case circuit breakers and fuses, within assemblies such as enclosures, panelboards, and switchboards. These assemblies can be connected to electrical distribution systems using various wiring methods.

The protective components are critical to the safe operation of distribution circuits. Their ability to protect these circuits is adversely affected by exposure to water and to the minerals and particles which may be present in the water. In molded case circuit breakers and switches, such exposure can affect the overall operation of the mechanism through corrosion, through the presence of foreign particles, and through removal of lubricants. The condition of the contacts can be affected and the dielectric insulation capabilities of internal materials can be reduced. Further, some molded case circuit breakers are equipped with electronic trip units and the functioning of these trip units might be impaired. For fuses, the water may affect the filler material. A damaged filler material will degrade the insulation and interruption capabilities.

Distribution assemblies contain protective components together with the necessary support structures, buswork, wiring, electromechanical or electronic relays and meters. Exposure to water can cause corrosion and insulation damage to all of these areas. In the case of exposure of distribution assemblies to water, the manufacturer should be contacted before further action is taken.

Items Which May Possibly Be Reconditioned by Trained Personnel in Consultation with Manufacturer:

- Enclosed switches—reference NEMA Standards Publication KS 1-2001, *Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)*, para 5.1, 5.1.2
- Busway—reference NEMA Standards Publication BU 1.1-2000, *General Instructions for Handling, Installation, Operation, and Maintenance of Busway Rated 600 Volts or Less*, para 3.4.4, 9.2.4.2
- Panelboards—reference Standards Publication ANSI/NEMA PB 1.1-2002, *General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less*, para. 10.3, 10.8.3, 10.8.4
- Switchboards—reference Standards Publication ANSI/NEMA PB 2.1-2002, *General Instructions for Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less*, para. 11.3.1.3, 11.10
- Fire Pump Controllers—reference NEMA Standards Publication ICS 15-1999 (R2004), *Instructions for the Handling, Installation, Operation, and Maintenance of Electric Fire Pump Controllers Rated Not More Than 600 V*

Motor Circuits

Motor circuits include motor control devices such as motor starters and contactors, together with overcurrent protection components such as overload relays, circuit breakers, and fuses often assembled into motor control panels and motor control centers as well as individual enclosures. Motor control centers contain both control and protective components together with support structures, buswork, and wiring.

The protective components are critical to the safe operation of motor circuits and their ability to protect these circuits is adversely affected by exposure to water, and to the minerals and particles which may be present in the water. For molded case circuit breakers, such exposure can affect the overall operation of the mechanism through corrosion, through the presence of foreign particles, and through removal of lubricants. The condition of the contacts can be affected and the dielectric insulation capabilities of internal materials can be reduced. Further, some molded case circuit breakers are equipped with electronic trip units, and the functioning of these trip units might

be impaired. For fuses, the water may affect the filler material. A damaged filler material will degrade the insulation and interruption capabilities.

Corrosion, loss of lubrication, and insulation quality can also be expected in contactors and starters. However, solid-state motor controllers and those electromechanical contactors or starters with integral electronic circuitry will be more severely affected by water.

Drives damaged by water can be remanufactured by the original manufacturer in some cases. Contact the drive manufacturer for specifics.

Items Requiring Complete Replacement:

- Electronically controlled and solid state contactors and starters
- Components containing semiconductors and transistors
- Overload relays
- Molded case circuit breakers and molded case switches—reference NEMA Standards Publication AB 4-2003, Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications, para 2.2
- Fuses

Items Which May Possibly be Reconditioned by Trained Personnel in Consultation with Manufacturer:

- Manual and magnetic motor controllers
- Motor control centers

Power Equipment

Power equipment involves low voltage or medium voltage protective devices within an overall switchgear assembly. The assembly may also contain cabling, buswork with appropriate insulators, current transformers, electromechanical or electronic relays, and metering.

Reliable operation of the protective devices is vital to system safety; however, these devices can be adversely affected by water. In the case of low voltage and medium voltage circuit breakers and switches, the operation of the mechanism can be impaired by corrosion, by the presence of particles such as silt, and by the removal of lubricants. The dielectric properties of insulation materials and insulators will degrade and, for air circuit breakers, the condition of the contacts can be affected. Further, low voltage power circuit breakers usually incorporate electronic trip units; the functioning of these units will be impaired. Similarly, the functionality of electronic protective relays and meters can be impaired.

In the case of fuses, water may affect the filler material. A damaged filler material will degrade the insulation and interruption capabilities of fuses.

Power circuit breakers and medium voltage breakers are designed to be maintainable with the possibility, for example, of replacing contacts in air circuit breakers. It may, therefore, be possible to reuse such breakers provided the refurbishing is performed in close consultation with the manufacturer. This would include cleaning and drying techniques, lubrication advice, and thorough testing prior to the reapplication of power. However, the electronic trip units of low voltage power circuit breakers, and electronic protective relays and meters in any power equipment should be discarded and replaced, or at least returned to the manufacturer for inspection and possible refurbishment.

In the case of fused equipment, the fusible units should be replaced, and the remainder of the apparatus may be suitable for refurbishing in close consultation with the manufacturer.

In all cases, great attention must be paid to the thorough cleaning, drying, and testing of insulators and insulation material.

The power equipment can be expected to contain additional electronic units such as solid state relays. These units can also be vital to the correct functioning of the protective device, and great care is needed in the cleaning and testing of such units. A first recommendation is to return the devices to the manufacturer. If this is not possible, the manufacturer should be consulted, for example, on the correct selection of cleaning agents which remove impurities without damaging the conformal coating. The manufacturer must also be contacted relative to the exact testing required of sophisticated electronic equipment containing, for example, microprocessors.

The overall power equipment assembly (switchgear) may be able to be reconditioned provided careful steps are taken in the cleaning, drying, and testing of the equipment prior to applying power. This would require input and advice from the manufacturer. An area of particular concern is the maintenance of the dielectric properties of insulation. In the field application of medium voltage equipment, for example, standoff insulators are subjected to a wide variety of high voltage surges. Such insulators might need replacement.

Items Requiring Complete Replacement:

- Fuses
- Electronic trip units of low voltage power circuit breakers

Items Which May Possibly be Reconditioned by Trained Personnel in Consultation with Manufacturer:

- Alternating current high-voltage circuit breakers—reference NEMA Standards Publication SG 4-2000, *Alternating-Current High Voltage Circuit Breaker*, para 6.12
- Low voltage power circuit breakers
- Protective relays, meters, and current transformers
- Low voltage switchgear
- Medium voltage switchgear

Transformers

Exposure of transformers to water can cause corrosion and insulation damage to the transformer core and winding. The ability of the transformer to perform its intended function in a safe manner can also be impaired by debris and chemicals which may be deposited inside the transformer during a flood. Water and contaminates also can damage transformer fluids.

Items Requiring Complete Replacement:

- All dry-type transformers regardless of kVA ratings
- All dry type control circuit transformers

Items Which May Possibly be Reconditioned by Trained Personnel in Consultation with Manufacturer:

- Liquid-filled transformers (analysis of the insulating medium is required for evaluation of this equipment)
- Cast-resin transformers

Wire, Cable, and Flexible Cords

When any wire or cable product is exposed to water, any metallic component (such as the conductor, metallic shield, or armor) is subject to corrosion that can damage the component itself and/or cause termination failures. If water remains in medium voltage cable, it could accelerate insulation deterioration, causing premature failure. Wire and cable that is listed for only dry locations may become a shock hazard, when energized, after being exposed to water.

The following recommended actions are based upon the concept that the water contains no high concentrations of chemicals, oils, etc. If it is suspected that the water has unusual contaminants, such as may be found in some flood water, the manufacturer should be consulted before any decision is made to continue using any wire or cable products.

Items Requiring Complete Replacement:

- Any wire or cable that is listed for dry locations only, such as type NM-B cable, should be replaced if it has been exposed to water.
- Any cable that contains fillers, such as polypropylene, paper, etc., should be replaced if the ends of the product have been exposed to water.

Items Which May Possibly be Reconditioned by Trained Personnel in Consultation with Manufacturer:

- Any wire or cable product that is suitable for wet locations and whose ends have not been exposed to water should be suitable for use or continued use. A qualified person, such as an electrical contractor or others familiar with wire and cable terminology, should make the determination of the product's suitability for wet locations.
- Any wire or cable product, not containing fillers, that is suitable for wet locations and whose ends have been exposed to water, may be considered a candidate for "purging" (using an inert gas under pressure to remove water contained in the product) under engineering supervision. If this procedure is employed, the wire or cable should be tested prior to energization. As a minimum, an insulation resistance test with a megohmmeter should be conducted.

Wiring Devices, Ground Fault Circuit Interrupters (GFCI), and Surge Protectors

Sediments and contaminants contained in water may find their way into the internal components of installed electrical products and may remain there even after the products have been dried or washed by the user. These may adversely affect the performance of those products without being readily apparent to the user community. Also, electrical products, such as GFCIs and surge protective devices, contain electronic circuitry and other components which can be adversely affected by water resulting in the device becoming non-functional or a hazard to the user.

As a result, such products subjected to or believed to be subjected to water damage are not suitable for continued use and must be replaced with new undamaged products. Air drying and washing of water damaged products of this type should not be attempted.

Lighting Fixtures and Ballasts

Fluorescent, high-intensity discharge, and incandescent lights are not intended for submersion in water except for those that are listed as submersible lighting fixtures. Flooded lighting fixtures and associated equipment may be damaged by corrosive materials, sediment, or other debris in the water. Corrosion of metallic parts and contamination of internal circuitry may prevent the equipment from operating properly. Lighting fixtures and associated equipment known to have been submerged should be replaced.

Motors

Motors which have been flooded by water may be subjected to damage by debris or pollutants. This may result in damage to insulation, switches, contacts of switches, capacitors and overload protectors, corrosion of metallic parts, and contamination of the lubricating means and should be evaluated by qualified personnel.

The manufacturer should be contacted for specific instructions on possible disassembly, cleaning, and drying of the motor housing and internal components by trained personnel. Also, a method for drying is described in ANSI/IEEE 43-2000, A2 and A3.

Electronic Products, Including Signaling, Protection, Communication Systems, and Industrial Controls

Equipment used in signaling, protection, and communication systems generally contain electronic components, and the exposure of such equipment to flooding by water can adversely affect the reliability of those systems. Contamination by pollutants or debris in flood waters may cause corrosion of components of the system, shorting of printed circuits, or alteration of circuit characteristics. Since some of these types of installations are classified as life safety systems, it is important that the reliability of those systems be maintained.

Where such systems are damaged by water, it is recommended that components of these systems be replaced or returned to the manufacturer for appropriate cleaning, recalibration, and testing. Manufacturers of these systems should be contacted for information on specific equipment.

Cable Trays

Carefully inspect the cable tray system to determine if its mechanical and/or electrical integrity has been breached. *(WARNING—Do not use cable tray as a walkway.)* Repair or replace any damaged portions per original installation requirements. Remove all debris from the cable tray. If any labels warning against the use of the cable tray as a walkway have been obliterated, obtain new labels from the manufacturer and apply as required.

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NEMA STANDARDS PUBLICATION PB 2.1-1996

GENERAL INSTRUCTIONS FOR PROPER HANDLING, INSTALLATION, OPERATION, AND MAINTENANCE OF DEADFRONT DISTRIBUTION SWITCHBOARDS RATED 600 VOLTS OR LESS

RETAIN FOR USE OF QUALIFIED MAINTENANCE PERSONNEL

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION ■ 1300 N. 17TH STREET, ROSSLYN, VA 22209

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FOREWORD

This publication is a guide of practical information containing instructions for the proper handling, installation, operation, and maintenance of deadfront distribution switchboards rated 600 Volts or less.

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency regarding handling, installation, operation, or maintenance.

It is recommended that work described in this set of instructions be performed only by qualified personnel familiar with the construction and operation of switchboards and that such work be performed only after reading this complete set of instructions. For specific information not covered by these instructions, you are urged to contact the manufacturer of the switchboard directly.

PB 2.1-1996 revises and supersedes PB 2.1-1991.

These recommendations will be reviewed periodically by the Section and updated as necessary.

Vice President, Engineering
National Electrical Manufacturers Association
1300 N. 17th. Street
Rosslyn, Virginia, 22209

This Standards Publication was developed by the Panelboard and Distribution Board Section. Section approval of the standard does not necessarily imply that all section members voted for its approval or participated in its development. At the time it was approved, the Panelboard and Distribution Board Section was composed of the following members:

American Circuit Breaker Co.—Albemarle, NC
Circle AW Products—Portland, OR
Current Technology, Inc.—Richardson, TX
Cutler-Hammer, Inc.—Pittsburgh, PA
The Durham Company—Lebanon, MO
GE—Plainville, CT
Hubbell, Inc.—Bridgeport, CT
Lamson & Sessions—Cleveland, OH
Milbank Manufacturing Company—Kansas City, MO
Penn Panel & Box Company—Collingdale, PA
The Pringle Electrical Mfg. Co.—Fort Washington, PA
Siemens Energy & Automation, Inc.—Alpharetta, GA
Square D Company—Palatine, IL
Thomas & Betts Corporation—Memphis, TN

Section 1
GENERAL

1.1 SCOPE

This publication covers floor-mounted deadfront switchboards which consist of an enclosure, molded case and low-voltage power circuit breakers, fusible or non-fusible switches, instruments, and metering, monitoring, or control equipment, with associated interconnections and supporting structures. These units are used in the distribution of electricity at:

a. 600 volts and less
b. 6000 amperes or less

1.2 REFERENCED STANDARDS

National Electrical Manufacturers Association
1300 North 17th Street
Rosslyn, Virginia 22209

AB 4-1996 — *Guidelines for Inspection and Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications*

PB 2.2-1988 (R1994) — *Application Guide for Ground Fault Protective Devices For Equipment*

Guidelines for Handling Water Damaged Electrical Equipment

National Fire Protection Association
Batterymarch Park
Quincy, MA 02269

NFPA 70-1996 — *National Electrical Code*

NFPA 70E-1994 — *Safety Related Work Practices*

1.3 GENERAL

1.3.1 The successful operation of switchboards is dependent upon proper handling, installation, operation, and maintenance. Neglecting fundamental installation and maintenance requirements may lead to severe personal injury, death, or damage to electrical equipment or other property.

1.3.2 Installation, operation, and maintenance of switchboards should be conducted only by qualified personnel.

1.3.3 For purposes of these guidelines, a qualified person is one who is familiar with the installation, construction, and operation of the equipment and the hazards involved. In addition, the person is:

1.3.3.1 Knowledgeable of the requirements of the *National Electrical Code* and of all other applicable codes, laws, and standards.

1.3.3.2 Trained and authorized to test, energize, clear, ground, tag, and lockout circuits and equipment in accordance with established safety practices.

1.3.3.3 Trained in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, and flash resistant clothing in accordance with established safety practices.

1.3.3.4 Trained in rendering first aid.

WARNING: Hazardous voltages in electrical equipment can cause severe personal injury or death. Unless otherwise specified, inspection and maintenance should only be performed on switchboards and equipment to which power has been turned off, disconnected and electrically isolated so that no accidental contact can be made with energized parts. Follow all manufacturer's warnings and instructions.

Safety related work practices, as described in NFPA 70E, part II should be followed at all times.

CAUTION: Hydrocarbon spray propellants and hydrocarbon based sprays or compounds will cause degradation of certain plastics. Contact the switchboard manufacturer before using these products to clean, dry, or lubricate switchboard components during installation or maintenance.

Section 2
HANDLING

These guidelines are provided to help avoid personal injury and equipment damage during handling and to facilitate moving the switchboard at the job site.

2.1 Follow the manufacturer's handling instructions for the specific equipment, if available.

2.2 Handle the switchboard with care to avoid damage to components, the frame or finish.

2.3 Keep the switchboard in an upright position unless otherwise indicated by the manufacturer.

2.4 Verify that the switchboard weight is within the rated capacity of the handling equipment to be used.

2.5 When the switchboard is received, unpack it sufficiently to inspect it for concealed damage and to determine that the shipment is complete and correct.

2.6 If the switchboard is to be stored prior to installation, replace the packing for protection during that period. When conditions permit, leave the packing intact until the switchboard or sections are at their final installation location. If the packing is removed, cover the top and any openings to protect the equipment against dust and debris during the construction period. (See section 3).

2.7 The switchboard should remain secured to the shipping skid to prevent distortion of the bottom of the frame during moving.

2.8 Rod or pipe rollers, with the aid of pinch bars, provide a simple method of moving the switchboard on one floor level if there is little or no incline. Steady the load to prevent tipping.

2.9 A forklift truck may offer a more convenient method of handling the switchboard and has the added advantage of permitting it to be hoisted between levels. Balance the load carefully and use a safety strap when handling or moving switchboards with a forklift.

2.10 When it is necessary to move the switchboard between elevations without a suitable platform elevator, overhead hoisting may be required. Lifting plates and eye bolts (Figure 2-1), or channels, angles, or bars with lift holes (Figure 2-2) may be provided as a permanent or removable part of the switchboard. If they are not, cable, chain, or band slings (Figure 2-3) may be rigged around the switchboard.

2.10.1 Use rigid spreaders (Figure 2-1) or spanner bars (Figure 2-3) to provide the vertical lift on eye bolts and lifting slings to avoid crushing or otherwise damaging the frame or its finish. Lifting bars on long lineups may require additional spreaders to reduce the horizontal compressive force.

2.10.2 Select or adjust the rigging lengths to compensate for any unequal weight distribution of load and to maintain the switchboard in an upright position.

2.10.3 Do not allow the angle between the lifting cables and vertical to exceed 45 degrees in order to reduce the tension on the rigging and the compressive load on the lifting or spanner bars and spreaders.

2.10.4 Do not pass ropes or cables through the lift holes in bars, angles, or channels. Use slings with safety hooks or shackles.

2.10.5 The switchboard may contain a heavy transformer with overhead lifting means. Consult the manufacturer regarding the removal of the switchboard top covers and the utilization of such internal lifting means.

