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NEW INDEPENDENT STATES

OPERATION AND MAINTENANCE MANUAL FOR ELECTRICAL EQUIPMENT

PUMP STATION REHABILITATION PROJECT

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Pump Stations, Kzylorda Oblast, Kazakstan

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SQUARE D

Instruction Bulletin

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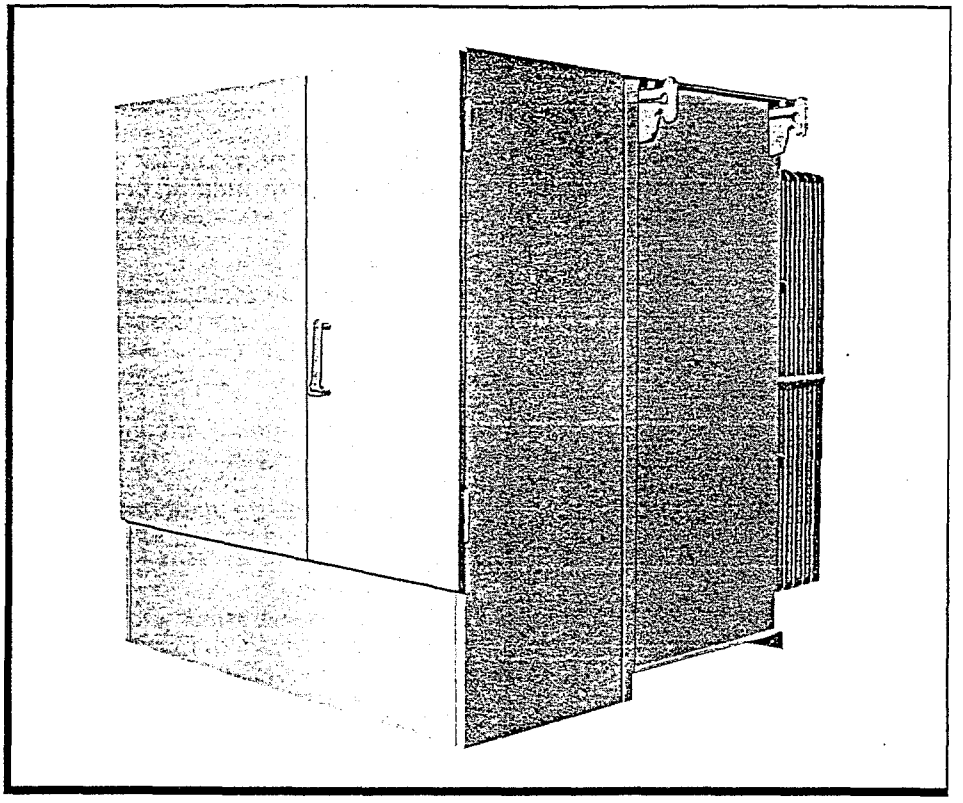
Three Phase, Liquid-Filled, Compartmental Type, Pad Mounted Transformers

Class 7230



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⚠ DANGER

HAZARDOUS VOLTAGE.

- Read and understand this bulletin in its entirety before installing or operating pad mounted transformers. Installation, adjustment, repair and maintenance of these transformers must be performed by qualified personnel.
- Disconnect all power and verify transformer is de-energized before servicing transformer.
- User is responsible for conforming to all applicable codes with respect to grounding all equipment. Improper grounding can cause high voltage on the transformer tank and secondary terminals. For more information on grounding, see page 12.
- Under certain fault conditions, the secondary voltages from line to ground of transformers with ungrounded secondary windings (i.e. delta, floating wye and open delta) may approach a level as high as the supply voltage.
- Using a properly rated meter, always measure terminal to verify it is de-energized.
- Do not change position of tap changer switch or dual voltage switch when the transformer is energized.
- Operation of a primary protective device may be evidence of a faulted transformer. Do not re-energize the unit if any indication of a failure is evident.
- Many parts of the transformer operate at high voltages. DO NOT TOUCH. Use only electrically insulated tools.
- Do not rely on visual indications such as switch position or fuse removal for determining a de-energized condition. Always assume that a terminal is energized unless checked and grounded.

Failure to observe these precautions will cause shock or burn, resulting in severe personal injury or death!

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INTRODUCTION

This instruction bulletin includes information on shipping, inspecting, handling, storing, installing, operating, and maintaining pad mounted transformers. Each transformer has its own specification and unique combination of construction features. These features are detailed in the transformer outline and nameplate drawings. Use the outline and nameplate drawings along with this bulletin to install, operate, and maintain a pad mounted transformer.

This booklet is not intended as an application guide for pad mounted transformers or a substitute for adequate training in safe working procedures for this and related high voltage equipment.

If further information is needed or if a particular problem arises that is not covered sufficiently by this bulletin, the matter should be referred to the nearest Square D Company field office.

SAFETY PRECAUTIONS

Lifting

Using cranes or jacks, lift the transformers only from the lifting hooks or jacking areas provided for lifting; do not lift from areas other than the hooks or jacking areas. Make sure personnel are kept at a safe distance away from the transformer.

Installing

Always properly secure the cabinet doors and ensure that the cabinet is properly attached to the tank to prevent access of unauthorized personnel.

Installation must be on a flat, level pad or other foundation strong enough to support the weight of the transformer and to prevent tilting by more than 1 1/2 degrees; a greater tilt may leave energized parts above the liquid.

Follow normal good safety practices when working on or around a transformer. The following procedures are unique to transformers and must be followed for protection of personnel and equipment:

1. Ground the transformer tank at all times. Windings and bushings must be de-energized and grounded except when electrical tests are being performed. Also, all liquid-handling equipment and vacuum pumps must be grounded. This reduces the possibility of static discharges.
2. Do not perform electrical tests when vacuum is being applied to the transformer.
3. Before making any electrical tests, ventilate the transformer tank with dry air or nitrogen to remove any combustible gas that might be present.
4. Provide fire extinguishers for emergency use. Place one extinguisher on top of the transformer when work is being done inside the tank. Do not allow smoking in the vicinity of the liquid-handling equipment or on top of the transformer when any covers are open.