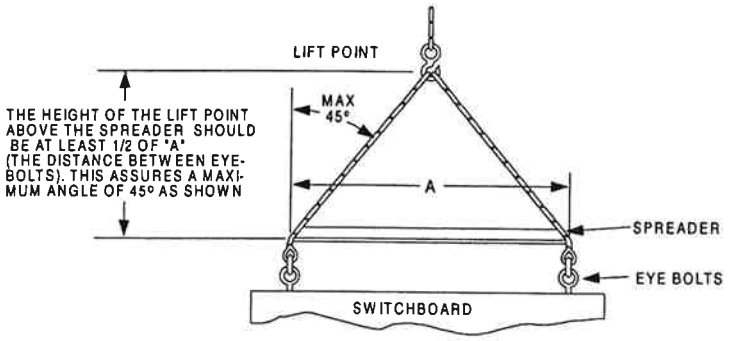


Figure 2-1
LIFTING WITH EYE BOLTS

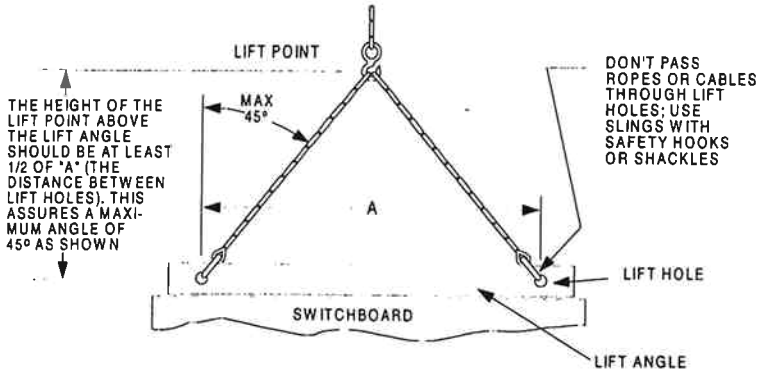


Figure 2-2
LIFTING WITH INTEGRAL LIFT ANGLE

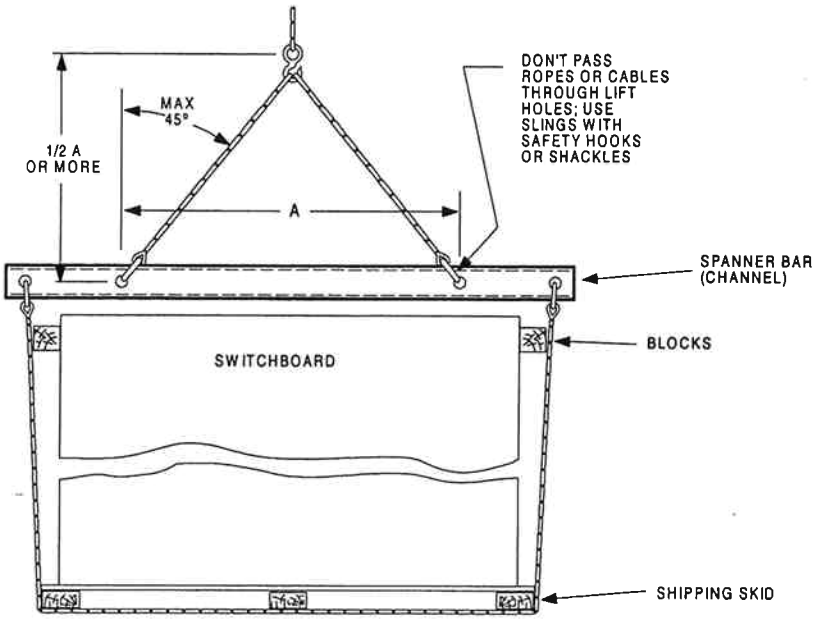


Figure 2-3
LIFTING WITH SLING RIGGING

Section 3
STORAGE

3.1 A switchboard which is not installed and energized immediately should be stored in a clean dry space having a uniform temperature to prevent condensation. Preferably, it should be stored in a heated building having adequate air circulation and protected from dirt, fumes, water, and physical damage.

3.2 It is recommended that switchboards should not be stored outdoors. However, if it must be stored outdoors, cover it securely to provide protection from weather and dirt. Temporary electrical heating should be installed to prevent condensation; approximately 250 watts per section is adequate for the average switchboard size and environment. All loose packing or flammable materials inside the switchboard should be removed before energizing space heaters.

3.3 Outdoor switchboards are not weather resistant until completely and properly installed and should be treated exactly the same as indoor switchboards until after it is installed.

3.4 An un-energized outdoor switchboard should be kept dry internally by installing temporary heating (see 3.2) or by energizing any self-contained space heaters.

Section 4
INSTALLATION OF SWITCHBOARD OR ENCLOSURE

4.1 Install the switchboard in a neat and workmanlike manner following the manufacturer's installation instructions, if available.

4.2 *Location.* Locate the switchboard in the area indicated on the building floor plans. If in a wet location or outside of the building, the switchboard should be enclosed in an outdoor enclosure or equipment to prevent moisture or water from entering and accumulating within the enclosure. Recommended clearances or working spaces are as follows:

4.2.1 Clearance from walls (not rear accessible)-minimum of 1/2 inch for indoor and 6 inches for outdoor or wet locations.

4.2.2 Working clearances vary substantially depending on voltage and specific applications. See Section 110-16 of the *National Electrical Code.*

NOTE—Working clearances and clearances from walls should not be used for storage. Working spaces should have adequate lighting.

4.3 *Channel Sills.* When channel sills are used, they should be embedded in the concrete floor or grouted on the surface. In either case, they should be installed in an aligned position and be level over the entire length prior to installing the switchboard.

4.4 *Conduits.* Position the switchboard so that the conduit stubs or floor openings are located in the area specified on the manufacturer's drawing. In the absence of drawings, locate the switchboard over the conduits or floor openings so as to provide cable bending space and clearances to energized parts or other obstructions. See Section 384-10 of the *National Electrical Code.*

4.5 *Leveling and Securing.* Install the switchboard in its final position, progressively leveling each section and bolting the frames together if they are separated. If necessary, secure the switchboard to walls or other supporting surfaces. Security should not depend on wooden plugs driven into holes in masonry, concrete, plaster, or similar materials.

4.6 *Splice Bus.* Connect all through and ground bus at shipping breaks, using the splice bus and hardware supplied with the switchboard. Tighten bolted connections in accordance with the manufacturer's torque specifications. If not furnished consult the manufacturer.

4.7 *Grounding and Bonding.* Ground and bond the switchboard as follows:

4.7.1 *Grounded Systems.* Switchboard used as service equipment for a grounded system or as a main switchboard for a separately derived system.

4.7.1.1 If the connection for the grounding electrode system is to be in the switchboard, install a grounding electrode conductor sized in accordance with Sections 250-93 or 250-94 of the *National Electrical Code* from the grounding electrode to the switchboard ground bus or ground terminal designated by the manufacturer. See Sections 250-91 and 250-92 of the *National Electrical Code.*

4.7.1.2 Switchboards used as service equipment on systems that are grounded at any point are required to have a grounded conductor brought to the switchboard in accordance with Section 250-23(b) of the *National Electrical Code.* This conductor is required even if the switchboard is supplying loads that are only phase-to-phase connected.

4.7.1.3 Unless already done at the factory, install the main bonding jumper from the incoming grounded conductor bus (neutral) to the ground bus or other location designated by the manufacturer.

4.7.1.4 Steps 4.7.1.1 through 4.7.1.3 must effectively connect together the grounding electrode, the switchboard frame, all outgoing equipment grounding conductors, and the grounded conductor bus (neutral) of the system on the supply side of any neutral disconnecting link.

4.7.1.5 Do not connect any grounding conductors to the load side of any neutral disconnecting link or any sensor used for ground fault protection. Do not connect equipment grounding conductors directly to the grounded conductor bus (neutral).

4.7.1.6 Where the switchboard or system is dual fed (double-ended) and has ground fault protection, special precautions are necessary to accomplish proper grounding and bonding. Follow the manufacturer's instructions.

4.7.2 *Ungrounded Systems.* Service Equipment or Separately Derived System Main.

4.7.2.1 Install a grounding electrode conductor sized in accordance with Sections 250-93 or 250-94 of the *National Electrical Code* from the grounding electrode to the switchboard ground bus or ground terminal designated by the manufacturer. See Sections 250-91 and 250-92 of the *National Electrical Code.* This should effectively connect together the grounding electrode, the switchboard frame, and all outgoing equipment grounding conductors.

4.7.3 *Grounded or Ungrounded Systems.* Applications other than service equipment or other than main for separately derived systems.

4.7.3.1 Ground the switchboard frame and any ground bus by means of an equipment grounding conductor having a size in accordance with Section 250-95 of the *National Electrical Code* and run with the main supply conductors or by bonding to the raceway enclosing the main supply conductors in accordance with Sections 250-91 and 250-92 of the *National Electrical Code.*

4.8 *Unused Openings.* Effectively close all unused openings in the switchboard enclosure.

4.9 *Damp Indoor Locations.* In damp indoor locations, shield the switchboard so as to prevent moisture and water from entering and accumulating therein.

4.10 *Unusual Service Conditions.* Unless the switchboard has been designed for unusual service conditions, it should not be located where it will be exposed to ambient temperatures above 40°C (104°F), high humidity, corrosive or explosive fumes, dust, vapors, dripping or standing water, abnormal vibration, mechanical shock, tilting, or other unusual operating conditions.

Section 5
INSTALLATION OF CONDUIT AND CONDUCTORS

5.1 Conduits should be installed to prevent moisture or water from entering and accumulating within the enclosure. All metallic conduits (including stubs) should be bonded to the switchboard. All conduits should be located in the areas recommended by the manufacturer to avoid conductor interference with structural members and energized parts. Before pulling any conductors into the switchboard, verify that their size, temperature rating, and conductor insulation comply with the switchboard markings. See Section 110-14(c) of the *National Electrical Code.*

5.2 Care should be exercised to ensure that the types and temperature ratings of conductors being installed in the switchboard are suitable for use with the terminals which have been provided.

5.3 If compression (crimp) terminals are used, crimp with the tool(s) recommended by the terminal manufacturer.

5.4 Care should be exercised in stripping insulation from the conductors so as not to nick or ring the conductor. For aluminum, clean all oxide from the stripped portion and apply an oxide inhibiting joint compound. All mechanical terminals should be tightened per the manufacturer's torque specifications. If not furnished, consult the manufacturer.

5.5 Refer to Article 300 of the *National Electrical Code* for proper wiring methods. Conductors should enter the switchboard in the section in which they are to be terminated, except as noted in Section 384-3 of the *National Electrical Code.*

5.6 Provision should be made to locate conductors in the switchboard so that they will be free from physical damage and to avoid overheating. If required by the manufacturer's instructions, secure the conductors as necessary in order to withstand short-circuit forces. The largest practical bending radii should be maintained to avoid damaging the insulation and causing terminals to loosen. Exercise care so that the conductors will not interfere with any moving parts.

5.7 Conductors 1/0 AWG in size and larger may be run in parallel. All parallel conductors should be of the same size, length, and material to assure the equal division of current, as required by Section 310-4 of the *National Electrical Code.* If conductors pass through metal having magnetic properties, all of the circuit conductors, including the neutral, should be run through the same opening, as specified by Section 300-20(a) of the *National Electrical Code.*

5.8 All incoming and outgoing control connections should be made in accordance with the switchboard manufacturer's schematic and wiring diagrams.

5.9 Installation of conductors should be done at temperatures above freezing to prevent conductor insulation from cracking or splitting, unless the conductor insulation is suitable for installation at temperatures below freezing.

Section 6
INSTALLATION OF SWITCHBOARD INTERIOR

6.1 Follow these instructions if the switchboard interior(s) was not mounted at the factory.

6.2 *Unpacking.* Exercise care in unpacking the switchboard interior to prevent damage.

6.3 *Inspection.* Check for shipping damage and check to make sure the interior is the correct one for the installation.

6.4 *Storage.* Store the switchboard interior in a clean dry place and locate it so that it will not be subject to mechanical damage.

6.5 *Cleaning.* Clean the switchboard enclosure of all foreign material prior to the installation of the interior. If parts at connection points are splattered with cement, plaster, paint, or other foreign material, remove the foreign material with great care to avoid damage to the plating.

CAUTION: Hydrocarbon spray propellants and hydrocarbon based sprays or compounds will cause degradation of certain plastics. Contact the switchboard manufacturer before using these products to clean, dry, or lubricate switchboard components during installation or maintenance.

6.6 *Manufacturer's Instructions.* Carefully follow the switchboard manufacturer's instructions.

6.7 *Interior Installation.* Install the interior and tighten it securely in the enclosure. Install the section bus connection to the through bus, if needed.

Section 7
STEPS TO BE TAKEN BEFORE ENERGIZING

7.1 Tighten all accessible electrical connections to the manufacturer's torque specifications. If such information is not provided with the equipment, consult the manufacturer.

7.2 Remove all blocks or other temporary holding means used for shipment from all component devices and the switchboard interior.

7.3 Check the integrity of all bus mounting means.

7.4 Check the enclosure to see that it has not been damaged in such a manner as to reduce electrical spacings.

7.5 Manually exercise all switches, circuit breakers, and other operating mechanisms to make certain that they operate freely.

7.6 Conduct an electrical insulation resistance test to ensure that the switchboard is free from short circuits and grounds. With the neutral isolated from ground and the switches and circuit breakers open, conduct electrical insulation resistance tests from phase to phase, phase to ground, phase to neutral, and neutral to ground. If the resistance reads less than 1 megohm while testing with the branch circuit devices in the open position, the system may be unsafe and should be investigated. If after the investigation and possible corrections, low readings are still observed, the manufacturer should be contacted.

7.7 Check electrical relays, meters, and instrumentation to determine that connections are made properly and that the devices function properly.

7.8 With loads disconnected, electrically exercise all electrically operated switches, circuit breakers, and other mechanisms to determine that the devices operate properly. An auxiliary source of control power may be necessary to provide power to the electrical operators.

Test the ground fault protection system (if furnished) in accordance with the manufacturer's instructions. See section 230-95 of the *National Electrical Code* and NEMA Standards Publication PB 2.2.

7.10 Set any adjustable time current trip device settings to the proper values. Experience has indicated that damage from overcurrent can be reduced if the devices used for overload and short-circuit protection are set to operate instantaneously (that is, without intentional time delay) at 115 percent of the highest value of phase current which is likely to occur as the result of any anticipated motor starting or welding currents.

7.11 Make certain that field wiring is clear of energized parts and, when specified by the manufacturer, physically secured to withstand the effects of short circuits.

7.12 Check to determine that all grounding connections are properly made. If the switchboard is used as service equipment, make certain that the neutral, if present, is properly bonded to the cabinet. If there is no ground bus, make certain that the sections of the switchboard which are shipped separately are connected in such a way as to ensure a continuous grounding path.

7.13 Remove all foreign material from the inside of the switchboard before closing the enclosure.

7.14 Install covers, close doors, and make certain that no conductors are pinched and that all enclosure parts are properly aligned and tightened.

Section 8
ENERGIZING EQUIPMENT

WARNING: Hazardous voltages in electrical equipment can cause severe personal injury or death. Energizing a switchboard for the first time after initial installation or maintenance is potentially dangerous.

8.1 Qualified personnel should be present when the equipment is energized for the first time. If short circuit conditions caused by damage or poor installation practices have not been detected in the checkout procedure specified in section 7, serious personal injury and damage can occur when the power is turned on.

8.2 There should be no load on the switchboard when it is energized. Turn off all the downstream loads.

8.3 The equipment should be energized in sequence by starting at the source end of the system and working towards the load end. In other words, energize the main devices, then the feeder devices, and then the branch-circuit devices. Turn the devices on with a firm positive motion.

8.4 After all main, feeder, and branch circuit devices have been closed, loads such as lighting circuits, contactors, heaters, and motors may be turned on.

Section 9
MAINTENANCE

9.1 A maintenance program for switchboards should be conducted on a regularly scheduled basis in accordance with the following:

9.2 A switchboard which has been carrying its regular load for at least 3 hours just prior to inspection should be field tested by feeling the deadfront surfaces of circuit breakers, switches, interior trims, doors, and enclosure sides with the palm of the hand. If the temperature of these surfaces does not permit you to maintain contact for at least 3 seconds, this may be an indication of trouble and investigation is necessary.

WARNING: Hazardous voltages in electrical equipment can cause severe personal injury or death. Unless otherwise specified, inspection and maintenance should only be performed on switchboards to which power has been turned-off, disconnected and electrically isolated so that no accidental contact can be made with energized parts. Follow all manufacturer's warnings and instructions.

Safety related work practices, as described in NFPA 70E, Part II should be followed at all times.

CAUTION: Hydrocarbon spray propellants and hydrocarbon based sprays or compounds will cause degradation of certain plastics. Contact the switchboard manufacturer before using these products to clean, dry, or lubricate switchboard components during installation or maintenance.

9.3 Inspect the switchboard once each year or after any severe short circuit.

9.4 If there is an accumulation of dust and dirt, clean out the switchboard by using a brush, vacuum cleaner, or clean lint-free rags. Avoid blowing dust into circuit breakers or other components. Do not use a blower or compressed air.

9.4.1 Carefully inspect all visible electrical joints and terminals in the bus and wiring system.

9.4.2 Visually check all conductors and connections to be certain that they are clean and secure. Loose and/or contaminated connections increase electrical resistance which can cause overheating. Such overheating is indicated by discoloration or flaking of insulation and/or metal parts. Pitting or

melting of connecting surfaces is a sign of arcing due to a loose, or otherwise poor connection. Parts which show evidence of overheating or looseness should be cleaned and re-torqued or replaced if damaged. Tighten bolts and nuts at bus joints to manufacturers torque specifications.

CAUTION: Do not remove plating from aluminum parts in joints or terminations. Damage to plating can result in overheating. Replace damaged aluminum parts.

9.4.3 Examine fuse clip contact pressure and contact means. If there is any sign of overheating or looseness follow the manufacturer's maintenance instructions or replace the fuse clips. Loose fuse clips can result in overheating.

9.4.4 BE SURE THAT ALL CONDITIONS WHICH CAUSED THE OVERHEATING HAVE BEEN CORRECTED.

9.5 Check circuit breakers, switches, and fuses to ensure they have the proper ampere, voltage and interrupting ratings. Ensure that non-current-limiting devices are not used as replacements for current-limiting devices. Never attempt to defeat rejection mechanisms which are provided to prevent the installation of the incorrect class of fuse.

9.5.1 Operate each switch or circuit breaker several times to ensure that all mechanisms are free and in proper working order. Replace as required. See NEMA AB 4 for maintenance of molded case circuit breakers.

9.6 Check the operation of all mechanical components. Replace as required.

9.6.1 Exercise switch operating mechanisms and external operators for circuit breakers to determine that they operate freely to their full on and off positions.

9.6.2 Check the integrity of all electrical and mechanical interlocks and padlocking mechanisms.

9.6.3 Whenever practical, check all devices for missing or broken parts, proper spring tension, free movement, corrosion, dirt, and excessive wear.