   Note: However, use of a fire extinguisher inside the transformer will severely damage or ruin the transformer insulation.
5. Before removing any cover or fittings from the transformer, ensure the pressure gauge in the tank has a zero reading and the liquid level is below the opening.
6. Never allow anyone to enter the transformer tank unless an analysis of the air in the tank shows at least 19.5% oxygen. Whenever anyone is in the tank, station another person at the hole outside the tank to act as a sentry.
7. Use only explosion proof lights with liquid-resistant cords.

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SAFETY PRECAUTIONS
(continued)

Liquid Level

Before voltage is applied to the transformer, the oil (or silicone or High Molecular Weight Hydrocarbon fluids such as R-Temp) must be at the proper level as indicated by the liquid level gauge.

Grounding

The transformer must be properly grounded before energizing.

Pressure

Always vent the transformer using the manual pressure relief device to relieve internal pressure before energizing, before operating the Bay-O-Net fuse holders, or before distributing the tank seal at the hand-hole access or at other fittings.

Fuses

Operation of a fuse may indicate a faulty transformer. Do not replace the fuse unless the cause of the fuse operation is positively identified and corrected.

Fuses must be operated within their ratings and replaced with fuses having equivalent voltage and time-current characteristics.

Switches

De-energize the transformer before operating the tap changer or the dual voltage switch, if one is provided.

If the dual voltage switch is moved to the alternate position, check fuse ratings. The change in voltage may require different fuses.

When de-energizing the transformer, never rely on the switch handle position or other visual indicators that measure voltage. Always check the voltage at the terminals with a meter and ground the terminals externally in an approved manner.

Hook-Sticks

Some devices, such as Under Oil Switches, Bay-O-Net fuses, Dry-Well canister fuses, and Dead-Front Elbow terminators are designed to be operated only with a "shot-gun stick" or "hook-stick" tool. Follow the instructions of the tool manufacturer for proper operation. Never attempt to operate such devices by hand.

Observing Damage

Leaking fluid, broken parts, excessive pressure or temperature, or indication of arcing or burning should always be treated as a potentially hazardous situation. De-energize the transformer at once if these or other dangerous conditions are observed. Remove the transformer from service until repairs can be made.

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STANDARD FEATURES

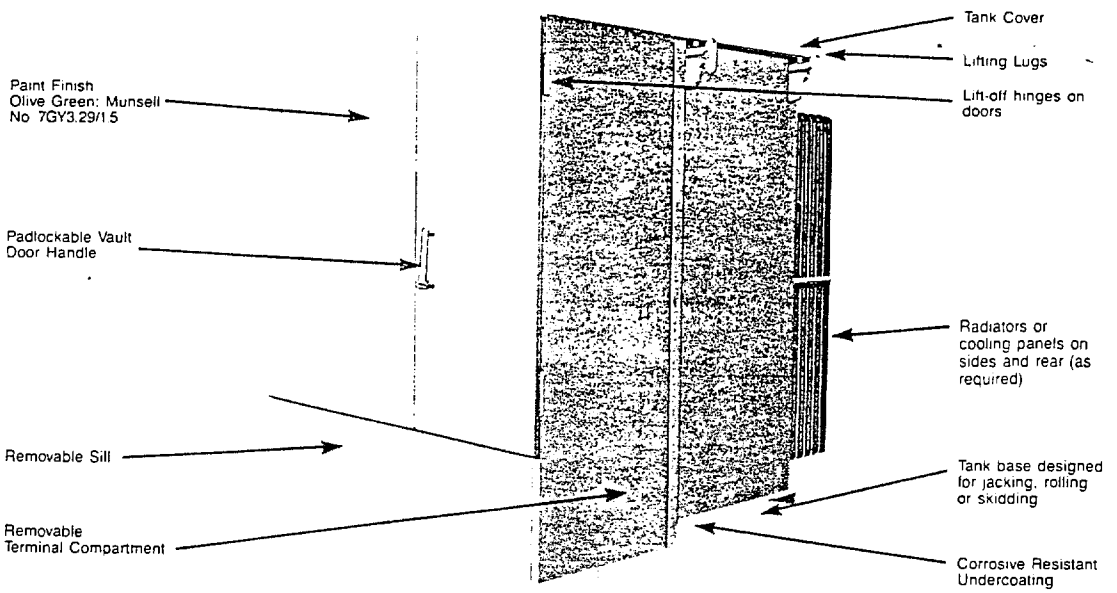

Figure 1 External Features—The Pad Mounted Transformer differs from the substation or pole-style transformer by its applications and external appearance. Designed for application with underground feeders, the Pad Mounted Transformer is waterproof, tamperproof, compartmentalized on the front, low in profile, and painted a dark olive green.