9.6.4 Adjust, clean, and lubricate or replace parts according to the manufacturers instructions.

9.6.4.1 Use clean nonmetallic light grease or oil as instructed.

9.6.4.2 Do not oil or grease parts of molded case circuit breakers.

9.6.4.3 If no instructions are given on the devices, sliding copper contacts, operating mechanisms, and interlocks may be lubricated with clean, light grease.

9.6.4.4 Wipe off excess lubrication to avoid contamination.

CAUTION: Hydrocarbon spray propellants and hydrocarbon based sprays or compounds will cause degradation of certain plastics. Contact the switchboard manufacturer before using these products to clean, dry, or lubricate switchboard components during installation or maintenance.

9.6.5 Clean and dress readily accessible copper electrical contacts, blades, and jaws according to the manufacturer's instructions when inspection indicates the need.

9.7 Look for and replace deteriorated insulating material and assemblies where sealing compounds have melted.

9.8 Look for any moisture or signs of previous wetness or dripping inside the switchboard. Condensation in conduits or dripping from outside sources is one known cause of switchboard malfunction.

9.8.1 Seal off any conduits which have dripped condensate, and provide means for further condensate to drain away from the switchboard.

9.8.2 Seal off any cracks or openings which have allowed moisture to enter the enclosure. Eliminate the source of any dripping on the enclosure and any other source of moisture.

9.8.3 Replace or thoroughly dry and clean any insulating material which is damp or wet or shows an accumulation of deposited material from previous wettings.

9.8.4 Inspect all component devices. Replace any component device which shows evidence of moisture damage or has been subjected to water damage or flooding. Additional information may be found in the NEMA document " Guidelines for Handling Water Damaged Electrical Equipment."

9.9 In the event of water damage, e.g., flooding or sprinkler discharge, the manufacturer should be consulted before clean up and corrective action is attempted.

9.10 If a severe electrical short circuit has occurred, the excessive currents may have resulted in structural component and/or bus and conductor damage due to mechanical distortion, thermal damage, metal deposits, or smoke. Examine all devices and bus supports for cracks or breakage. The manufacturer should be consulted before clean up and correction is attempted.

9.11 Test the ground fault protection system (if furnished) in accordance with the manufacturer's instructions. See Section 230-95 of the *National Electrical Code* and NEMA Standards Publication PB 2.2.

9.12 Check insulation resistance (See 7.6) under any of the following conditions:

a. If a severe short circuit has occurred. (See 9.10)
b. If it has been necessary to replace parts or clean insulating surfaces
c. If the switchboard has been exposed to high humidity, condensation, or dripping moisture.

Section 10
PERMISSIBLE LOADING OF SWITCHBOARDS

10.1 For switchboards without main overcurrent protective devices (main lug switchboard), the total continuous load current through the supply bus should not exceed the current rating of the switchboard.

10.2 For switchboards with a single main overcurrent protective device, the total continuous load current on the protective device should not exceed 80 percent of its ampere rating unless the device is rated to carry 100 percent of its ampere rating.

10.3 For switchboards with a multiple main overcurrent protective devices, the total continuous current through the supply bus should not exceed the current rating of the switchboard. The total continuous load current on each main overcurrent protective device should not exceed 80 percent of its ampere rating unless the device is rated to carry 100 percent of its ampere rating.

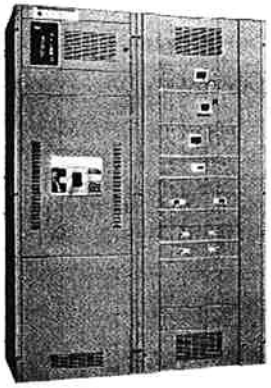
10.4 For feeder and branch circuit overcurrent protective devices in switchboards, the total continuous load current on the overcurrent protective device should not exceed 80 percent of its ampere rating unless the device is rated to carry 100 percent of its ampere rating.

10.5 Some types of electrical equipment cause harmonics in the electrical system which may result in overheating. This condition should be considered when determining switchboard loading.

EATON | Cutler-Hammer
January 2003
Vol. 1, Ref. No. [0890]

Product Description

Cutler-Hammer Pow-R-Line C Distribution Switchboards by Eaton Corporation combine a space-saving design with modular construction and increased systems rating to provide economical and dependable electrical system distribution and protection.



Pow-R-Line C Group Mounted Distribution Switchboard

Application Description

- Refer to the *Cutler-Hammer Consulting Application Guide, 13th Edition.*

15

Features, Benefits and Functions

- 6000A maximum main bus rating.
- 600V AC and below.
- Front or rear accessible.
- Type 1 or Type 3R enclosures.
- ANSI-61 gray powder coat paint finish.
- The IQ family of microprocessor-based metering and monitoring devices.
- Utility metering provisions.
- Transient Voltage Surge Suppression (TVSS).
- Ground Fault protection on mains and distribution devices.
- Busway and transformer connections.
- Complete protective device accessory capability.
- 65 kAIC standard bus bracing; optional 100 or 200 kAIC.
- Standard tin-plated aluminum bus; optional copper- or silver-plated copper bus.
- Standard bus ampacities based on UL heat test ratings. Optional density rated bus systems are also available.

Main Devices

- DS/DSL air power circuit breakers, 800 – 4000A, fixed or drawout.
- Magnum DS power circuit breakers, 800 – 5000A, fixed or drawout.
- Molded case circuit breakers, 400 – 2500A, fixed mounted.
- Bolted pressure switches, 800 – 5000A.
- FDPW fusible switches, 400 – 1200A.

Group-Mounted Distribution Devices

- Molded case circuit breakers, 15 – 1200A.
- FDPW fusible switches, 30 – 1200A.

Standards and Certifications

- Meets NEMA Standard PB-2 and UL 891.
- Seismically qualified.

Fast Delivery Service

The FDS Switchboard Program provides a 4-week shipment on standard switchboards by utilizing stock devices and reduced cycle times. If shorter times are required, contact your Satellite Plant for price and delivery.

FDS Switchboard Program Parameters

- 3000A maximum.
- Five structures maximum.
- Type 1 or Type 3R (flat roof) NEMA 1 or NEMA 3R enclosures.
- Standard dimensions.
- Standard components and accessories.

For complete application and pricing information, contact your local Cutler-Hammer sales office.

Switchboard General Information

Pow-R-Line C -Specifications

FDS Qualifier:	Yes		
Quantity:	1		
Alignment:	Front Access/ Front and Rear Align		
Service:	208Y/120V 3-Phase 4-Wire	Minimum Interrupting Capacity:	65 kA

Bus Specifications

Bus Amps:	1600	Bus Bracing Rating:	65kA
Neutral Amps:	1600		
Bus Material:	Aluminum	Heat Test	
(1) 350 MCM Ground Lug			

Incoming Information

Incoming Entry:	Bottom	Incoming Location:	Left
Incoming Qty & Size:	Terminals, Mechanical, Bottom, See Utility Specifications		

Structure Specifications

Service Entrance

Enclosure Type: NEMA 1

Utility Specifications

1600 Amps Util. Mtr. Compt. - SNOHOMISH CO. PUD #1

EUSERC Page References:

Lug Drillings Per Page: 347 — CT Compartment Per Page 322/330

UGPS Per Page 354/346 — Meter Door per Page 332

LUGS — (5) 300-800 kcmil

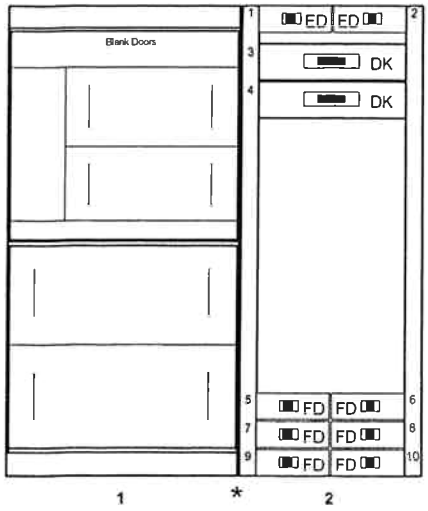
Enclosure properties

Struct #	Width	Depth	Description/Modifications
1	45.00	30.00	Incoming Utility Structures (Incoming Utility Section) Vertical isolating barrier - full height Horizontal isolating barrier Auxiliary Bus
2	36.00	30.00	50x chassis mounted feeders (Feeder Structure) Auxiliary Bus

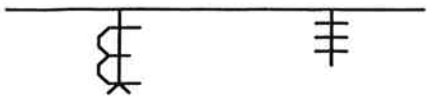
Total of 2 Structures, Total Width of 81 Inches

PREPARED BY: Nichols, David W	DATE: 09/05/03	EATON			Sumter, SC
APPROVED BY:	DATE:	JOB NAME: MONROE FITNESS			
		DESIGNATION: MDP			
VERSION: 4.4.2		TYPE: Switchboards		DRAWING TYPE: Customer Appr.	
NEG-ALT NUMBER: SE2109055304-0000	REVISION: 0	DWG SIZE: A	G.O.	ITEM: 001	SHEET: 1 OF 3

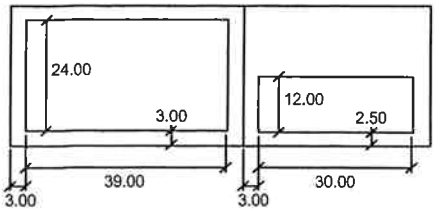
Front View



Power Flow



Floor Plan



Width-Inches Width-MM	45.00 1142	36.00 914	
Depth-Inches Depth-MM	30.00 761	30.00 761	
Height-Inches Height-MM	90.00 2285	90.00 2285	
Weight-Lbs(Est.) Weight-Kg(Est.)	1000 453	1000 453	

PREPARED BY: Nichols, David W	DATE: 09/05/03	EATON			Sumter, SC
APPROVED BY:	DATE:	JOB NAME: MONROE FITNESS			
		DESIGNATION: MDP			
	VERSION: 4.4.2	TYPE: Switchboards		DRAWING TYPE: Customer Appr.	
NEG-ALT NUMBER: SE2109055304-0000	REVISION: 0	DWG SIZE: A	G.O.	ITEM: 001	SHEET: 2 OF 3

Switchboard Units Information

Str#	Unit	Description/Modifications	Nameplate
1		1000-2000A Util Mtr - SNOHOMISH CO. PUD #1	
2	1	Feeder Brkr.-200A 3P [ED 225A Frame], Trip 200 A. Thermal Mag Terminals, Mechanical, #6-300 kcmil	
	2	Feeder Brkr.-200A 3P [ED 225A Frame], Trip 200 A. Thermal Mag Terminals, Mechanical, #6-300 kcmil	
	3	Feeder Brkr.-400A 3P [DK 400A Frame], Trip 400 A. Thermal Mag Terminals, Mechanical, (1) 2/0-500 kcmil	
	4	Feeder Brkr.-400A 3P [DK 400A Frame], Trip 400 A. Thermal Mag Terminals, Mechanical, (1) 2/0-500 kcmil	
	5	Feeder Brkr.-60A 3P [FD 225A Frame], Trip 60 A. Thermal Mag Terminals, Mechanical, #14-1/0	
	6	Feeder Brkr.-60A 3P [FD 225A Frame], Trip 60 A. Thermal Mag Terminals, Mechanical, #14-1/0	
	7	Feeder Brkr.-60A 3P [FD 225A Frame], Trip 60 A. Thermal Mag Terminals, Mechanical, #14-1/0	
	8	Feeder Brkr.-60A 3P [FD 225A Frame], Trip 60 A. Thermal Mag Terminals, Mechanical, #14-1/0	
	9	Feeder Brkr.-100A 3P [FD 225A Frame], Trip 100 A. Thermal Mag Terminals, Mechanical, #14-1/0	
	10	Feeder Brkr.-100A 3P [FD 225A Frame], Trip 100 A. Thermal Mag Terminals, Mechanical, #14-1/0	

PREPARED BY: Nichols, David W	DATE: 09/05/03	EATON	Sumter, SC
APPROVED BY:	DATE:	JOB NAME: MONROE FITNESS	
		DESIGNATION: MDP	
VERSION: 4.4.2		TYPE: Switchboards	DRAWING TYPE: Customer Appr.
NEG-ALT NUMBER: SE2109055304-0000	REVISION: 0 / DWG SIZE: A	G.O.	ITEM: 001 / SHEET: 3 OF 3

Series Rated Combinations (Continued)

Table 14-6. 120/240V Breaker/Breaker

Ground Fault Circuit Breakers (Suffix GF) are valid for 15 to 30 amperes only.

Main Breaker Maximum Amperes	Series Equipment Rating — kA Symmetrical										
	18	22	42	65			100			200	
100	EHD	QBHW, QPHW		GB, GHB			FB-P			FCL	
	BAB QBGF HQP QPGF	BAB QBGF HQP QPGF		BAB QBGF QBHW HQP QPGF QPHW			BAB HQP QBGF QPGF QBHW QPHW EHD FD			BAB HQP QBGF QPGF QBHW QPHW GB, GHB EHD FD HFD GHQ	
150	FDB										
	BAB HQP QBGF										
200							LA-P				
							BAB HQP QBHW QPHW EHD FD				
225		CAH		ED, FD			EDH, EDC	HFD	FDC		FDC
		BAB HQP QBGF QPGF		BAB BABR BABRS HQP QBGF QPGF QBHW QPHW QBHGF QPHGF			BAB HQP QBGF QPGF	BAB HQP QBGF QBHW QPHW QBHGF GB, GHB EHD FD GHQ	BAB HQP QBHW QPHW GHQ		GB, GHB EHD FD HFD GHQ
250				JD, JDB	HJD		HJD	JDC		JDC	
				BAB (15 – 70A) HQP (15 – 70A) QBHW QPHW EHD	BAB HQP QBHW QPHW		GB, GHB EHD FD	BAB HQP QBHW QPHW		GB, GHB EHD FD HFD	
400		DK, KD, KDB	DK, KD, KDB	HKD	DK, KD, KDB	KDC	HKD	KDC		KDC	LCL
		BAB HQP QBGF QPGF	BAB (15-70A) HQP (15-70A) QBHW QPHW	BAB (15 – 70A) HQP (15 – 70A) QBHW QPHW	EHD	BAB (15 – 70A) HQP (15 – 70A)	GB, GHB EHD FD HFD	QBHW QPHW		GB, GHB EHD FD HFD	BAB HQP QBGF QPGF QBHW QPHW GB, GHB EHD FD HFD

Note: Ratings shown for Type **BAB** circuit breakers also apply to Type **BA** circuit breakers.

NEMA Standards Publication PB 1.1-2002

General Instructions
for
Proper Installation, Operation, and Maintenance
of
Panelboards Rated 600 Volts or Less

Published by

National Electrical Manufacturers Association
1300 North 17th Street
Rosslyn, Virginia 22209

www.nema.org

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CONTENTS

Figures

Foreword

This publication is a guide of practical information containing instructions for the proper installation, operation, and maintenance of panelboards rated 600 volts or less.

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency regarding installation, operation, or maintenance.

It is recommended that work described in this set of instructions be performed only by qualified personnel familiar with the construction and operation of panelboards and that such work be performed only after reading this complete set of instructions. For specific information not covered by these instructions, you are urged to contact the manufacturer of the panelboard directly.

In the preparation of this Standards Publication input of users and other interested parties has been sought and evaluated. Inquiries, comments, and proposed or recommended revisions should be submitted to the concerned NEMA product section by contacting the following: These recommendations will be reviewed periodically and updated as necessary.

Vice President, Engineering
National Electrical Manufacturers Association
1300 North 17th Street, Suite 1847
Rosslyn, Virginia 22209

Publication No. PB 1.1-2002 revises and supersedes PB 1.1-1996.

This Standards Publication was developed by the Panelboard and Distribution Board Product Group of the LVDE Section. Product Group approval of the standard does not necessarily imply that all Product Group members voted for its approval or participated in its development. At the time it was approved, the Product Group was composed of the following members:

Cooper B-Line—Highland, IL
The Durham Company—Lebanon, MO
Eaton Corporation—Cleveland, OH
GE—Plainville, CT
Hubbell, Inc.—Orange, CT
Industrial Electric Manufacturing, Inc.—Fremont, CA
Milbank Manufacturing Company—Kansas City, MO
Penn Panel & Box Company—Collingdale, PA
Post Glover Resistors, Inc.—Erlanger, KY
The Pringle Electrical Mfg. Co.—Montgomeryville, PA
Reliance Controls Corporation—Racine, WI
Siemens Energy & Automation, Inc.—Alpharetta, GA
Square D Company—Palatine, IL
Thomas & Betts Corporation—Memphis, TN

Section 1
SCOPE

This publication covers single panelboards or groups of panel units suitable for assembly in the form of single panelboards, including buses, and with or without switches or automatic overload protective devices (fuses or circuit breakers), or both. These units are used in the distribution of electricity at 600 volts and less with:

1600—ampere mains or less
1200—ampere branch circuits or less

Specifically excluded are live-front panelboards, panelboards employing cast enclosures for special service conditions, and panelboards designed primarily for residential and light commercial service equipment.

Section 2
REFERENCES

National Fire Protection Association (NFPA)
Batterymarch Park
Quincy, MA 02269

NFPA 70 2002	*National Electrical Code*
NFPA 70E 2000	*Safety Related Work Practices*

National Electrical Manufacturers Association (NEMA)
1300 North 17th Street, Suite 1847
Rosslyn, Virginia 22209

AB 4-2000	*Guidelines for Inspection and Preventative Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications*
PB 2.2-1999	*Application Guide for Ground Fault Protective Devices for Equipment*
	Guidelines for Handling Water Damaged Electrical Products

Section 3
GENERAL

WARNING: Hazardous voltages in electrical equipment can cause severe personal injury or death. Unless otherwise specified, inspection and maintenance should only be performed on panelboards and equipment to which power has been turned off, disconnected and electrically isolated so that no accidental contact can be made with energized parts. Follow all manufacturer's warnings and instructions.

Safety related work practices, as described in NFPA 70E, Part II should be followed at all times.

CAUTION: Hydrocarbon spray propellants and hydrocarbon based sprays or compounds will cause degradation of certain plastics. Contact the panelboard manufacturer before using these products to clean, dry, or lubricate components during installation or maintenance.

3.1 SUCCESSFUL OPERATION OF PANELBOARDS

The successful operation of panelboards is dependent upon proper installation, operation, and maintenance. Neglecting fundamental installation and maintenance requirements may lead to personal injury, death, or damage to electrical equipment or other property.

3.2 QUALIFIED PERSONNEL

Installation, operation, and maintenance of panelboards should be conducted only by qualified personnel.

3.3 DEFINITION OF QUALIFIED PERSONNEL

For purposes of these guidelines, a qualified person is one who is familiar with the installation, construction, and operation of the equipment and the hazards involved. In addition, the person is:

3.3.1 Requirements

Knowledgeable of the requirements of the *National Electrical Code* and of all other applicable codes, laws, and standards.

3.3.2 Established Safety Practices

Trained and authorized to test, energize, clear, ground, tag, and lockout circuits and equipment in accordance with established safety practices.

3.3.3 Protective Equipment

Trained in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, and flash resistant clothing in accordance with established safety practices.

3.3.4 First Aid

Trained in rendering first aid.

3.4 SUITABLE RATINGS

Verify that all equipment being installed has ratings suitable for the installation.

Section 4
INSTALLATION OF PANELBOARD CABINETS (BOXES)

4.1 INSTALLATION INSTRUCTIONS

Installation of the cabinet in a neat and workmanlike manner. Follow the manufacturer's installation instructions.

4.2 LOCATION IN BUILDING

Locate the cabinet so that it is readily accessible and not exposed to physical damage.

4.3 FLAMMABLE MATERIAL

Locate the cabinet well away from flammable material.

4.4 UNUSUAL SERVICE CONDITIONS

Do not locate the cabinet where it will be exposed to ambient temperatures above 40°C (104°F), corrosive or explosive fumes, dust, vapors, dripping or standing water, abnormal vibration, mechanical shock, high humidity, tilting, or unusual operating conditions, unless the cabinet/panelboard combination has been designed and so identified by the manufacturer for these conditions.

4.5 INDOOR DAMP LOCATIONS

Locate or shield the cabinet so as to prevent moisture and water from entering and accumulating therein. Mount the cabinet so that there is at least 1/4 inch of air space between the cabinet and the wall or other supporting surface.

4.6 WET LOCATIONS

Cabinets should be specifically approved for wet locations. Mount the cabinet so that there is at least 1/4 inch of air space between the cabinet and the wall or other supporting surface.

4.7 CLEARANCE FROM CEILING

Do not locate the cabinet against a non-fireproof ceiling; allow a space of 3 feet between the ceiling and cabinet unless an adequate fireproof shield is provided.

4.8 SPACE AROUND THE CABINET

When selecting a location, provide sufficient access and working space around the cabinet (See Section 110.26 of the *National Electrical Code*). The width of the working space in front of the panelboard should be at least 30 inches and this space should not be used as storage. The working space should have adequate lighting and a minimum head room of 6 feet 6 inches.

4.9 MOUNTING OF CABINET

The cabinet should be reliably secured to the mounting surface. Do not depend on wooden plugs driven into holes in masonry, concrete, plaster, or similar materials. (See Section 110.13 of the *National Electrical Code*.)

4.10 FLUSH MOUNTING IN WALL

In walls of concrete, tile, or other noncombustible material, install the cabinet so that its front edge will not set back more than 1/4 inch from the finished surface. In walls of wood or other combustible material, cabinets should be flush with or project beyond the finished surface. (See Section 312.3 of the *National Electrical Code*.)

4.11 UNUSED OPENINGS IN CABINET

Effectively close unused openings in the cabinet to provide protection which is substantially equivalent to that afforded by the wall of the cabinet.

4.12 GROUNDING OF PANELBOARD CABINETS

Ground the cabinet as specified in Article 250 of the *National Electrical Code*. When the cabinet contains service equipment, it is necessary to bond the cabinet to the grounded (neutral) service conductor.

Section 5
INSTALLATION OF CONDUIT AND CONDUCTORS

5.1 CONDUITS INSTALLATION

Conduits should be installed so as to prevent moisture or water from entering and accumulating within the enclosure. Provision should be made to protect conductors from abrasion in accordance with Article 312 of the *National Electrical Code*.

5.2 KNOCKOUTS REMOVAL

Knockouts should be removed as follows:

IMPORTANT: Remove knockouts, ONE AT A TIME, alternating INWARD and OUTWARD.

5.2.1 First Step—Remove Center Knockout

Remove center knockout INWARD.

5.2.1.1 Screwdriver Blade

Place screwdriver blade against point farthest from tie and strike INWARD (Figure 1). Bend back and forth to break tie.

5.2.2 Next Step—Remove Rings

Remove rings ONE AT A TIME without straining remaining rings.

5.2.2.1 Pry First Ring

Pry first ring OUTWARD with screwdriver midway between ties, using pliers flat against box under screwdriver (Figure 2). Bend ring sections OUTWARD with pliers, then back and forth to break ties (Figure 5-3).

5.2.2.2 Second Ring

Remove second ring INWARD by striking screwdriver (with blade against point midway between ties) then breaking ring sections inward and back and forth to break ties.

5.3 NATIONAL ELECTRICAL CODE, ARTICLE 300

Refer to the *National Electrical Code*, Article 300 for proper wiring methods. See 6.7 for making proper connections.

5.4 CONDUCTOR LENGTH

Keep conductor length to a minimum within the wiring gutter. Excessive conductor length will result in additional heating and may result in overheating. However, conductors should be long enough to reach the terminal location in a manner that avoids strain on the terminal.

5.5 EXERCISE CARE

Exercise care to maintain the largest practical bending radius of conductors; otherwise the insulation may be damaged and terminal connections may become loosened. Deflection of conductors shall comply with NEC Section 312.6.

5.6 NATIONAL ELECTRICAL CODE, ARTICLE 725.54

Refer to the National Electrical Code, Article 725.54 for the separation requirements for conductors of Class 2 and Class 3 remote-control, signaling and power-limited circuits.

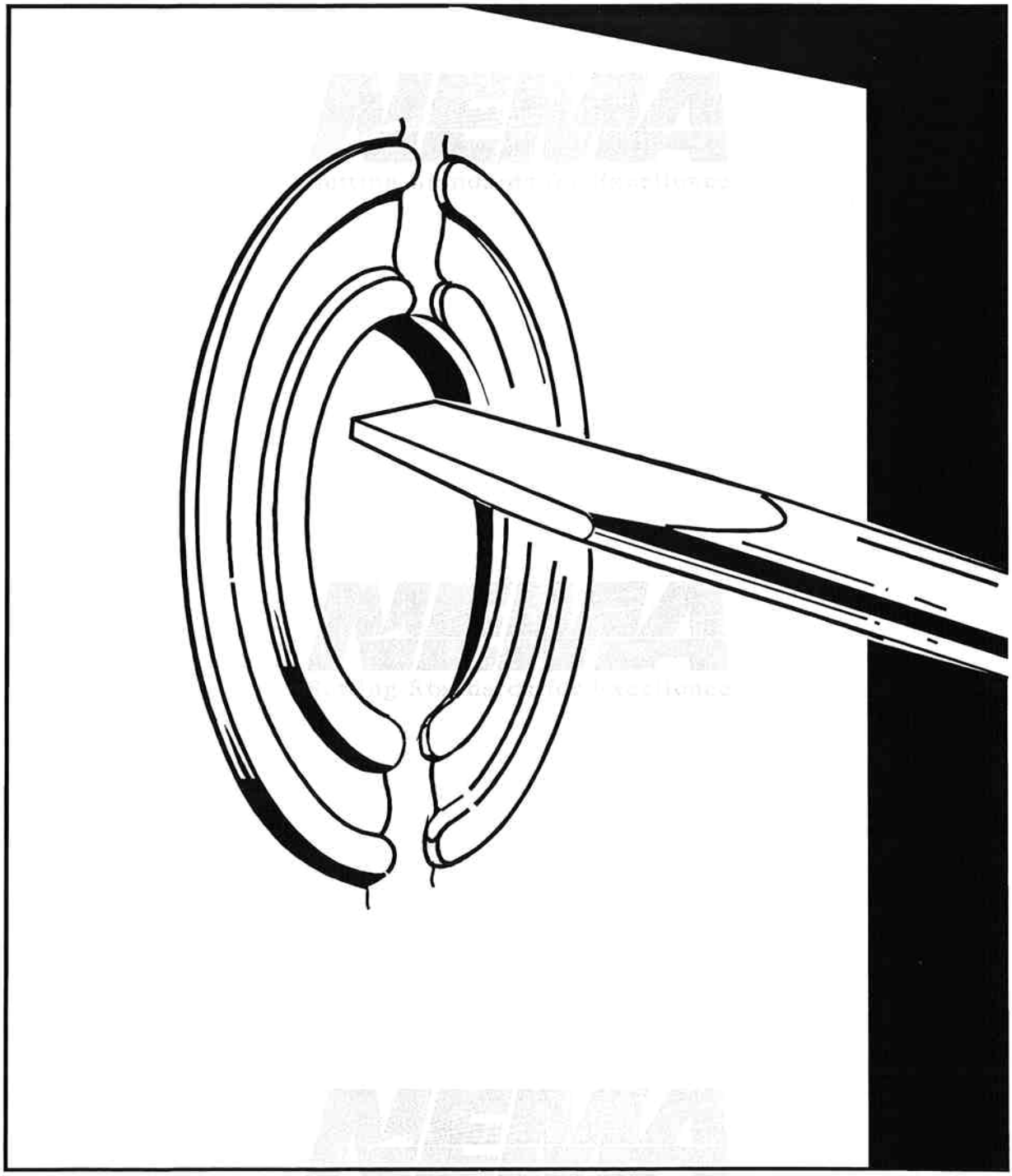

Figure 5–1
KNOCKOUT REMOVAL—STEP 1

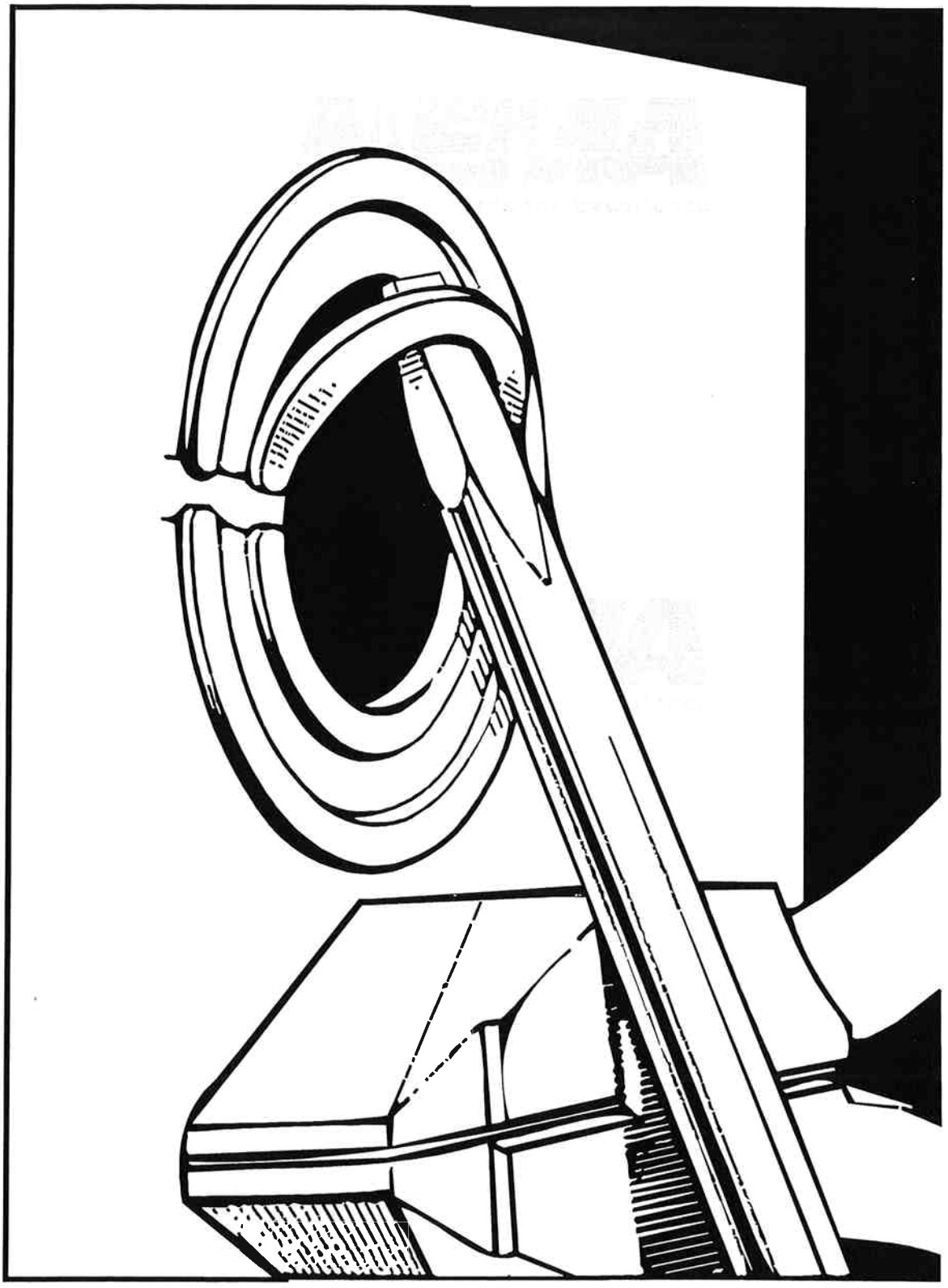

Figure 5–2
KNOCKOUT REMOVAL—STEP 2

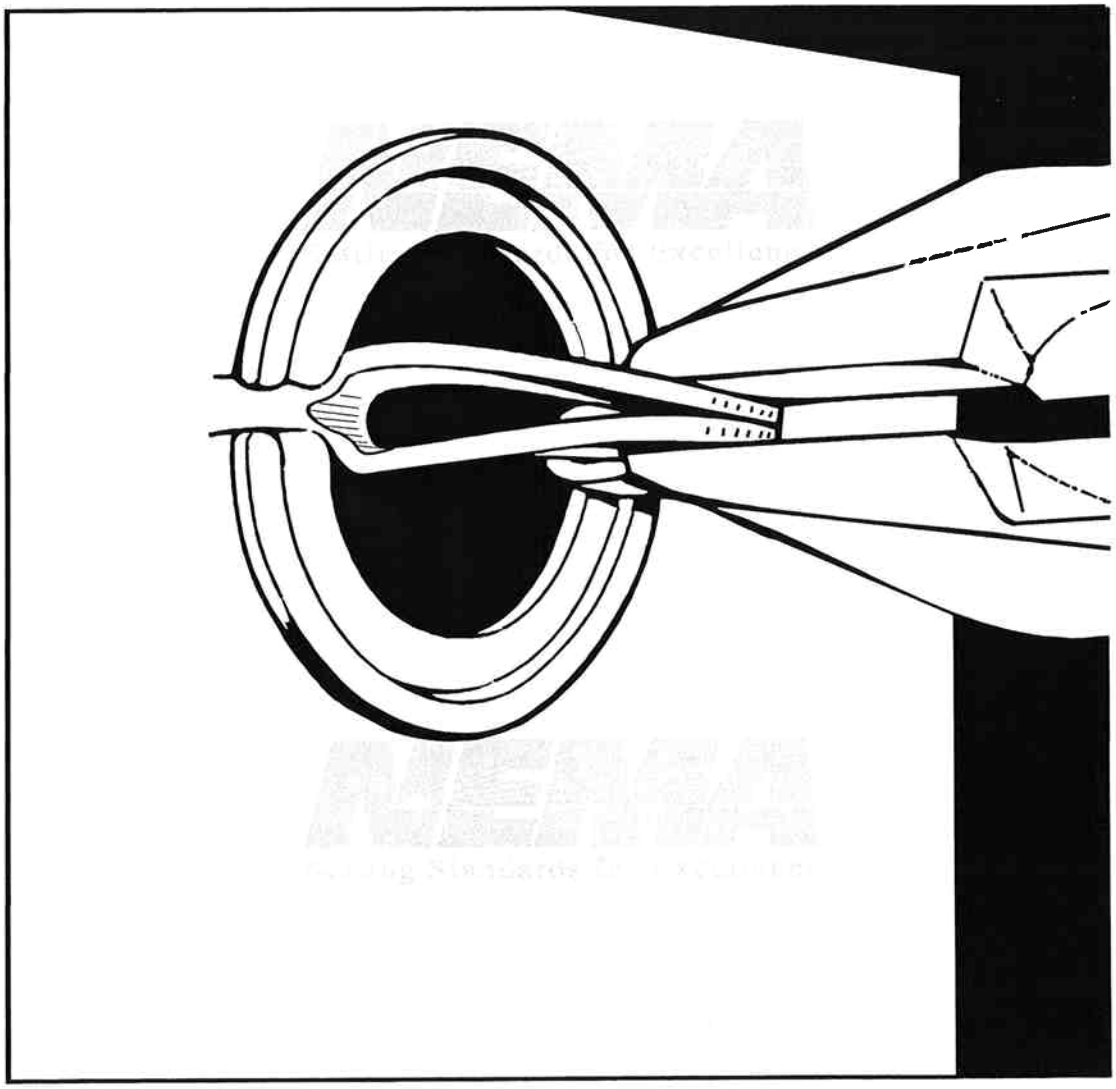

Figure 5–3
KNOCKOUT REMOVAL—STEP 3

Section 6
INSTALLATION OF PANELBOARD

6.1 PROPER STORAGE

Store the panelboard in a clean, dry place located so that mechanical damage from work personnel in the area is not likely to happen.

6.2 UNPACKING

Care should be exercised in unpacking the panelboard to prevent damage and loss of instruction materials and loose parts.

6.3 INSPECTION

Check for shipping damage and check to make sure that the panelboard is the correct one for installation in the cabinet.

6.4 CARE

Care should be taken to protect the panelboard internal parts from contamination during the installation process.

6.4.1 Cleaning

Clean the cabinet of all foreign materials. If parts at connection points are spattered with cement, plaster, paint, or other foreign material, remove the foreign materials with great care to avoid damage to the plating.

CAUTION: Hydrocarbon spray propellants and hydrocarbon based sprays or compounds will cause degradation of certain plastics. Contact the panelboard manufacturer before using these products to clean, dry, or lubricate panelboard components during installation or maintenance.

6.5 MANUFACTURER'S INSTRUCTIONS

Carefully follow the manufacturer's instructions and labels.

6.6 INSTALLATION

6.6.1 Alignment Devices

Adjust the alignment devices where provided.

6.6.2 Panelboard

Install the panelboard, finalize its alignment, and tighten it securely in the cabinet.

6.6.3 Flange of Deadfront Shield

Unless otherwise instructed by the manufacturer, adjust the panelboard so that the flange of the deadfront shield is no more than 3/16 inch from (1) the front of the cabinet for surface mounting or (2) the surrounding wall surfaces for flush mounting.