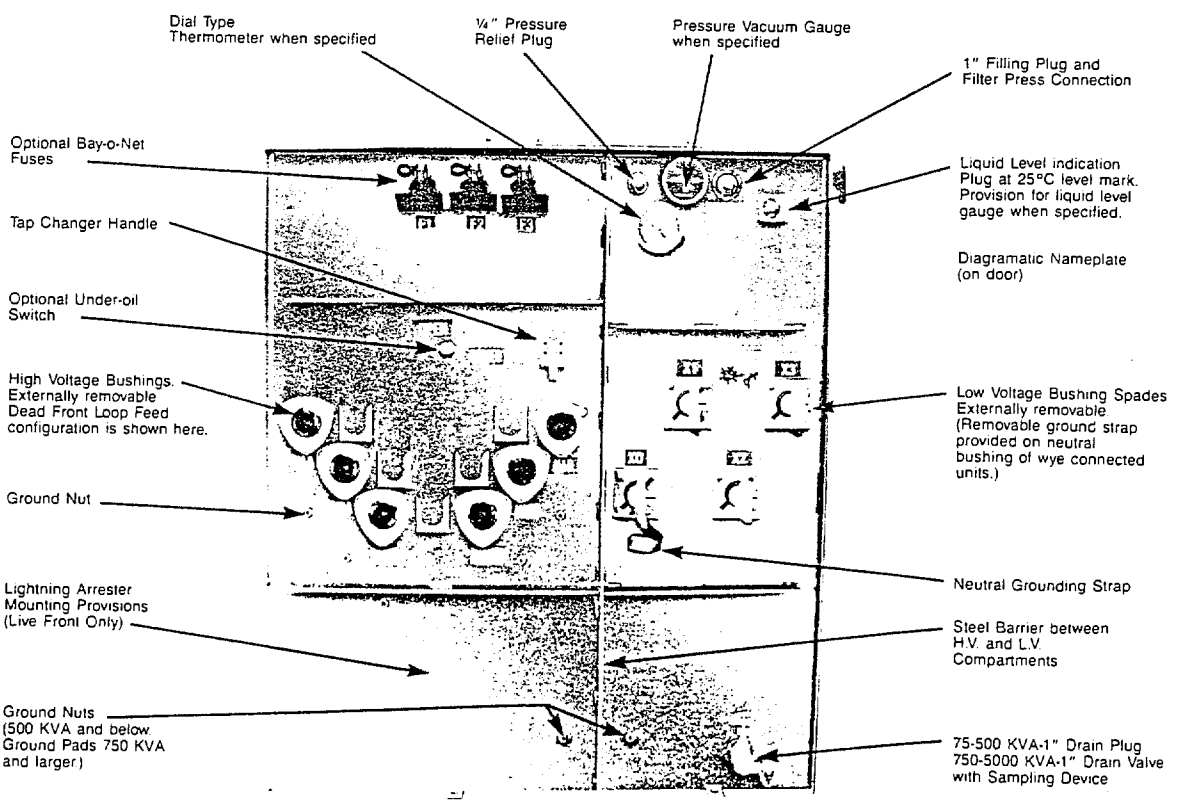

Figure 2 Terminal Compartment Features

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SHIPPING, INSPECTING, HANDLING AND STORING

Shipping

The pad mounted transformers are sealed for open carrier shipment. Associated spare fuses, cable terminator kits, or other miscellaneous parts are crated separately and may be shipped with the transformer.

Inspecting

Immediately upon receiving and before unloading, visually inspect the transformer and any boxes containing miscellaneous parts. If damage or rough handling is evident, promptly file a claim with the transportation company and notify the nearest Square D Company field office. Consult Square D Company before rejecting any unit or performing any additional labor.

External Inspection

Check the following external transformer features before unloading:

- Check for any obvious dents or scratches in the front door and sill, tank walls, cooling radiator, or corrugate assembly. Simple touch-up procedures can most often correct dents and scratches in the paint finish. If necessary, the door and sill parts are field replaceable.
- Check for liquid coolant leaks. Oily streaks on the transformer surface, at weld seams, on high or low voltage bushing parts, and any collection of the insulating coolant at the base of the transformer must be investigated thoroughly to determine if a leak is present on the transformer being inspected. A "pin-hole" leak or any bushing leak that causes a very slow loss of liquid is field repairable. Refer to section "Fluid Leaks" on page 20 of this bulletin for further information on this repair process.
- Check the nameplate for design compliance. Figure 3 shows a typical nameplate showing items that should be verified. Voltages, kVA ratings, percent voltage impedance (IZ), and other design features must comply with the job specification and outline drawing.
- Check for accessories. The transformer outline drawing for the specific order shows which accessories should be present and their location in the low or high voltage compartment.

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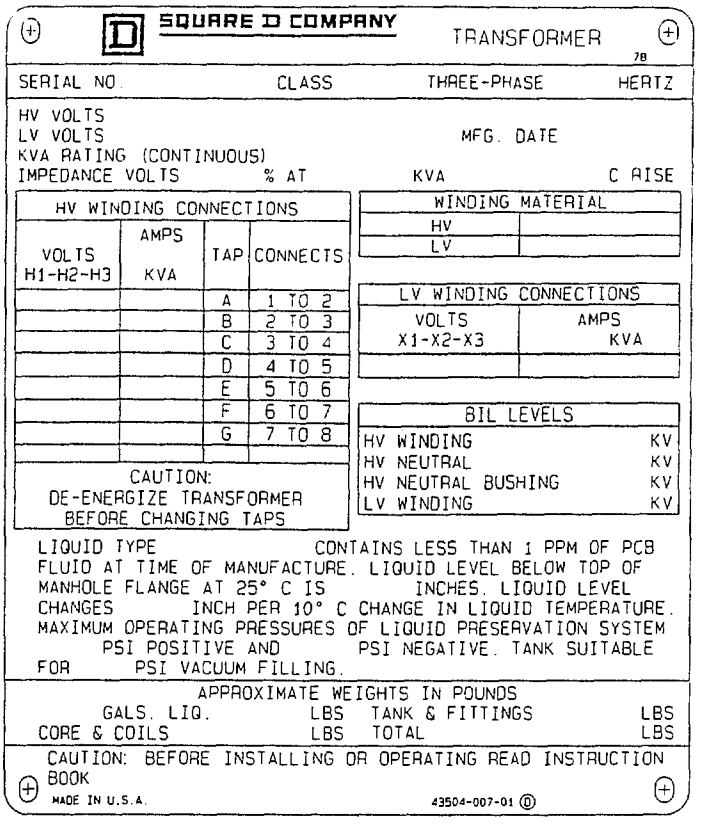