6.7 LINE AND BRANCH CONDUCTORS

Connect Line and Branch Conductors

6.7.1 Conductors

Use care in stripping insulation from conductors so as not to nick or ring the conductor. For aluminum, clean all oxide from the stripped portion and apply an antioxide compound.

6.7.1.1 Wiring Gutters

Distribute and arrange conductors neatly in the wiring gutters. (See Section 5.)

6.7.1.2 Types and Temperature Ratings

Care should be exercised to ensure that the types and temperature ratings of conductors being installed in the panelboard are suitable for use with the terminals, which have been provided.

6.7.1.3 Tighten All Terminals

Use the manufacturer's torque values. (See 7.1).

6.8 PANELBOARD GROUNDING

Ground the panelboard cabinet in accordance with 4.12. (See Section 408.20 of the *National Electrical Code*.)

6.8.1 Equipment Grounding Conductors

Where separate equipment grounding conductors are used, prepare equipment grounding conductors in accordance with 6.7.1 and connect them to the equipment grounding terminal bar. Check to be sure that the terminal bar is securely bonded to the cabinet or panelboard frame and that it is not connected to the neutral bar except at service equipment (as permitted in Section 250.28 of the *National Electrical Code*) or at separately derived systems (as permitted in Section 250.30 of the National Electrical Code).

NOTE—An equipment grounding terminal bar is not always required. For example, when a properly installed metallic raceway is used as the equipment grounding path or when the grounded conductor terminals (neutral bar) complies with the conditions of the last sentence of Section 408.20 of the National Electrical Code.

6.9 PROPER TYPE OR CLASS AND RATING

When installing circuit breakers or fuses, ensure that they are of the proper type or class and rating.

6.10 DEBRIS

Clean the cabinet of all debris, which has accumulated during the panelboard installation (see 6.4.1).

6.11 STEPS IN SECTION 7

If the job is complete, perform the steps in Section 7 and then install the cabinet front (see Section 8).

Section 7
STEPS TO BE TAKEN BEFORE ENERGIZING

7.1 ACCESSIBLE ELECTRICAL CONNECTIONS

Tighten all accessible electrical connections to the manufacturer's torque specifications. If such information is not provided with the equipment, consult the manufacturer.

7.2 BLOCKS AND PACKING MATERIALS

Make certain that all blocks and packing materials used for shipment have been removed from all component devices and the panelboard.

7.3 SWITCHES, CIRCUIT BREAKERS, AND OTHER OPERATING MECHANISMS

Manually exercise all switches, circuit breakers, and other operating mechanisms to make certain they operate freely.

7.4 SHORT CIRCUITS AND GROUND FAULTS

To make sure that the system is free from short circuits and ground faults, conduct an insulation resistance test phase to ground and phase to phase with the switches or circuit breakers in both the open and closed positions. If the resistance reads less than 1 megohm while testing with the branch circuit devices in the open position, the system may be unsafe and should be investigated. If after investigation and possible correction, low readings are still observed, the manufacturer should be contacted. Some electronic equipment (metering, TVSS, etc.) may be damaged by this testing. Refer to the manufacturers equipment markings for guidelines.

7.5 GROUND FAULT PROTECTION SYSTEM

Test the ground fault protection system (if furnished) in accordance with the manufacturer's instructions. See Section 230.95 of the *National Electrical Code* and NEMA Standards Publication PB 2.2, Application Guide for Ground Fault Protective Devices for Equipment.

7.6 ADJUSTABLE TIME CURRENT TRIP DEVICE SETTINGS

Set any adjustable time current trip device settings to the proper values.

NOTE—Experience has indicated that damage from overcurrent can be reduced if the devices used for overload and short-circuit protection are set to operate instantaneously (that is, without intentional time delay) at 115 percent of the highest value of phase current which is likely to occur as the result of any anticipated motor starting or welding currents.

7.7 GROUNDING CONNECTIONS

Check to determine that all grounding connections are properly made. If the panelboard is used as service equipment, make certain that the neutral, if present, is properly bonded to the cabinet.

7.8 FOREIGN MATERIAL

Remove all foreign material from the panelboard and cabinet before installing the cabinet front. Make certain that all deadfront shields are properly aligned and tightened. Install the cabinet front in accordance with Section 8.

Section 8
INSTALLATION OF CABINET FRONT

8.1 CABINET FRONT OR TRIM PACKAGE

The cabinet front or trim package is designed to prevent damage to the front during shipment and handling.

8.2 UNPACKING

Care should be used when unpacking and handling the cabinet front.

8.3 COVERS AND DOORS

Install covers, close doors, and make certain that no conductors are pinched and that all enclosure parts are properly aligned and tightened.

8.4 TOUCH-UP

A suitable paint or other corrosion-resistant finish should be applied to those places where the finish is damaged.

8.5 FRONT ALIGNMENT

The cabinet front may be provided with an adjusting means to align it squarely with the building even though the cabinet may be slightly out of plumb with the building.

Section 9
ENERGIZING EQUIPMENT

WARNING: Hazardous voltages in electrical equipment can cause severe personal injury or death. Energizing a panelboard for the first time after initial installation or maintenance is potentially dangerous.

9.1 QUALIFIED PERSONNEL

Qualified personnel should be present when the equipment is energized for the first time. If short circuit conditions caused by damage or poor installation practices have not been detected in the procedures specified in Section 7, serious personal injury and damage can occur when the power is turned on.

9.2 LOAD ON THE PANELBOARD

There should be no load on the panelboard when it is energized. Turn off all of the downstream loads.

9.3 ENERGIZED IN SEQUENCE

The equipment should be energized in sequence by starting at the source end of the system and working towards the load end. In other words, energize the main devices, then the feeder devices, and then the branch-circuit devices. Turn the devices on with a firm positive motion.

9.4 LOADS SUCH AS LIGHTING CIRCUITS, CONTACTORS, HEATERS, AND MOTORS

After all main, feeder, and branch circuit devices have been closed, loads such as lighting circuits, contactors, heaters, and motors may be turned on.

Section 10
MAINTENANCE

10.1 MAINTENANCE PROGRAM

A maintenance program for panelboards should be conducted on a regularly scheduled basis in accordance with the following:

10.2 PANELBOARD WHICH HAS BEEN CARRYING ITS REGULAR LOAD FOR AT LEAST 3 HOURS

A panelboard which has been carrying its regular load for at least 3 hours just prior to inspection should be field tested by feeling the deadfront surfaces of circuit breakers, switches, interior trims, doors, and enclosure sides with the palm of the hand. If the temperature of these surfaces does not permit you to maintain contact for at least 3 seconds, this may be an indication of trouble and investigation is necessary. Thermographic (infrared) scanning has become a useful method of investigating thermal performance.

WARNING: Hazardous voltages in electrical equipment can cause severe personal injury or death. Unless otherwise specified, inspection and maintenance should only be performed on panelboards to which power has been turned off, disconnected and electrically isolated so that no accidental contact can be made with energized parts. Follow all manufacturer's warnings and instructions.

Safety related work practices, as described in NFPA 70E, Part II should be followed at all times.

CAUTION: Hydrocarbon spray propellants and hydrocarbon based sprays or compounds will cause degradation of certain plastics. Contact the panelboard manufacturer before using these products to clean, dry, or lubricate panelboard components during installation or maintenance.

10.3 INSPECT PANELBOARD ONCE EACH YEAR

Inspect the panelboard once each year or after any severe short circuit.

10.4 ACCUMULATION OF DUST AND DIRT

If there is an accumulation of dust and dirt, clean out the panelboard by using a brush, vacuum cleaner, or clean lint-free rags. Avoid blowing dust into circuit breakers or other components. Do not use a blower or compressed air.

10.4.1 Visible Electrical Joints and Terminals

Carefully inspect all visible electrical joints and terminals in the bus and wiring system.

10.4.2 Conductors and Connections

Visually check all conductors and connections to be certain that they are clean and secure. Loose and/or contaminated connections increase electrical resistance which can cause overheating. Such overheating is indicated by discoloration or flaking of insulation and/or metal parts. Pitting or melting of connecting surfaces is a sign of arcing due to a loose, or otherwise poor connection. Parts which show evidence of overheating or looseness should be cleaned and re-torqued or replaced if damaged. Tighten bolts and nuts at bus joints to manufacturer's torque specifications.

CAUTION: Do not remove plating from aluminum parts in joints or terminations. Damage to plating can result in overheating. Replace damaged aluminum parts.

10.4.3 Fuse Clip Contact Pressure and Contact Means

Examine fuse clip contact pressure and contact means. If there is any sign of overheating or looseness, follow the manufacturer's maintenance instructions or replace the fuse clips. Loose fuse clips can result in overheating.

10.4.4 Plug Fuses

Re-tighten plug fuses.

10.4.5 Conditions Which Caused Overheating

Be sure that all conditions which caused the overheating have been corrected.

10.5 PROPER AMPERE, VOLTAGE, AND INTERRUPTING RATINGS

Check circuit breakers, switches, and fuses to ensure they have the proper ampere, voltage, and interrupting ratings. Ensure that non-current-limiting devices are not used as replacements for current-limiting devices. Never attempt to defeat rejection mechanisms which are provided to prevent the installation of the incorrect class of fuse.

10.5.1 Mechanisms Free and in Proper Working Order

Operate each switch or circuit breaker several times to ensure that all mechanisms are free and in proper working order. Replace as required. See NEMA AB-4 for maintenance of molded case circuit breakers.

10.6 OPERATION OF ALL MECHANICAL COMPONENTS

Check the operation of all mechanical components. Replace as required.

10.6.1 Switch Operating Mechanisms

Exercise switch operating mechanisms and external operators for circuit breakers to determine that they operate freely to their full on and off positions.

10.6.2 Integrity of Electrical and Mechanical Interlocks

Check the integrity of all electrical and mechanical interlocks and padlocking mechanisms.

10.6.3 Missing or Broken Parts

Whenever practical, check all devices for missing or broken parts, proper spring tension, free movement, corrosion, dirt, and excessive wear.

10.6.4 Manufacturer's Instructions

Adjust, clean, and lubricate or replace parts according to the manufacturer's instructions.

10.6.4.1 Clean Nonmetallic Light Grease or Oil

Use *clean* nonmetallic light grease or oil as instructed.

10.6.4.2 Molded Case Circuit Breakers

Do *not* oil or grease parts of molded case circuit breakers.

10.6.4.3 Clean, Light Grease

If no instructions are given on the devices, sliding copper contacts, operating mechanisms, and interlocks may be lubricated with clean, light grease.

10.6.4.4 Excess Lubrication

Wipe off excess lubrication to avoid contamination.

CAUTION: Hydrocarbon spray propellants and hydrocarbon based sprays or compounds will cause degradation of certain plastics. Contact the panelboard manufacturer before using these products to clean, dry, or lubricate panelboard components during installation or maintenance.

10.6.5 Accessible Copper Electrical Contacts, Blades, and Jaws

Clean and dress readily accessible copper electrical contacts, blades, and jaws according to the manufacturer's instructions when inspection indicates the need.

10.7 DAMAGED INSULATING MATERIAL AND ASSEMBLIES

Look for and replace damaged insulating material and assemblies where sealing compounds have deteriorated.

10.8 MOISTURE OR SIGNS OF PREVIOUS WETNESS OR DRIPPING

Look for any moisture or signs of previous wetness or dripping inside the cabinet.

NOTE—Condensation in conduits or dripping from outside sources is one known cause of panelboard malfunction.

10.8.1 Conduits Which Have Dripped Condensate

Seal off any conduits which have dripped condensate, and provide means for further condensate to drain away from the panelboard.

10.8.2 Cracks or Openings

Seal off any cracks or openings which have allowed moisture to enter the enclosure. Eliminate the source of any dripping on the enclosure and any other source of moisture.

10.8.3 Insulating Material Which is Damp or Wet

Replace or thoroughly dry and clean any insulating material, which is damp or wet or shows an accumulation of deposited material from previous wettings.

10.8.4 Component Devices Which Show Evidence of Moisture Damage

Inspect all component devices. Replace any component device which shows evidence of moisture damage or has been subjected to water damage or flooding. Additional information may be found in the NEMA document "Guidelines for Handling Water Damaged Electrical Products."

10.9 BEFORE CLEANUP AND CORRECTIVE ACTION IS ATTEMPTED

In the event of water damage, e.g., flooding or sprinkler discharge, the manufacturer should be consulted before clean up and corrective action is attempted.

10.10 SEVERE ELECTRICAL SHORT CIRCUIT

If a severe electrical short circuit has occurred, the excessive currents may have resulted in structural component and/or bus and conductor damage due to mechanical distortion, thermal damage, metal deposits, or smoke. Examine all devices and bus supports for cracks or breakage. The manufacturer should be consulted before cleanup and correction is attempted.

10.11 GROUND FAULT PROTECTION SYSTEM

Test the ground fault protection system (if furnished) in accordance with the manufacturer's instructions. See Section 230.95 of the *National Electrical Code* and NEMA Standards Publication PB 2.2, *Application Guide for Ground Fault Protective Devices for Equipment.*

10.12 INSULATION RESISTANCE

Check insulation resistance (see 7.4) under any of the following conditions:

10.12.1 Severe Short Circuit

If a severe short circuit has occurred (see 10.10);

10.12.2 Parts Replaced

If it has been necessary to replace parts or clean insulating surfaces;

10.12.3 Panelboard Exposed to High Humidity

If the panelboard has been exposed to high humidity, condensation, or dripping moisture.

Section 11
PERMISSIBLE LOADING OF PANELBOARDS

11.1 NATIONAL ELECTRICAL CODE

In compliance with the *National Electrical Code*, the normal continuous loads (3 hours or more) of panelboard circuits should be not more than 80 percent of the rating of the overcurrent protective device, unless the marking of the device indicates that it is suitable for continuous duty at 100 percent of its rating.

11.2 HARMONICS IN ELECTRICAL SYSTEM

Some types of electrical equipment cause harmonics in the electrical system, which may result in overheating. This condition should be considered when determining panelboard loading.

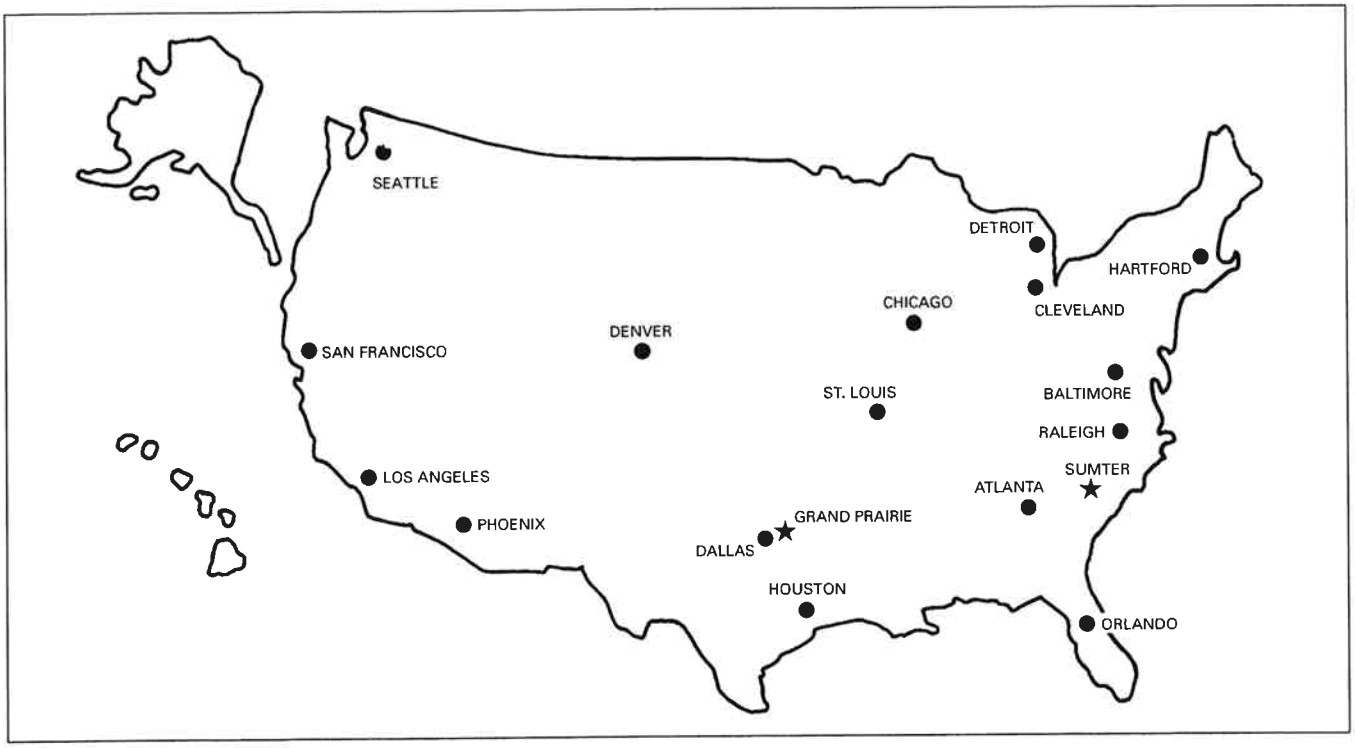

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Figure 14-17. Manufacturing Plant Locations

Main Plants

Sumter
#11 Corporate Circle
P.O. Box 2258
Sumter, SC 29150
(803) 481-3131

Grand Prairie
1102 Avenue T
Grand Prairie, TX 75050
(972) 606-5900

Satellite Plants

Atlanta
7990-A 2nd Flag Drive
Austell, GA 30001
Fax (770) 944-2033
Phone (770) 944-1022

Baltimore
6671 Santa Barbara Court
Elk Ridge, MD 21227
Fax (410) 796-7755
Phone (410) 796-7777

Chicago
959 AEC Drive
Wood Dale, IL 60191
Fax (630) 860-3569
Phone (630) 860-3500

Cleveland
4711 Hinkley Industrial Pkwy.
Cleveland, OH 44109
Fax (216) 485-1943
Phone (216) 485-1940

Dallas
1100 Avenue T
Grand Prairie, TX 75050
Fax (972) 641-6435
Phone (972) 988-3339

Denver
14101 East 33rd Place
Suite F
Aurora, CO 80011
Fax (303) 371-4175
Phone (303) 371-7844

Detroit
22670 Heslip Drive
Novi, MI 48375-4141
Fax (248) 735-2917
Phone (248) 735-2911

Hartford
625 Day Hill Road
Windsor, CT 06095
Fax (860) 688-4982
Phone (860) 688-7330