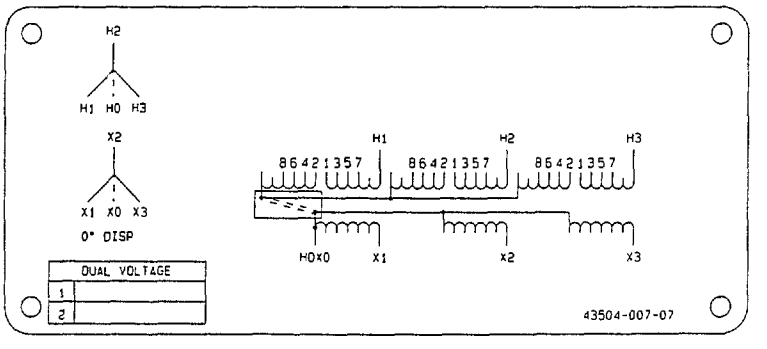

Figure 3 Stainless Steel Nameplate (Typical)

Internal Inspection

An inspection of the internal tank is rarely necessary and is required only if the tank has obviously sustained severe impact damage in transit. If removing the tank cover or maintenance hand-hole cover is necessary, precautions should be taken as described on the next page. For instructions on how to remove the tank cover, see "Removing and Replacing the Tank Cover" on page 24 of this bulletin.

The tank has been sealed at the factory to eliminate any possibility of moisture contaminating the liquid coolant. Accumulating moisture can destroy the insulating properties of the liquid coolant. On delivery, inspect the pressure seal by following either method 1 or 2 below.

Method 1—Observe the pressure vacuum gauge, if supplied. A consistent rise and fall in pressure readings with rise and fall of liquid coolant and ambient temperature demonstrates an effective seal. A "flat" or unchanged reading over time and at varying temperatures is evidence of a leak that must be located and repaired (see "Locating and Repairing Pressure Leaks" on page 23 of this bulletin.)

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Internal Inspection
(continued)

Method 2—Pull the pressure relief valve ring momentarily, if supplied, or loosen the vent plug. The sound of rushing air indicates the unit has maintained an effective seal. If no sound of rushing air can be heard, it is still possible to have an effective seal, but may indicate the present ambient temperature and pressure is approximately the same as when the transformer was sealed at the factory. If this is the case, repeat this test when the temperature is significantly different. After repeating the test, if the internal pressure is unchanging, review "Locating and Repairing Pressure Leaks" on page 23 of this bulletin to find and repair a leak.

⚠ CAUTION

HAZARD OF FOREIGN MATERIALS IN TRANSFORMER.

Take extreme care to protect the transformer insulation from damage and to prevent foreign materials entering the tank during inspection and assembly. The following procedures must be followed to protect the transformer insulation during inspection and assembly.

Failure to observe this precaution can result in personal injury or product damage.

1. Whenever the transformer is open, do not permit individuals on top of the transformer until they have emptied their pockets, checked their clothes for loose objects such as in pants cuffs, and removed watches and jewelry.
2. Persons entering the transformer must not have loose dirt particles on their clothing. Any persons entering the tank must wear clean cloth shoe covers or nitrile rubber overshoes. Never stand directly on any electrical insulation part.
3. Use clean drop cloths under working areas in the transformer to prevent objects from dropping into the structure.
4. All tools must be accounted for. If possible, attach lines made from clean cotton tape or seine cord to tools so they cannot be lost.
5. One person should be responsible for policing the people and materials into and out of the tank and should make certain nothing is left in the tank accidentally. Also, this person should be responsible for observing the precautions for opening the tank.
6. Never open the transformer unless the temperature of the tank and internal parts is at least 10°C (14°F) higher than the dew point of the outside air.
7. Prepare to close the tank quickly to protect the insulation in the event of sudden weather changes such as threatening rain or snow. Do not conduct vacuum operations when it is raining or while the transformer is unattended.
8. If any object is dropped into the transformer and cannot be retrieved, notify a Square D representative immediately.
9. When pressure tests or vacuum operations are required, check the transformer nameplate notes and equalize the pressure between the main tank and other compartments separated by the terminal boards. Also, disconnect any rigid connections to the bushing tops to avoid breaking the insulation if the tank and cover should deflect under test pressure or vacuum.
10. Avoid using pressure gauges containing mercury unless an effective catch trap is placed between the gauge and the transformer to ensure mercury does not leak into the tank accidentally. For measuring vacuum, properly calibrated thermocouple gauges and aneroid absolute pressure gauges are preferred.

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Fluid Sampling

An initial visual or chemical inspection of the liquid insulating coolant is not required unless there is indication that moisture or other contaminants have accidentally entered the tank during transit. If sampling the liquid coolant is required, see "Sampling the Fluid" on page 23 of this bulletin for instructions.

Fluid Level Inspection

The transformer is shipped with the liquid coolant at the correct operational level. To verify this when the transformer is received, read the coolant level on the level gauge (if supplied) or by removing the liquid level one-inch pipe plug located near the top of the tank wall inside the low voltage compartment. If reading the liquid level gauge, the correct position of the indicator is halfway between the "25°C" mark and the "high" or "low" mark. If viewing the level from the plug opening, the correct level can range one inch above or below the level plug. Consult Square D Company if an incorrect level is observed.

Handling

⚠ WARNING

HANDLING AND LIFTING HAZARD.

- **Keep area below any equipment being lifted clear of all personnel and property.**
- **Use appropriate lifting methods as described below.**
- **DO NOT allow slings to strike or make a loop around the bushings or other fragile parts.**

Improper handling and lifting methods can result in equipment damage, severe personal injury or death!