Houston
10810 West Little York
Suite 100
Houston, TX 77041
Fax (713) 688-3764
Phone (713) 688-8430

Los Angeles
2021 Locust Court
Ontario, CA 91761
Fax (909) 923-2344
Phone (909) 923-2040

Orlando
3827 St. Valentine Way
Orlando, FL 32811
Fax (407) 841-9135
Phone (407) 843-3863

Phoenix
7160 South Harl Ave.
Tempe, AZ 85283
Fax (480) 777-3958
Phone (480) 777-3957

Raleigh
2933 S. Miami Blvd.
Suite 111
Durham, NC 27703
Fax (919) 572-9751
Phone (919) 544-7074

St. Louis
12947 Gravois Road
St. Louis, MO 63127
Fax (314) 842-2552
Phone (314) 842-7662

San Francisco
20923 Cabot Boulevard
Hayward, CA 94545
Fax (510) 784-8980
Phone (510) 784-8981

Seattle
18657 72nd Avenue S.
Kent, WA 98032
Fax (425) 251-0079
Phone (425) 251-9081

EATON | Cutler-Hammer

Panelboards and Switchboards
Torque Requirements

Torque Values For Bus Bar Connections

(Copper and Aluminum)

Bolt Size (Dia.)	Torque		
	Lb - In	Lb - Ft	N - m
# 10	28 - 32	-	3.2 - 3.6
1/4"	62 - 68	-	7.0 - 7.7
5/16"	-	9.0 - 11	12.2 - 14.9
3/8"	-	18 - 22	24.4 - 29.8
1/2"	-	47 - 53	63.7 - 71.9

Torque Values For Wire Connections

Use For All Connections *Except* :
Panelboard Neutral and Ground Bars *and*
Molded Case Circuit Breakers & FDPW Switches

Screw Driver

Wire AWG	Torque	
	Lb - In	N - m
# 18 - 10	28 - 32	3.2 - 3.6
# 8	38 - 42	4.3 - 4.7
# 6 - 4	43 - 47	4.9 - 5.3
# 2 - 2/0	47 - 53	5.3 - 6.0

Socket Head

Across Flats		Torque	
In.	mm	Lb - In	N - m
1/8"	3.2	43 - 47	4.9 - 5.3
5/32"	3.9	95 - 105	10.7 - 11.9
3/16"	4.8	114 - 126	12.9 - 14.2
7/32"	5.6	143 - 158	16.2 - 17.9
1/4"	6.4	190 - 210	21.5 - 23.7
5/16"	7.9	261 - 289	29.5 - 32.7
3/8"	9.5	356 - 394	40.2 - 44.5
1/2"	12.7	475 - 525	53.7 - 59.3
9/16"	14.3	570 - 630	64.4 - 71.2

Torque Values For Wire Connections

Molded Case Circuit Breakers & FDPW Switches

See device markings for torque requirements

Torque Values For Wire Connections

Panelboard Neutral and Ground Bars

Small Opening

Wire AWG	Torque		Max. No. Wires Per Opening
	Lb - In	N - m	
# 14 - 12	18 - 22	2.0 - 2.5	2
# 10	18 - 22	2.0 - 2.5	1
# 8	23 - 27	2.6 - 3.1	1
# 6	33 - 37	3.7 - 4.2	1

Large Opening

Wire AWG	Torque		Max. No. Wires Per Opening
	Lb - In	N - m	
# 14 - 10	33 - 37	3.7 - 4.2	3 *
# 8	38 - 42	4.3 - 4.8	1
# 4 - 6	43 - 47	4.9 - 5.3	1
# 3 - 1/0	47 - 53	5.3 - 6.0	1

* When using 3 #10 copper conductors per opening, apply 47 - 53 Lb-In (5.3 - 6.0 N-m) torque.

EATON | Cutler-Hammer
January 2003
Vol. 1, Ref. No. [0818]

Product Types

Type PRL1a

Bolt-on or Plug-on Circuit Breakers
240V AC Maximum

- Main Lugs Only
  400 amperes maximum.
- Main Circuit Breaker
  400 amperes maximum.
- Branch Circuit Breakers
  100 amperes maximum,
  1-, 2- and 3-pole.

Type PRL1a

Type PRL2a

Bolt-on Circuit Breakers
240V or 480Y/277V AC; 125/250V DC Maximum

- Main Lugs Only
  400 amperes maximum.
- Main Circuit Breaker
  400 amperes maximum.
- Branch Circuit Breakers
  100 amperes maximum,
  1-, 2- and 3-pole.

Type PRL2a

Type PRL3a

Bolt-on Circuit Breakers
240V, 480V or 600V AC; 250V DC Maximum

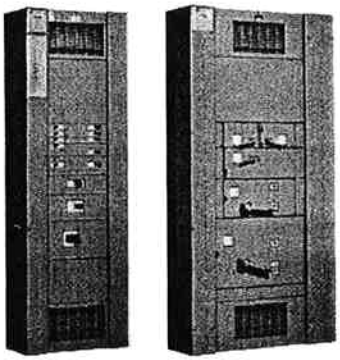
- Main Lugs Only
  800 amperes maximum.
- Main Circuit Breaker
  600 amperes maximum.
- Branch Circuit Breakers
  225 amperes maximum,
  1-, 2- and 3-pole.

Type PRL3a

Type PRL4

Circuit Breakers or Fusible Switches
240V, 480V or 600V AC; 250V DC Maximum

- Main Lugs Only
  1200 amperes maximum.
- Main Circuit Breaker
  1200 amperes maximum.
- Main Fusible Switch
  1200 amperes maximum.
- Branch Circuit Breakers
  1200 amperes maximum,
  1-, 2- and 3-pole.
- Branch Fusible Switches
  1200 amperes maximum,
  2- and 3-pole.



Type PRL4

Type PRL5P

Plug-on Circuit Breakers
240V, 480V or 600V AC; 250V DC Maximum

- Main Lugs Only
  1200 amperes maximum.
- Main Circuit Breaker
  1200 amperes maximum.
- Branch Circuit Breakers
  1200 amperes maximum,
  1-, 2- and 3-pole.

Type PRL5P

Pow-R-Command

Bolt-on Circuit Breakers
240V or 480Y/277V AC

- Main Lugs Only
  400 amperes maximum.
- Main Circuit Breaker
  400 amperes maximum.
- Branch Circuit Breakers
  225 amperes maximum,
  1-, 2- and 3-pole.
- Integral Power Switching Controls.

Pow-R-Command

Metering Service Section

Bolt-on Circuit Breaker or Fusible Switch 240V, 480V or 600V AC

- Service entrance panels combining a main disconnect with a power company metering compartment. 400 – 1200 amperes.

Metering Service Section

Product Description

Lighting and Distribution Panelboards

Cutler-Hammer assembled panelboards by Eaton Corporation are designed for sequence phase connection of branch circuit devices. This allows complete flexibility of circuit arrangement (1-, 2- or 3-poles) to allow balance of the electrical load on each phase.

Sturdy, rigid chassis assembly assures accurate alignment of interior with panel front; prevents flexing and minimizes possibility of loosening or damage to current carrying parts during and after installation.

Four-point in-and-out adjustment of panel interior is provided to meet critical depth dimensions on flush installations. This compensates for possible misalignment of box at installation.

Main lugs are mechanical solderless type and approved for copper or aluminum conductors.

Enclosures

Boxes are code-gauge galvanized steel except for column type panelboards which include a painted box finished in ANSI-61 light gray to match the trim.

Standard panelboard cabinets are designed for indoor use. Alternate types are available for indoor and special purpose applications.

All enclosures are furnished in accordance with Underwriters Laboratories standards and include wiring gutters with proper wire bending space. Special cabinets can be provided at an additional charge.

The box dimensions shown are inside dimensions. For outside dimensions, add 1/4-inch (6.4 mm).

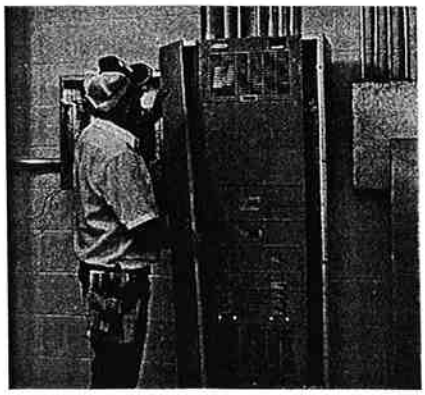
Standard panelboard boxes are supplied without knockouts (blank endwalls).

Fronts

Fronts (trims) for all panelboards are made of code-gauge steel and have a high durability ANSI-61 light gray finish applied by a baked-on polyester powder coating paint system.

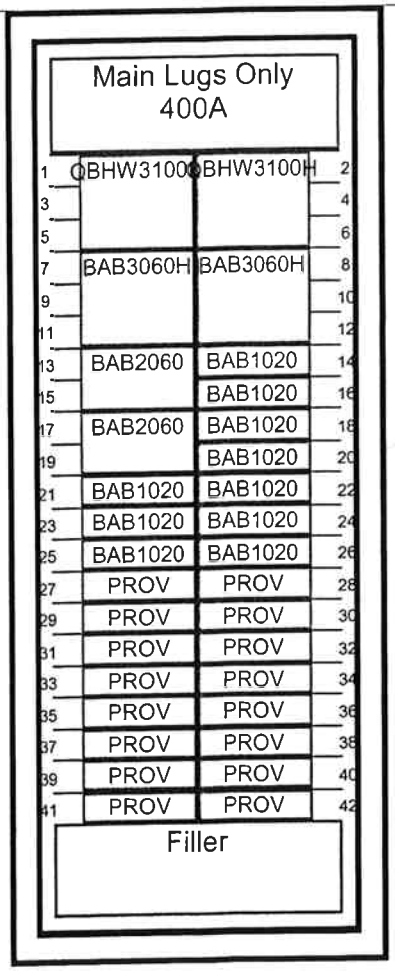
The fronts for lighting and appliance branch circuit panelboards and small power distribution panelboards include a door with rounded corners and concealed hinges that allow a 130-degree door swing. A flush-type latch and lock assembly is included. All locks are keyed alike. These trims are available in both surface and flush mounted designs.

Standard trims with doors are laser cut to eliminate sharp edges and to provide a consistently tight fit



The three-piece trim for larger power distribution panelboards provides for easy handling and installation

Fronts for power distribution panelboards utilize a unique breaker front cover design in which each device has a dedicated bolt-on steel cover. The individual covers form a single dead-front for the panelboard that is used in conjunction with two wiring gutter covers to complete the trim. A door is not finished as part of the standard offering on these panelboards but can be provided, for an additional charge, using a deeper than standard box.



General Information

Service Voltage:	208Y/120V 3Ph 4W	**Enclosure:**	NEMA 1
Bus Rating & Type:	400A Aluminum	**Neutral Rating:**	400A
Ground Bar:	Std. Bolted Aluminum, Al or Cu cable		
S.C. Rating:	42k A.I.C. Series Rated		

Main Device Type: MLO-Upstream DK - Top Cable Entry
Main Terminals: Mechanical - (2) #4-500 kcmil (Cu/Al)
Neutral Terminals: Mechanical - (2) #4-500 kcmil (Cu/Al)
Box Catalog No.: YS2048
Trim: Standard Trim (LT2048S)
Surface Mounted

Box Dimensions: 48" [1219.2mm]H x 20" [508.0mm]W x 5.75" [146.0mm]D
Min. Gutter Size: Top = 5.5" [139.7mm] Bottom = 5.5" [139.7mm]
Left = 6.0" [152.4mm] Right = 6.0" [152.4mm]

Panel ID Nameplate: **(1) PANEL HVAC**
Type: Plastic, adhesive-backed **(2) 208Y/120V 3Ph 4W**
Color: Black with White Letters **(3)**

NEC Lighting & Appliance, UL CTL ***Non-Interchangeable Main Device***

Trim Lock: Standard Latch & Lock
Circuit Directory: Plastic Sleeve with Card

Device Modifications:

Ref #	Description

Branch Devices

Qty	Poles	Trip	Frame	Amps	KAIC
10	1	20	BAB	100	42
2	3	60	BAB	100	42
2	3	100	QBHW	100	42
2	2	60	BAB	100	42
16	1		PROV		

Notes

PREPARED BY: Nichols, David W	DATE: 09/05/03	Eaton's Cutler-Hammer Business	
APPROVED BY	DATE	JOB NAME: MONROE FITNESS	
		DESIGNATION: PANEL HVAC	
VERSION: 4.4.2		TYPE: PRL1a	DRAWING TYPE: Customer Approval
NEG-ALT NUMBER: SE2109055304-0000	REVISION	DWG SIZE: A	G.O.
			ITEM: 0051
			SHEET: 1 OF 1

Cutler-Hammer Communications Newsletter

1/12/99

BR & Challenger Loadcenters

New Residential Series Ratings with ED Frame Breakers

We are happy to announce enhanced Series Ratings for our BR Loadcenters.

These new series ratings apply to all 14 inch wide single and three phase BR Loadcenters from 100-225 Amps, and 8-42 Circuits. Small Loadcenters (2-8 Circuits) and 400-600 Amp Commercial Loadcenters are **NOT** listed for these series ratings.

We now have UL listing of our Cuter-Hammer BR/C and BRH/HC breakers with upstream ED breakers @ 65 kAIC and with EDC/EDH breakers @100 kAIC.

Production of Loadcenters with the new series ratings and new bilingual (English and Spanish) Pubs started in Mid-November 1998. A new bilingual end carton label indicates that the loadcenter contains new Pubs with ED and EDC/EDH series ratings. The new BR label includes a Cutler-Hammer logo (red and black) on the left and BR logo (black and white) on the right. These labels are the best way to identify the use of the new bilingual pub with enhanced series ratings.

If a project requires the use of the new series ratings, but the loadcenters do not have the new bilingual pub, which includes ED and EDC/EDH series ratings, the UL files listing these ratings are as follows.

1-phase loadcenters

File E52977, Vol. 1, Sec. 32, page 3, issued 6-16-87, revised 4-15-98

3-phase loadcenters

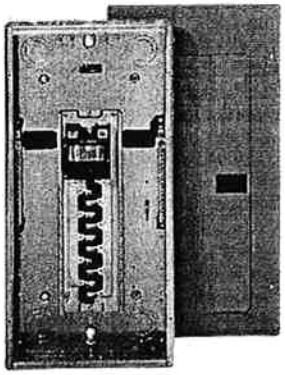
File E52977, Vol. 5, Sec. 16, page 2A-1, issued 12-12-67, revised 4-15-98

These file numbers may be used with inspectors for the acceptance of our new series ratings on loadcenters that contain old Pubs.

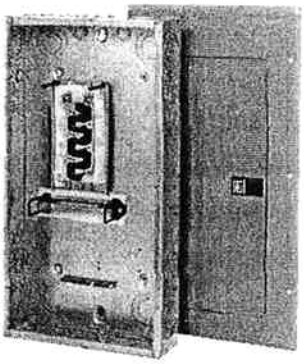
Residentially Yours,
Brendan Foley
Product Manager
Loadcenters and Residential Circuit Breakers

Product Description

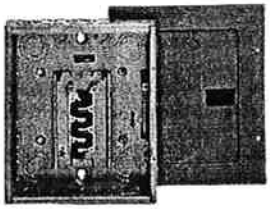
Single-Phase



Main Circuit Breaker

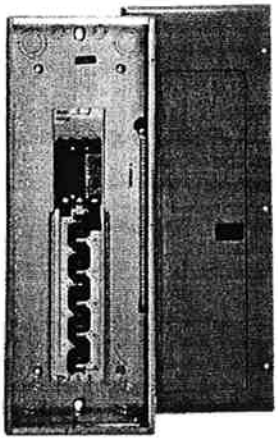


Riser Panel

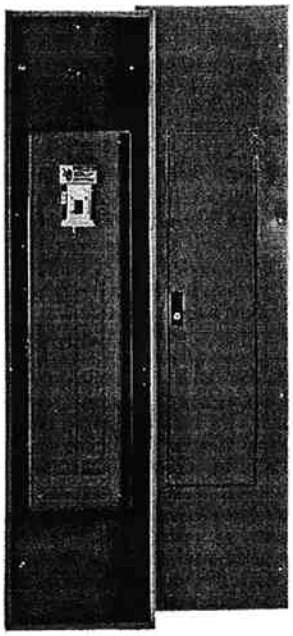


1-Phase Main Lugs

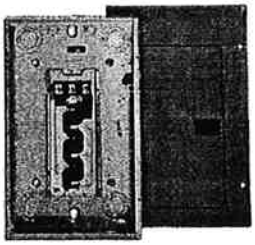
Three-Phase



Main Circuit Breaker

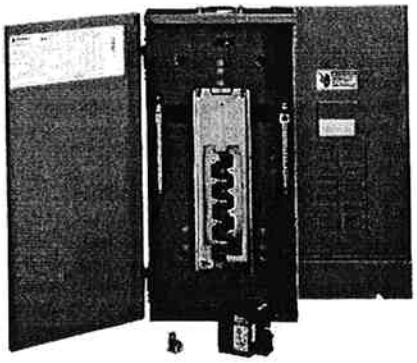


Main Circuit Breaker Commercial



3-Phase Main Lugs

Convertible

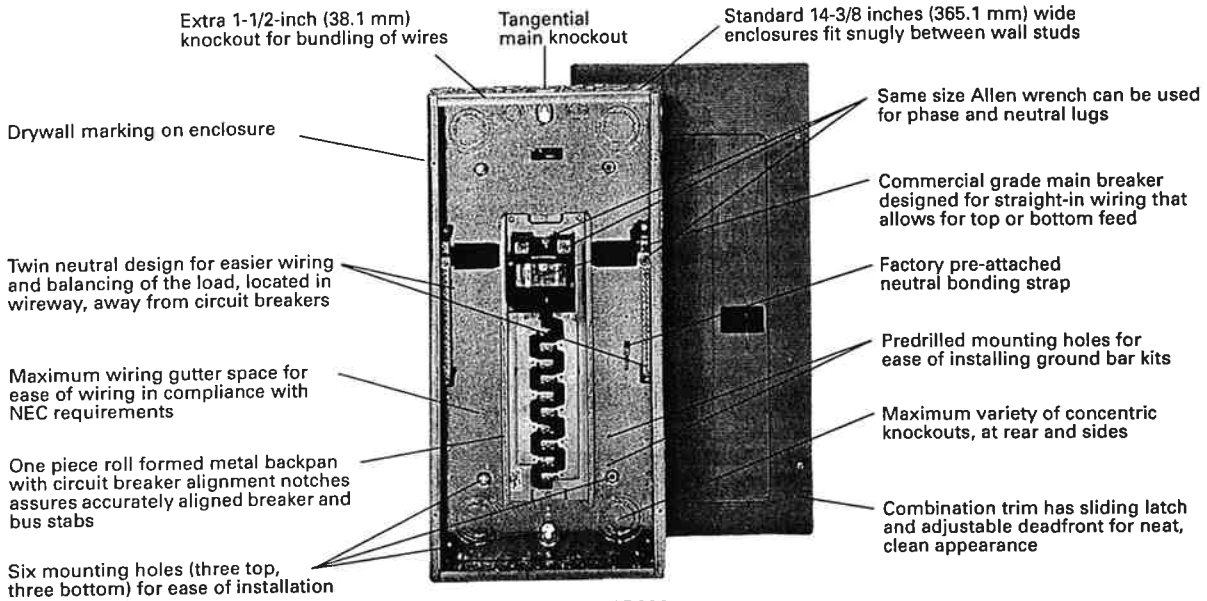


Convertible — Outdoor

Outdoor Circuit Breaker Unit Enclosures

ECB Breaker Enclosure

Features, Benefits and Functions



BR2040B200

Product Selection

Table 3-64. BR Loadcenter Selection Chart

Service	■ Single-phase, three-wire, 120/240V AC	■ Three-phase, four-wire, 208Y/120V AC ■ Three-phase, three-wire, 240V AC delta
Short Circuit Current Rating	■ 10,000 AIC: All single- and three-phase loadcenters 70 through 225 amperes, 8 to 42 circuits. ■ 22,000 AIC: All convertible loadcenters using 125 amperes rated Type BRH main breakers or selected factory installed 125 ampere rated Type BRH main breaker.	■ 25,000 AIC: All convertible and factory installed single-phase loadcenters rated 150 and 200 amperes using Type BWH main breakers.
Main Breaker/Main Lug Loadcenters	Single-Phase ■ Main Breaker: 100, 125, 150, 200, 225, 400, 600 amperes. ■ Main Lugs: 70, 125, 150, 200, 225, 400, 600 amperes.	Three-Phase ■ Main Breaker: 100, 125, 150, 200, 225, 400, 600 amperes. ■ Main Lugs: 100, 125, 150, 200, 225, 400, 600 amperes.
Convertible Loadcenters	■ Main Breaker: Single-phase up to 200 amperes and three-phase up to 225 amperes ■ Main Lugs: Single-phase up to 200 amperes and three-phase up to 150 amperes	
Branch Breakers	■ Types BR, BRH, and BRH: 10 to 125 amperes. One-, two-, and three-pole. Selected amperages available in switching duty, HACR, shunt trip, and high magnetic setting. ■ Type GFCB: 15 to 50 amperes. One- and two-pole ground fault breakers. ■ Types BJ, and BJH: 125 to 225 amperes Two- and three-pole. ■ Type BD Twin: 10 to 50 amperes Two of one-pole. Take one 1-inch (25.4 mm) space.	■ Type BQ and BQC Multibreaker: 15 to 30 amperes. Two of two-pole or one two-pole and two one-pole. Takes two 1-inch (25.4 mm) spaces. ■ Type BRW: 15 to 30 amperes. Two-pole water heater breakers. ■ Type BRSN: 15 to 30 amperes. Two-pole switching neutral breakers. ■ Type BR 15 to 100 amperes. Two-pole, 240V AC delta breakers. ■ BR-AFCI arc fault circuit interrupter.
Enclosures	■ NEMA Type 1 indoor. ■ NEMA Type 3R outdoor.	■ Meets or exceeds UL requirements for indoor or outdoor applications
Loadcenter and Breaker Accessories	■ Branch Circuit Breaker Auxiliary components. Hold Down Kits. Handle ties. Lockoffs. Lockdogs. ■ Complete Line of Ground Bar Kits 5, 10, 14, and 21 circuit, some with additional #2/0 lugs. Each terminal will accommodate: (3) #14 – #10 Cu/Al or (1) #14 – #4 Cu/Al ■ Main and Sub-feed Lugs 125, 150, 225 amperes — two- and three-pole. ■ Shunt Trips	■ Surge Protection Single-phase plug-on surge protector. Single-phase bottle type surge protector. Three-phase bottle type surge protector. Single-phase whole home surge protector. ■ Universal Rainproof Conduit Hubs Group One: 3/4, 1, 1-1/4, 1-1/2, 2 inches (19.1, 25.4, 31.8, 38.1, 50.8 mm) Group Two: 2, 2-1/2, 3 inches (50.8, 63.5, 76.2 mm) Adapter plate.
Bussing	■ Tin-plated aluminum as standard. ■ Some copper bus panels available.	

Application Description

Loadcenter Construction

Cutler-Hammer Type BR loadcenters have standard tin-plated aluminum bus with a limited availability of copper bus. The sum of the handle ratings connected to any stab is limited to 150 amperes maximum on the 100 and 125 ampere loadcenters, and 200 amperes on loadcenters with 150 ampere or higher main bus. NEMA Type 1 boxes or enclosures are manufactured from galvanized steel. Raintight boxes are manufactured from galvanized steel, then finished using an electrostatic powder coat, baked urethane paint process.

Neutrals

Cutler-Hammer Type BR loadcenters have three types of neutrals:

Factory Bonded Split Neutrals

Certain single-phase main circuit breaker panels are supplied with a factory-bonded twin neutral. When used as a sub panel, the bonding strap should be removed, and the bonding screw should be reinstalled. The bonded side is now the ground, and the un-bonded side is the neutral. When used as a service entrance panel, the unused neutral holes on either side may be used for terminating ground wires.

Insulated Split Neutrals

Most single-phase panels (12 circuit and greater) are supplied with a twin neutral with an insulated cross strap. These panels are shipped in an un-bonded state. For service entrance applications, the neutral must be bonded utilizing the bonding strap supplied with the panel. For sub-feed applications, the panel may be installed as is. Separate ground bars are provided on these panels.

Single Neutral

Single-phase 2-8 circuit, three-phase and commercial loadcenters are supplied with a single insulated/bondable neutral. The three-phase loadcenter neutral is movable to the other side if desired. The neutral is bondable in the field by means of a bonding strap that is supplied with each loadcenter. For sub-feed applications, a separate ground bar must be used. In a service entrance application, where the neutral is bonded, unused neutral connections may be used for equipment ground protectors.

Grounds

In service entrance applications where the neutral is bonded, unused neutral holes may be used for terminating ground conductors. In sub-feed panels, the neutral must be isolated (non-bonded), and ground wires must be terminated on a separate ground bar.

The Factory Bonded Split Neutral panels have sufficient terminations for both ground and neutral conductors. The Insulated Split Neutral panels are supplied with a separate factory-installed ground bar if the catalog number contains a "G." If not, a separate ground bar should be installed. Insulated/Bondable Single Neutral panels are supplied without a ground bar (unless otherwise noted), and ground bar kits if needed must be purchased separately.

Neutral and Ground Terminals

The standard terminals on grounds and neutrals are rated to accept (3) — #14 – #10 Cu/Al or (1) — #14 – 4. For larger cables, add-on neutral lugs may be ordered from the accessories on **Page 3-61**.

Note: NEC allows only one current carrying conductor per hole on neutrals unless otherwise noted.

Bottom Fed Loadcenters

Where power cable is brought into the loadcenter from below the panel, main lug panels, and single-phase, 225 ampere and below loadcenters can be rotated 180 degrees to allow straight-in wiring of power cables to the main terminals. Because the main circuit breaker handle operates horizontally, the orientation of the main circuit breaker handle is consistent with the requirements of NEC Article 240-81.

Gutter Splicing

Loadcenters are not UL listed as wiring troughs. Therefore, gutter splicing of riser cables to tap off to the main device is not permitted. Refer to NEC article 373-8.

Fire Rating

Due to the numerous openings in both loadcenter boxes and trims, they should not be mounted in firewalls. There is no approved method for sealing the enclosures for this application.

Date Code

The date of manufacture of each loadcenter is printed on the outside of the carton as well as inside the loadcenter. On the carton, the date code is printed on the end carton label. In the loadcenter, the date code is located on the small white label located on the right side wall (with the main device on top).

The date code is in the following format: F # # # &. The "F" is the numeric code for the Lincoln, IL plant, and the three numbers are the year and week of manufacture e.g., 023. The "&" sign at the end signifies the decade of the 2000s. Therefore, the date code F023& would indicate that the product was manufactured in the 23rd week of 2000. The 1980s are represented by a "+" sign and the 1990s are represented by a "=" at the end of the code.

Surge Protectors

The BRSURGE Surge Protector has indicating lights that indicate when the units should be replaced. The CHSA01 and CHSA03 Surge Protectors internally short, causing the circuit breaker feeding the surge protector to trip. All but the BRSURGE Surge Protector should be wired to the load side of 15 or 20 ampere feeder circuit breakers mounted adjacent to the main incoming device.

The CHSPCH Cutler-Hammer Home Surge Protector is an externally mounted TVSS unit that provides industrial level surge protection in a residential design.

Circuit Breaker Case Interrupting Capacity

- 10,000 AIC Black
- 22,000 AIC Gray

Extended Residential Warranty Highlights

Note: See Cutler-Hammer Publication Number SA-365 for complete details.

- Five-year branch breaker warranty.
- Five-year loadcenter warranty.
- Both the loadcenter and branch circuit breaker warranties are extended to 10 years if a functioning surge protector is installed in the loadcenter.

Standards and Certifications

UL Listings

All Cutler-Hammer Type BR loadcenters are listed under UL file E52977 except the 2 – 8 circuit loadcenters, up through and including 125 amperes, which are listed under UL file E8741.

Ratings

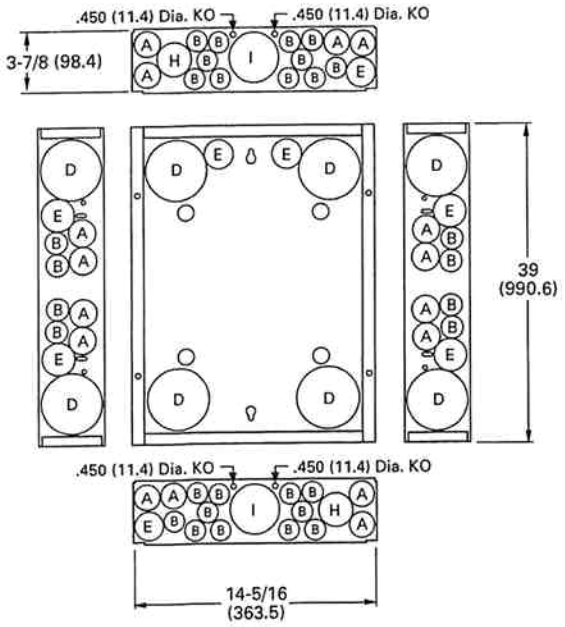
- Main Lugs
- 200 Amperes, 3-Phase, 4-Wire, 120/208V AC or 240V AC
- Tin-Plated Aluminum Bus Bar
- Interrupting Rating 10 kAIC
- Spaces/Poles: 42/42
- Insulated/Bondable Neutral
- Enclosure Type: Indoor
- Trim Type: Combination
- Paint Type: ANSI 61 Light Gray Finish
- Incoming Wire Range: #1 – 300 kcmil, Cu/Al 60 or 75°C

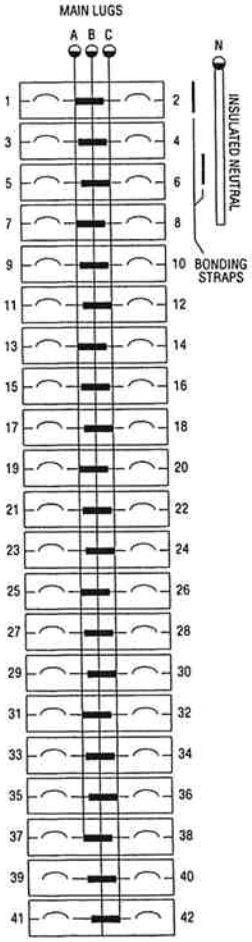
Notes

1. Ground bar kits priced separately. See page C-16.

Knockouts

Code	Diameter in Inches					Diameter in mm				
A	1/2	3/4	—	—	—	12.7	19	—	—	—
B	1/2	—	—	—	—	12.7	—	—	—	—
C	1/2	1-1/4	1-1/2	2	2-1/2	12.7	31.7	38.1	50.8	63.5
D	1-1/4	1-1/2	2	2-1/2	—	31.7	38.1	50.8	63.5	—
E	1/2	3/4	1	—	—	12.7	19.0	25.4	—	—
F	1/2	3/4	1	1-1/2	2	12.7	19.0	25.4	38.1	50.8
G	1-1/4	1-1/2	2	—	—	31.7	38.1	50.8	—	—
H	1/2	3/4	1	1-1/4	1-1/2	12.7	19.0	25.4	31.7	38.1
I	1	1-1/4	1-1/2	2	2-1/2	25.4	31.7	38.1	50.8	63.5
J	1	1-1/4	1-1/2	—	—	25.4	31.7	38.1	—	—





Reference DWG # 96-4967

Dimensions in Inches (mm)

THE INFORMATION ON THIS DOCUMENT IS CREATED BY CUTLER-HAMMER. IT IS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT IS SUPPLIED.	PREPARED BY	DATE	**Cutler-Hammer**	PITTSBURGH, PA	
	APPROVED BY	DATE	JOB NAME DESIGNATION		
	VERSION		TYPE 3BR4242L200	DRAWING TYPE	
NEG-ALT NUMBER	REVISION	DWG SIZE	G.O.	ITEM	SHEET

Plug-On Circuit Breakers, Types BR
10,000/22,000/42,000 Amperes
Interrupting Capacity 120V AC, 120/240V AC and 240V AC

BR120

BR215

BR320

Table 3-113. Type BR Breakers, 1-Inch (25.4 mm) per Pole 120/240, 10,000, 22,000 and 42,000 AIC

Note: All Type BR 1-, 2-, and 3-pole circuit breakers carry listing for HACR application.
For circuit breakers with a shunt trip, add ST suffix and obtain pricing from table on **Page 3-75.**

Ampere Rating	Wire Size Range Cu/Al 60°C or 75°C	1-Pole 120/240V AC Requires One 1-Inch (25.4 mm) Space — 10 per Shelf Carton				2-Pole 120/240V AC Common Trip Requires Two 1-Inch (25.4 mm) Spaces — 5 per Shelf Carton					
		10 kAIC		22 kAIC		10 kAIC		22 kAIC		42 kAIC	
		Catalog Number	Price U.S. $	Catalog Number	Price U.S. $	Catalog Number	Price U.S. $	Catalog Number	Price U.S. $	Catalog Number	Price U.S. $
10	#14 – 4	BR110	18.70	—	—	BR210	42.25	—	—	—	—
15		BR115 ①②	18.70	BRH115	41.25	BR215 ④	42.25	BRH215	85.50	—	—
20		BR120 ①②	18.70	BRH120	41.25	BR220 ④	42.25	BRH220	85.50	—	—
25		BR125	18.70	BRH125	41.25	BR225 ④	42.25	BRH225	85.50	—	—
30		BR130	18.70	BRH130	41.25	BR230 ④	42.25	BRH230	85.50	—	—
35	#14 – 4	BR135	18.70	BRH135	41.25	BR235 ④	42.25	BRH235	85.50	—	—
40		BR140	18.70	BRH140	41.25	BR240 ④	42.25	BRH240 ④	85.50	—	—
45		—	—	BRH145	41.25	BR245 ④	42.25	BRH245	85.50	—	—
50		BR150	18.70	BRH150	41.25	BR250 ④	42.25	BRH250 ④	85.50	—	—
55	#14 – 3	BR150	18.70	BRH155	41.25	BR255	42.25	BRH255	85.50	—	—
60	#4 – 1/0	BR160	18.70	BRH160	41.25	BR260	42.25	BRH260	85.50	BRHH260	131.00
70		BR170	40.50	BRH170	51.50	BR270	84.50	BRH270	131.00	BRHH270	200.00
80		—	—	—	—	BR280	122.00	BRH280	159.00	BRHH280	281.00
90		—	—	—	—	BR290	122.00	BRH290	165.00	BRHH290	281.00
100		—	—	—	—	BR2100	122.00	BRH2100	165.00	BRHH2100	281.00
110		—	—	—	—	BR2110	254.00	BRH2110	610.00	BRHH2110	—
125	#4 – 2/0	—	—	—	—	BR2125	254.00	BRH2125	610.00	BRHH2125	810.00
150		—	—	—	—	BR2150 ③	269.00	—	—	—	—

① One pole, 1-inch (25.4 mm) per pole circuit breakers are available with high magnetic setting for switching large tungsten lamp loads. Add suffix H to catalog number.
③ Switching duty rated.
③ For use as a branch circuit breaker in 400 and 600 ampere panels only.
④ On the black handle breaker, add suffix "B" to the catalog number and $4.00 to the list price to obtain a tapped molded opening for proper use with hold-down kits.

Discount Symbol **22-CD**

Table 3-114. Type BR Breakers, 1-Inch (25.4 mm) per Pole 240V AC, 10,000, 22,000 and 42,000 AIC

Note: All Type BR 1-, 2-, and 3-pole circuit breakers carry listing for HACR application.
For circuit breakers with a shunt trip, add ST suffix and obtain pricing from table on **Page 3-75.**

Ampere Rating	Wire Size Range Cu/Al 60°C or 75°C	3-Pole 240V AC Common Trip Requires Three 1-Inch (25.4 mm) Spaces 			
		5 per Shelf Carton			
		10 kAIC		22 kAIC	
		Catalog Number	Price U.S. $	Catalog Number	Price U.S. $
10	#14 – 4	BR310	148.	—	—
15 ①②		BR315	148.	BRH315	226.
20 ①②		BR320	148.	BRH320	226.
25		BR325	148.	BRH325	226.
30		BR330	148.	BRH330	226.
35	#14 – 4	BR335	148.	BRH335	226.
40		BR340	148.	BRH340	226.
45		BR345	148.	BRH345	226.
50		BR350	148.	BRH350	226.
55	#14 – 3	BR355	148.	BRH355	226.
60	#4 – 1/0	BR360	148.	BRH360	226.
70		BR370	148.	BRH370	284.
80		BR380	148.	BRH380	317.
90		BR390	220.	BRH390	317.
100		BR3100	220.	BRH3100	317.

① One pole, 1-inch (25.4 mm) per pole circuit breakers are available with high magnetic setting for switching large tungsten lamp loads. Add suffix H to catalog number.
② Switching duty rated.