The transformer is shipped on an open carrier trailer to facilitate the use of a crane for unloading. Unloading the unit with a forklift is not recommended as the weights are often excessive and the cooling radiators and front compartment assembly are easily damaged. Always handle the transformer in an upright position to avoid internal stresses on the core and coil mounting assembly and to prevent trapping air in the windings which could create serious problems when the transformer is energized. The transformer weight is given on the nameplate.

Lifting lugs or ears, designed for vertical strain only, are attached for lifting the entire transformer. When the loops of the sling straddle the tank corner, the tank acts as a spreader and the unit may be lifted from a single hook. If the loops do not straddle the corner, a separate spreader or lifting beam must be used to prevent horizontal strain on the lugs. Use lifting cables of the same length to lift the transformer.

Jacking may be accomplished at the comers of the tank base plate. Do not attempt to raise the transformer by placing jacks under drain valves, pipe connections or other attachments.

When the transformer cannot be handled by a crane, it may be skidded or moved on rollers, but care must be taken not to damage the tank base structure. When rollers are used under large transformers, skids must be used to distribute stress over the tank base.

Storing

If the transformer must be stored, locate it preferably in its permanent location on the concrete pad. If a level concrete surface is not available, use a pallet of adequate strength to keep the unit from direct contact with the ground. The transformer should not be stored in the presence of explosive gases such as chlorine, etc.

Periodically inspect the stored transformer just as a unit that is in service. Ensure an effective pressure seal is maintained and check for leaks and any rust spots.

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INSTALLATION

Location

Place the transformer on a strong, level foundation, preferable of reinforced concrete, and allow for adequate air circulation and accessibility for inspection and maintenance. Install the transformer in a dry vault or compartment with adequate ventilation to avoid tank overheating. At high altitudes, above 3,300 feet, the decreased air density reduces transformer cooling efficiency. Contact Square D Company to verify the suitability of the unit for higher altitude application.

⚠ WARNING

FLAMMABLE INSULATING FLUID.

The insulating fluid in these transformers may be a flammable mineral liquid. Extra precaution must be taken when locating these transformers in close proximity to public thoroughfares or buildings.

Transformer failure can cause fire or explosion, resulting in severe personal injury or death and equipment damage.

Electrical Connections

Make sure all electrical connections are properly tightened and ensure there are no strains on the terminals that could cause loose connections. Prepare for expansion and contraction by using sufficiently flexible leads to avoid mechanical strains. The bushing can support a considerable weight, however, if cracked due to excessive strains, they must be replaced (contact Square D Company).

⚠ CAUTION

EQUIPMENT DAMAGE HAZARD.

- **Connect transformer in accordance with the wiring diagram on the transformer nameplate.**
- **Operate only at voltages shown. Failure to comply can result in transformer failure.**

Transformer failure can cause fire or explosion, resulting in severe personal injury or death and equipment failure.

⚠ WARNING

HAZARDOUS OPERATION.

Do not operate transformer with any phases open.

Unbalanced service voltages can cause single phasing of the load, resulting in severe personal injury or death and equipment damage.

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Grounding

⚠ DANGER

HAZARDOUS HIGH VOLTAGE.

Follow all applicable codes for grounding all equipment. Ensure proper grounding. Improper grounding can cause high voltage on the transformer tank and secondary terminals.

Failure to observe this precaution will cause shock or burn, resulting in severe personal injury or death!

Ground the transformer tank at all times. Windings and bushings must be de-energized and grounded except when electrical tests are being performed. Also, all liquid-handling equipment and vacuum pumps must be grounded to reduce the possibility of static discharges.

To ground the tank permanently, use ground pads or nuts at the base of the tank wall in both the high and low voltage compartments. A good permanent, low resistance ground is essential for adequate protection from the tank becoming momentarily energized by internal or external faults or lightning surges. Do not use cubicle hold-down bolts, cleats, or any other plug fitting to establish a tank ground.

High Voltage Bushing Connections

High voltage bushings are provided according to the job specification as either porcelain live-front with exposed metal eyebolt terminals (see Figure 4A) or as a molded dead-front (see Figure 4B). Lugs are not required to terminate the cable on a live front bushing. However, with the live front design and the use of shielded cable, a cable stress relief terminator kit must be installed on each high voltage cable. An elbow terminator kit must be installed on the cable to permit connection to the dead front bushing. On the dead front design, the elbow terminator kit includes the necessary cable stress relief. Installation instructions are provided with the terminator kits.

The one-piece integrated bushing is shipped with a red plastic protective cap that should be left in place until the transformer is energized to avoid dirt or moisture contaminating the internal bushing contact points. On an energized transformer, a ground cap must be plugged onto any unused bushing well or insert to avoid partial discharge and subsequent bushing damage.

The transformer diagrammatic nameplate (see Figure 3) illustrates the internal wiring and external marking of each bushing. Refer to the nameplate on the transformer for clarity on where to contact each incoming cable.

On live front designs, ensure adequate air clearances between all live parts in accordance with the latest ANSI Standard C57.12.22.