Discount Symbol..... **22-CD**

Sectional Divider- Supporting Materials:

Flood Damaged Electrical Requirements CNI-027 by Sonoma County, CA

Flood Damaged Electrical Requirements

CNI-027

❖ ❖

Purpose: To provide the requirements for the repair and replacement of flood damaged electrical wiring and equipment.

The following requirements apply to any electrical wiring and equipment which has been submerged in flood water for any length of time and/or sustained any other water or storm damage.

1. An electrical permit is required for all repairs and replacements of electrical wiring and equipment.

2. Before an electrical service panel may be re-energized it must be cleaned and dried throughout and all circuit breakers and/or other damaged components replaced.

3. The busbars must show no evidence of corrosion or oxidation and the connected load must be in an electrically safe condition.

4. The following electrical wiring and equipment must be replaced:

   a. Electronically controlled and solid state contactors and starters.

   b. Components containing semi-conductors and transistors.

   c. Overload relays.

   d. Adjustable speed drives.

   e. Molded case circuit breakers, switches and receptacle outlet devices.

   f. Fuses.

   g. Any cable or wire not listed for wet locations which has been submerged at either end thus allowing water to enter its body.
   Note Exception: The cable or wire does not need to be replaced if a report is submitted to the Permit and Resource Management Department with the results of a high voltage test of the wiring (such as a megohmeter test) which indicates that the insulation has not failed. This test must be performed by a licensed electrical contractor.

5. Manual and magnetic motor controllers and motor controlled centers may be reconditioned by trained personnel.

Sonoma County Permit and Resource Management Department
2550 Ventura Avenue ❖ Santa Rosa, CA ❖ 95403-2829 ❖ (707) 565-1900 ❖ Fax (707) 565-1103

Sectional Divider- Supporting Materials:

ANSI/NETA ATS-2009
Page 11, Section 3 - Qualifications of Testing Organizations and Personnel
Page 12, Section 4 - Division of Responsibility
Page 13,14,15 Section 5 - General
Page 38, 39 Section 7 - Inspection and Test Procedure

3. QUALIFICATIONS OF TESTING ORGANIZATION AND PERSONNEL

3.1 Testing Organization

1. The testing organization shall be an independent, third party entity which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems being evaluated.

2. The testing organization shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

3. The testing organization shall use technicians who are regularly employed for testing services.

4. An organization having a designation of "NETA Accredited Company" issued by the InterNational Electrical Testing Association meets the above criteria.

5. The testing organization shall submit appropriate documentation to demonstrate that it satisfactorily complies with these requirements.

3.2. Testing Personnel

1. Technicians performing these electrical tests and inspections shall be trained and experienced concerning the apparatus and systems being evaluated. These individuals shall be capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved. They must evaluate the test data and make a judgment on the serviceability of the specific equipment.

2. Technicians shall be certified in accordance with ANSI/NETA ETT-2000, *Standard for Certification of Electrical Testing Personnel*. Each on-site crew leader shall hold a current certification, Level III or higher, in electrical testing.

4. DIVISION OF RESPONSIBILITY

4.1 The Owner's Representative

The owner's representative shall provide the testing organization with the following:

1. A short-circuit analysis, a coordination study, and a protective device setting sheet as described in Section 6.

2. A complete set of electrical plans and specifications, including all change orders.

3. Drawings and instruction manuals applicable to the scope of work.

4. An itemized description of equipment to be inspected and tested.

5. A determination of who shall provide a suitable and stable source of electrical power to each test site.

6. A determination of who shall perform certain preliminary low-voltage insulation-resistance, continuity, and low-voltage motor rotation tests prior to and in addition to tests specified herein.

7. Notification of when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.

8. Site-specific hazard notification and safety training.

4.2 The Testing Organization

The testing organization shall provide the following:

1. All field technical services, tooling, equipment, instrumentation, and technical supervision to perform such tests and inspections.

2. Specific power requirements for test equipment.

3. Notification to the owner's representative prior to commencement of any testing.

4. A timely notification of any system, material, or workmanship that is found deficient based on the results of the acceptance tests.

5. A written record of all tests and a final report.

5. GENERAL

5.1 Safety and Precautions

All parties involved must be cognizant of industry-standard safety procedures. This document does not contain any procedures including specific safety procedures. It is recognized that an overwhelming majority of the tests and inspections recommended in these specifications are potentially hazardous. Individuals performing these tests shall be qualified and capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved.

1. Safety practices shall include, but are not limited to, the following requirements:

    1. All applicable provisions of the Occupational Safety and Health Act, particularly OSHA 29 CFR Part 1910 and 29 CFR Part 1926.

    2. ANSI/NFPA 70E, *Standard for Electrical Safety in the Workplace.*

    3. *The Electrical Safety Program Book,* Kenneth G. Mastrullo, Ray A. Jones, Jane G. Jones, NFPA.

    4. Applicable state and local safety operating procedures.

    5. Owner's safety practices.

2. A safety lead person shall be identified prior to the commencement of work.

3. A safety briefing shall be conducted prior to the commencement of work.

4. All tests shall be performed with the apparatus de-energized and grounded except where otherwise specifically required to be ungrounded or energized for certain tests.

5. The testing organization shall have a designated safety representative on the project to supervise operations with respect to safety. This individual may be the same person described in 5.1.2.

5.2 Suitability of Test Equipment

1. All test equipment shall meet the requirements in Section 5.3 and be in good mechanical and electrical condition.

2. Field test metering used to check power system meter calibration must be more accurate than the instrument being tested.

3. Accuracy of metering in test equipment shall be appropriate for the test being performed.

4. Waveshape and frequency of test equipment output waveforms shall be appropriate for the test to be performed and the equipment to be tested.

5. GENERAL

5.3 Test Instrument Calibration

1. The testing organization shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy for each test instrument calibrated.

2. The firm providing calibration service shall maintain up-to-date instrument calibration instructions and procedures for each test instrument calibrated.

3. The accuracy shall be directly traceable to the National Institute of Standards and Technology (NIST).

4. Instruments shall be calibrated in accordance with the following frequency schedule:

    1. Field instruments: Analog and Digital, 12 months maximum.

    2. Laboratory instruments: 12 months maximum.

    3. Leased specialty equipment: 12 months maximum.

5. Dated calibration labels shall be visible on all test equipment.

6. Records which show date and results of instruments calibrated or tested must be kept up to date.

7. Calibrating standard shall be of better accuracy than that of the instrument tested.

5. GENERAL

5.4 Test Report

1. The test report shall include the following:

    1. Summary of project.

    2. Description of equipment tested.

    3. Description of tests.

    4. Test data.

    5. Analysis and recommendations.

2. Test data records shall include the following minimum requirements:

    1. Identification of the testing organization.

    2. Equipment identification.

    3. Humidity, temperature, and other conditions that may affect the results of the tests and/or calibrations.

    4. Date of inspections, tests, maintenance, and/or calibrations.

    5. Identification of the testing technician.

    6. Indication of inspections, tests, maintenance, and/or calibrations to be performed and recorded.

    7. Indication of expected results when calibrations are to be performed.

    8. Indication of as-found and as-left results, as applicable.

    9. Sufficient spaces to allow all results and comments to be indicated.

3. The testing organization shall furnish a copy or copies of the complete report to the owner as specified in the acceptance testing contract.

6. POWER SYSTEM STUDIES

6.1 Short-Circuit Studies

1. Scope of Study

   Determine the short-circuit current available at each component of the electrical system and the ability of the component to withstand and/or interrupt the current. Provide an analysis of all possible operating scenarios which will be or have been influenced by the proposed or completed additions or changes to the subject system.

2. Procedure

   The short-circuit study shall be performed in accordance with the recommended practices and procedures set forth in ANSI/IEEE 399 and the step-by-step procedures outlined in the short-circuit calculation chapters of IEEE 141 and ANSI/IEEE 242.

3. Study Report

   Results of the short-circuit study shall be summarized in a final report containing the following items:

   1. Basis, description, purpose, and scope of the study.

   2. Tabulations of the data used to model the system components and a corresponding one-line diagram.

   3. Descriptions of the scenarios evaluated and identification of the scenario used to evaluate equipment short-circuit ratings.

   4. Tabulations of equipment short-circuit ratings versus available fault duties. The tabulation shall identify percentage of rated short circuit and clearly note equipment with insufficient ratings.

   5. Conclusions and recommendations.

7. INSPECTION AND TEST PROCEDURES

7.3.1 Cables, Low-Voltage, Low-Energy

— RESERVED —

* Optional

7.3.2 Cables, Low-Voltage, 600-Volt Maximum

1. Visual and Mechanical Inspection

1. Compare cable data with drawings and specifications.
2. Inspect exposed sections of cable for physical damage and correct connection in accordance with the single-line diagram.
3. Inspect bolted electrical connections for high resistance using one or more of the following methods:
    1. Use of a low-resistance ohmmeter in accordance with Section 7.3.2.2.
    2. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12.
    3. Perform thermographic survey in accordance with Section 9.
4. Inspect compression-applied connectors for correct cable match and indentation.
5. Inspect for correct identification and arrangements.
6. Inspect cable jacket insulation and condition.

2. Electrical Tests

1. Perform resistance measurements through bolted connections with low-resistance ohmmeter, if applicable, in accordance with Section 7.3.2.1.
2. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable. Test duration shall be one minute.
3. Perform continuity tests to insure correct cable connection.
*4. Verify uniform resistance of parallel conductors.

3. Test Values

3.1 Test Values – Visual and Mechanical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value. (7.3.2.1.3.1)
2. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12. (7.3.2.1.3.2)
3. Results of the thermographic survey shall be in accordance with Section 9. (7.3.2.1.3.3)

* Optional

7.3.2 Cables, Low-Voltage, 600-Volt Maximum (*continued*)

3.2 Test Values – Electrical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2. Insulation-resistance values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1. Values of insulation resistance less than this table or manufacturer's recommendations shall be investigated.

3. Cable shall exhibit continuity.

4. Deviations in resistance between parallel conductors shall be investigated.

* Optional

7.3.3 Cables, Medium- and High-Voltage

1. Visual and Mechanical Inspection

1. Compare cable data with drawings and specifications.
2. Inspect exposed sections of cables for physical damage.
3. Inspect bolted electrical connections for high resistance using one or more of the following methods:
    1. Use of a low-resistance ohmmeter in accordance with Section 7.3.3.2.
    2. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12.
    3. Perform a thermographic survey in accordance with Section 9.
4. Inspect compression-applied connectors for correct cable match and indentation.
5. Inspect shield grounding, cable supports, and terminations.
6. Verify that visible cable bends meet or exceed ICEA and manufacturer's minimum published bending radius.
*7. Inspect fireproofing in common cable areas.
8. If cables are terminated through window-type current transformers, inspect to verify that neutral and ground conductors are correctly placed and that shields are correctly terminated for operation of protective devices.
9. Inspect for correct identification and arrangements.
10. Inspect cable jacket and insulation condition.

2. Electrical Tests

1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable, in accordance with Section 7.3.3.1.
2. Perform an insulation-resistance test individually on each conductor with all other conductors and shields grounded. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1.
3. Perform a shield-continuity test on each power cable.

* Optional

Sectional Divider- Supporting Materials:

DATA BULLETIN 0110DB0401R9/05

0110DB0401R9/05
09/2005
Lexington, KY USA

Data Bulletin

Replaces 0110DB0401, 08/2004

Water Damaged Electrical Distribution and Control Equipment

Class 0110

Retain for future use.

Background

Flooding and other disasters prompt many questions about water damaged electrical equipment. Can the equipment be dried out? Is the circuit breaker still okay to use? Can the switchboard be re-energized?

Considering these and other questions, it's most important to remember that, in many cases, the water that has been in contact with the equipment has been contaminated with sewage, chemicals, or other substances that can negatively affect the electrical equipment's integrity.

The answers are not always simple, but this data bulletin is intended to provide some guidelines to help answer these and other questions related to water damaged electrical equipment.

Wet Electrical Equipment

Consider the following information when assessing wet electrical equipment.

- Electrical equipment that has been submerged or has come in contact with water must be replaced. There are exceptions to this rule for larger equipment (see "Reconditioning of Larger Equipment" on page 2).
- Attempting to dry out the equipment in many cases leaves portions of the current-carrying parts with damp or wet surfaces. These surfaces may be in contact with insulators or other materials that prevent them from being properly dried out and cleaned of debris.
- Residual debris or wet surfaces may result in a loss of dielectric spacing within the equipment, and could present a hazard upon re-energization.
- Molded case circuit breakers should never be re-energized if they have been subjected to or immersed in water. It is likely that wet or damp surfaces and foreign debris remain inside the circuit breaker housing.
- New equipment is built at the factory by trained personnel based on strict design guidelines. Non-trained personnel should not attempt to disassemble and reassemble equipment. This may result in improper assembly and could create a hazard upon re-energization.
- Equipment that must be replaced in its entirety is listed below:
  - — Miniature and molded case circuit breakers
  - — Molded case switches
  - — Multi-metering equipment
  - — Safety switches (AC and DC switches)
  - — Load centers or panelboard interiors and other components (see exceptions under "Equipment with Field Replaceable Interior Components" on page 2)
  - — Dry-type transformers
  - — Busway—mylar wrapped bars
  - — Solid state components
  - — Programmable logic controllers
  - — Fuses
  - — Electro-mechanical relays, contactors, starters, push buttons, limit switches, and other input logic and output controls
  - — Solid state motor starters
  - — Adjustable speed drives
  - — Motor control center components

Reconditioning of Larger Equipment

For certain types of equipment, disassembly may be performed by trained factory service personnel who are familiar with the equipment design and function. The Square D® Customer Information Center (CIC) can help in evaluating this equipment, and can make recommendations and discuss the next appropriate phase of recovery with customers. The number for the CIC is 1-888-SquareD (1-888-778-2733).

Equipment that may be reconditioned includes:

- Switchboard enclosures and bus structure (depends on bus structure arrangement and types of insulating materials used)
- Switchgear
- Low-voltage power circuit breakers[1]
- Medium voltage circuit breakers
- Low voltage bolted-pressure switches1
- Medium voltage switches
- Motor control center enclosures and bus structure (depends on bus structure arrangement and type of insulating materials used)
- Panelboard and load center enclosures
- Liquid-filled power transformers
- Cast-resin transformers
- Busway—epoxy coated bars

Reconditioning of this equipment may include repair or replacement of internal components. This service should only be performed by qualified personnel familiar with the operation and construction of such equipment. The ability to recondition this equipment will vary depending on equipment age, contamination level of the water, and the length of time in contact with water.

Equipment with Field Replaceable Interior Components

Generally, this type of replacement is limited to a load center or panelboard type of product where the entire assembly can be removed and replaced as a unit.

Enclosures possibly can be reused in this case if they have not been subjected to physical damage and if they have been properly cleaned of all debris and foreign materials.

Contact your local Schneider Electric/Square D representative for possible replacement interior assemblies.

Equipment with mechanical components that cannot be field replaced, such as a safety switch, must be removed and replaced in its entirety. These mechanical components are critical to proper operation of the equipment and may have sustained damage.

[1] Low voltage power circuit breakers and bolted-pressure switches cannot be dried out and cleaned. They must be repaired with new parts including mechanisms, trip units/fuses, and other electrical components.

Cleaning Agents and Abrasives

Do not apply cleaning agents, particularly petroleum-based cleaners such as WD-40® and CRC®, to the current-carrying portions of electrical equipment to remove foreign debris, residues, and other substances. This practice can be hazardous and should be avoided.

Some cleaning and lubricating compounds can cause deterioration of the non-metallic insulating or structural portions of the equipment (see National Electrical Code® 110.11 FPN No. 2).

Do not use abrasives such as sandpaper or steel wool to clean current-carrying parts of the equipment. These materials may remove plating or other conductive surfaces from the parts, which could result in a hazard when the equipment is re-energized.

Non-Submerged Equipment in Flooded Areas

Equipment in this situation should be inspected carefully by a qualified person to determine whether moisture has entered the enclosure. If any signs of moisture or damage exist, the equipment should be replaced or repaired, as previously described.

Other References

- NEMA Standard AB 4-2003, *Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications*
- NEMA Standard BU 1.1-2000, *General Instructions for Proper Handling, Installation, Operation, and Maintenance of Busway Rated 600 Volts or Less*
- NEMA Standard PB 1.1-2002, *General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less*
- NEMA Standard PB 2.1-2002, General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less
- NEMA Standard ICS 1.1-2003, Industrial Control and Systems: Safety Guidelines for the Application, Installation, and Maintenance of Solid State Controls

Other Considerations

Consideration must be given to other components in the electrical system such as conductors, connected utilization equipment, connections in junction boxes, etc.

Summary

In general, water damaged equipment must be replaced. It is important to the entire electrical system that distribution and control equipment function properly. Equipment or components that have been replaced due to water damage should be destroyed; they should not be reused in another application.

The Square D® Customer Information Center can answer any questions you have about water damaged equipment. In addition, the CIC offers a variety of services, including inspecting, testing, and reconditioning of electrical equipment. Contact the CIC or your local Schneider Electric/Square D representative by calling 1-888-SquareD (1-888-778-2733).

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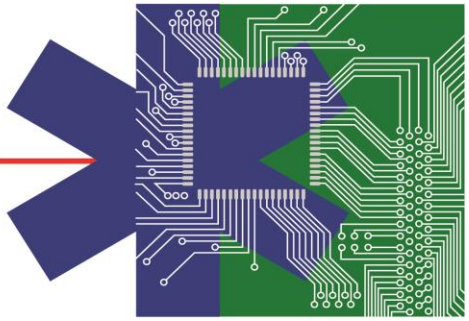

24 HOUR RESPONSE 1-877-378-4183

HOW TO CONTACT

Electro-Mechanical Recertifiers, Inc.

For NON-EMERGENCY call toll free 877-378-4183

A. Call **877-378-4183** - Leave name and number and we will call you back next business day.

B. In the event you cannot reach by **NON-EMERGENCY** Option A - Please Email us at info@er-emergency.com and we will respond back next business day.

For EMERGENCY call toll free 877-378-4183

A. Call **877-378-4183** - Tell the attendant you have an "**emergency"** and they will patch your call through anytime night or day immediately to an on call project manager.

B. In the event there is a disaster or communication glitch and you cannot reach by **EMERGENCY** Option A - Please Call or Text the Sr. Project Manager direct **443-397-7942** or **412-439-3442**. Your call will be returned within 1 Hour.

C. In the event there is a disaster or communication glitch and you cannot reach by **EMERGENCY** Option B - Please Email us at contact us with a project http://www.er-emergency.com/contact. Your email will be returned within 8 hours.