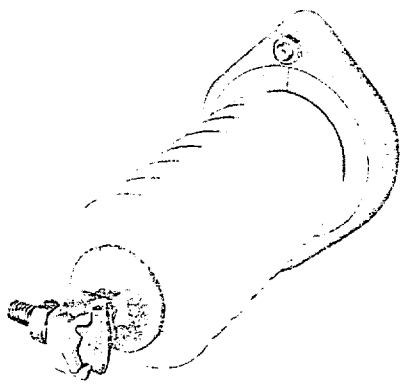

Figure 4A Live Front Porcelain HV Bushing (With Eyebolt Cable Terminal—No Separate Lugs Required)

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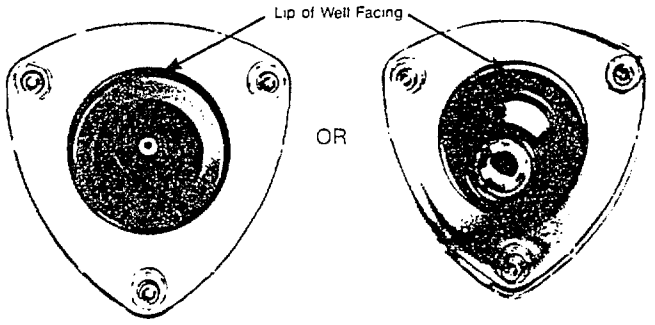
High Voltage Bushing Connections (continued)



Universal Bushing Well (Requires A Separate Insert)

One-Piece Integrated Bushing (Well And Insert Molded In One-Piece Construction

Figure 4B Dead Front Molded HV Bushing (Requires A Separate Elbows Terminator Kit For Each Cable)

Low voltage bushings through 600 volts (see Figure 2) are supplied with NEMA standard hole drillings and spacings but are not supplied with lugs. Lugs may be stacked or mounted on either face of the spade. A minimum one inch air clearance must be maintained between phase-to-phase ground live parts for 600 volts only.

OPERATION

Tap Changer Operation

⚠ DANGER

HAZARDOUS VOLTAGE.

Disconnect all power and verify transformer is de-energized before operating tap changer switch.

Failure to observe this precaution will cause shock or burn, resulting in severe personal injury or death!

A no load, de-energized, five-position tap changer is supplied as a standard accessory with each Square D transformer except dual voltage units. The tap switch is located in the high voltage compartment and is hand operated only. The source voltage must be disconnected before operating the switch to prevent damage to the transformer that could result in a safety hazard.

Before energizing or applying voltage to the transformer, turn the tap switch to the desired voltage position. Positions are marked A, B, C, D, and E and correspond to the primary voltages stamped on the transformer nameplate. The unit is shipped with the tap switch in the rated voltage position (normally position "C"). Each position changes the primary to secondary winding ratio as shown on the nameplate and can alter the secondary voltage by the increment shown. To raise the secondary voltage, move the tap switch to position D or E. To lower secondary voltage, move the tap switch closer to positions A or B.

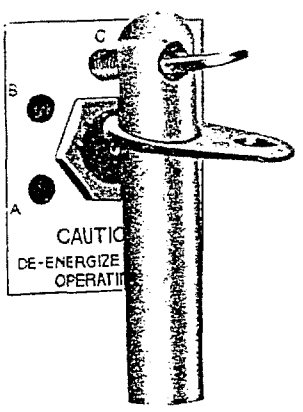


Figure 5 Tap Changer Handle

A common style of pad mount, tap switch handle is shown in Figure 5.

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Dual Voltage or Delta/Wye Switch Operation

⚠ DANGER

HAZARDOUS VOLTAGE.

- **Disconnect all power and verify transformer is de-energized before operating dual voltage switch.**
- **If dual voltage switch is in lower voltage position, check the nameplate to determine if a specific tap changer setting is required.**
- **Ensure fuses and lightning arrestors are properly sized for the voltage setting before energizing the transformer.**

Failure to observe these precautions will cause shock or burn, resulting in severe personal injury or death!

Transformers designed with dual voltage windings or reconnectable delta/wye windings as shown on the nameplate have a de-energized, two-position, dual voltage or delta/wye switch located in the high voltage compartment. Before hand-operating the switch, disconnect the source of voltage. Before energizing the transformer, ensure fuses and lightning arresters are the correct size for the particular voltage setting.

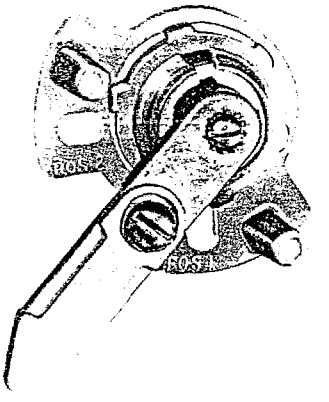

Figure 6 Dual Voltage or Delta/Wye Switch Handle

Load Break Switch and Fuse Operation

The following operating procedures are for switch and fuse devices that are supplied only if required by the specific job specifications.

Oil Switch Operation

If specified by design, a load break, gang operated, spring-loaded oil switch is supplied and located in the high voltage compartment. This type of switch is operated with an external hook stick handle. Depending on the design, this switch can be either a two-position (ON-OFF) switch for a radial fed transformer, or a three or four-position switch that provides sections for a loop or dual-fed transformer. The switching schematic is shown on the nameplate. Figure 7 shows one style of sectionalizing oil switch with four positions for a loop-feed application.

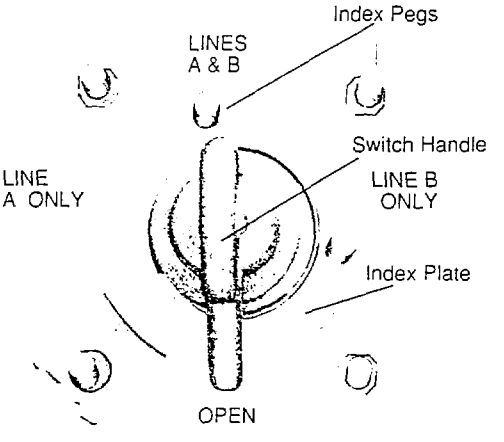

Figure 7 Four Position Oil Switch

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Elbow Terminator Operation

To operate this type of switch, apply a hook stick to the index plate and move the plate over the peg between the present setting and the desired new setting. This index plate prevents the switch from switching to more than 90°, or one position at a time. Next, apply the hook stick to the loop handle on the oil switch and turn it approximately 180° until the switch snaps into the next position.

The elbow terminator (shown in Figure 8A) is used in conjunction with dead front bushings only (Figure 4B). This eliminates the need for a cable stress relief kit and permits a completely dead front, visible disconnect operation. The elbow terminator is constructed of molded rubber and has a stainless steel reinforced pulling eye for convenient line tool operation. A hand grip "shot-gun" tool is recommended for this operation. Push the elbow terminator straight into the dead front bushing, insert to connect it, and pull out to disconnect it. The elbow, when properly installed, should be tightly secured over the circular lip of the well facing to avoid bushing damage. Consult Square D Company if the elbow terminator does not properly engage with the bushing. The voltage class of the elbow terminator and bushing must be identical to permit proper installation. Both load break and non-load break elbows are available. Load-break rated elbows are limited to 10 operations at maximum load conditions.

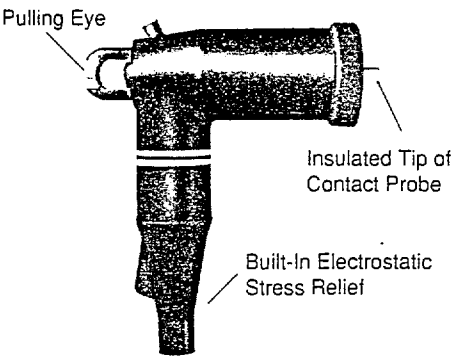

Figure 8A Dead Front Elbow Terminator

> **⚠ WARNING**
>
> EQUIPMENT DAMAGE HAZARD.
>
> **Unused dead front bushings that are energized through internal connections must be properly terminated with a grounding cap.**
>
> Improper termination of unused dead front bushings can cause a partial discharge, resulting in severe personal injury or death and equipment damage!

A parking bracket is supplied and located adjacent to the dead front bushing. (Figure 8B.) When supplied with a portable, stand-off parking bushing, the bracket provides a convenient storage location for the disengaged elbow.

Consult Square D Company for order and application information on the elbow, inserts, parking bushings, grounding caps, line tools, or any other related equipment.

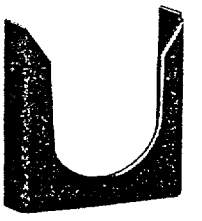

Figure 8B Parking Bracket

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Bay-O-Net Fuse Operation

The Bay-O-Net fuse is a dead-front, individual-phase disconnect device that is load-break rated and operated by a hook stick. This type of fuse is located in the high voltage compartment above the primary bushings. The Bay-O-Net fuse can be either an expulsion type or a full range current-limiting type fuse (Figures 9A and 9B). Before energizing, ensure the Bay-O-Net fuse is properly latched into place.

⚠ DANGER

HAZARD OF EXCESS AIR PRESSURE.

Release built-up air pressure in the tank before removing the fuse.

Failure to observe this precaution will cause shock or burn, resulting in severe personal injury or death!

Before removing the Bay-O-Net fuse, release excess air pressure in the tank to avoid spraying fluid out of the open holder. To remove the fuse, insert the hook stick into the operating hook, twist 90° to the unlatched position, and pull firmly until the entire fuse is removed. When the Bay-O-Net is inserted into its holder, the operating hook must be twisted 90° into the latched position.

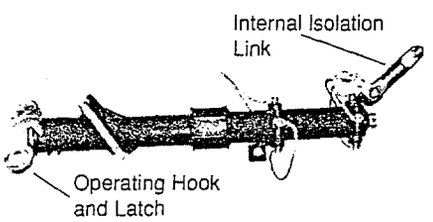

Figure 9A Bay-O-Net Expulsion Fuse and Holder With Isolation Link

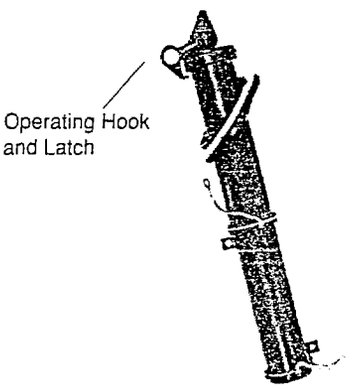

Figure 9B Bay-O-Net Current Limiting Full Range Fuse and Holder

To replace the fuse element, unscrew the fuse barrel located at the end of the cartridge holder. The Bay-O-Net fuse holder must be reinserted to avoid moisture contaminating the fluid.

If the internal isolation link on the expulsion-style Bay-O-Net fuse has opened due to a high fault, an internal inspection of the transformer fluid and core and coil is necessary before replacing the link. For inspection procedures, review "Safety Precautions" on page 4 and refer to "Inspecting" on page 7. See also, "Maintenance Procedures" on page 23 of this bulletin.

⚠ DANGER

HAZARDOUS VOLTAGE.

Operation of a primary protective device may be evidence of a faulted transformer. Do not re-energize the unit if any indication of a failure is evident.

Failure to observe these precautions will cause shock or burn, resulting in severe personal injury or death!

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Dry Well Canister Fuse Operation

The dry well canister is an fluid-tight, current-limiting fuse holder that extends under fluid into the tank above the high voltage bushings (see Figure 10).

The canister fuse normally supplied is a non-load, break-and-make, individually-phased fuse device. If required, the dry well canister is supplied in conjunction with a mechanical interlock to a load-break oil switchthat prevents removal of the fuse unless the switch is in the "OFF" or de-energized position (see "Oil Switch Operation" on page 14). When required, a load break-and-make rated canister is supplied. (Not available on all kVA sizes.)

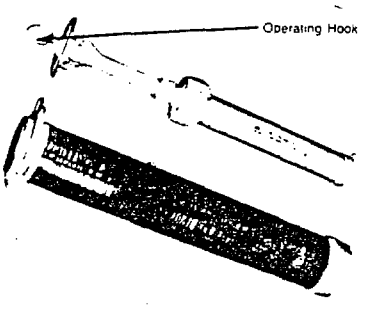

Figure 10 Canister Type Fuse

Arc-Strangler Switch Operation

To operate the non-load break canister, first ensure the service to the fuse is disconnected. Insert a line tool in the operating hook on the canister front plate and pull out firmly until the fuse is completely out of the dry well canister. To replace fuses, use set screws on each end of the fuse holder.

The Arc-Strangler is a 200 ampere hotstick-operated, load-break rated, individual-phase switch device. The Arc-Strangler may incorporate a full range, current-limiting fuse on the switch blade or, depending on design, may be tandem-mounted with a clip-style, current-limiting fuse (see Figures 11A, 11B, and 11C).

Figure 11A Arc-Strangler

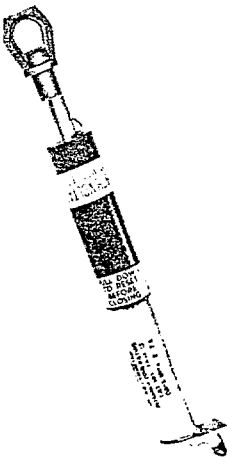

Figure 11B Fused Arc-Strangler

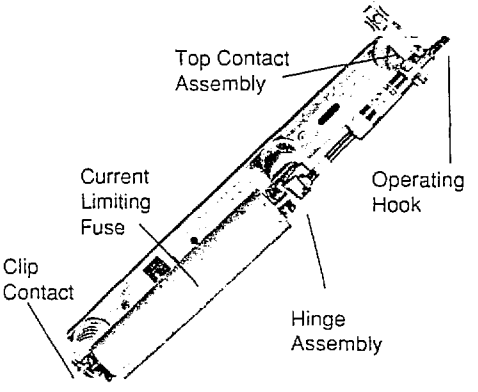

Figure 11C Arc-Strangler With Clip Fuse

To operate the switch, insert the switch stick in the operating hook and pull forward. The Arc-Strangler should swing open. To remove the Arc-Strangler, insert the switch stick in the hinge opening and lift up.

The top and hinge contact assemblies must be rigidly fasted to the insulators to prevent rotation and misalignment of the contacts. The contact spacings are set at the factory and normally do not require adjustment. If contact adjustment is ever required, consult Square D Company.

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Weak Link Fuses

When required by the design, weak-link expulsion-type cartridge fuses are supplied factory installed under fluid on a terminal block at the top of the internal core and coil assembly. (See Figure 12.) To replace these fuse elements, remove the tank cover (or maintenance hole cover, when included). Refer to "Removing and Replacing the Tank Cover" on page 24 of this bulletin for this procedure.

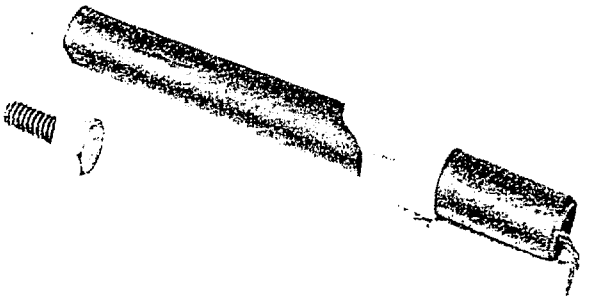

Figure 12 Expulsion Type Fuse

Inspection Following Energization

After energizing the transformer, check the following:

- Confirm no blue glow or partial discharge effect is present at the high voltage terminations.
- When a thermometer is included, confirm the proper liquid temperature. (Refer to "Dial Thermometer" on page 21 of this bulletin).
- Verify metering equipment has sufficient voltage range to measure secondary voltage listed on nameplate.
- Using a meter set to the proper range, confirm the proper secondary voltage by metering.
- Confirm no leaks are visible around bushing parts or weld seams.

⚠ DANGER

HAZARDOUS VOLTAGE.

Use extreme caution when measuring voltage on secondary terminals. Use properly rated metering equipment in accordance with nameplate.

Failure to observe these precautions will cause shock or burn, resulting in severe personal injury or death!

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MAINTENANCE

General

Normally, little maintenance work will be required. However, periodic inspections are necessary to detect problems with the unit that might eventually shorten the transformer life.

Never touch any energized or "live" parts inside the pad mounted transformer. Low voltage bushings are always exposed and within arms reach from the compartment opening. High voltage bushings and lightning arresters are exposed on live front designs and are also within arms reach of the compartment opening. Improper grounding can cause high voltage on the transformer tank and secondary terminals. Protective clothing, proper line tool equipment, and adequate experience with high voltage equipment and related safe work habits are essential to the safety of maintenance personnel.

Routine Inspection Schedule

The frequency of inspection should be determined by factors such as transformer size, application, and importance of service continuity as experience dictates. Also, local climatic and atmospheric conditions will influence the inspection schedule. Consider the following items in the inspection program.

Items to inspect:

- condition of metal surfaces
- cleanliness of bushings
- ground connection and resistances
- liquid temperature
- load amps and volts
- fluid leaks and liquid level
- fluid sample and tests
- pressure relief diaphragm or valve

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Maintenance of External Features

Exterior Finish

Periodically, check the tank and compartment exterior metal for rust spots, fluids and excess dirt build up, and any damaged areas. Clean rust spots down to the bare metal and repair with one primer coat and two finish coats of paint color Munsell No. 7.0GY3.29/1.5. Remove all fluids and excess dirt build up to maximize the tank wall and radiator cooling effectiveness. Inspect any continued build up of fluid to determine the presence of a fluid leak.

Correct damaged areas as necessary. Bent doors and sill parts can be replaced in the field. A few bent radiators will not significantly effect the transformers cooling efficiency or life. Major radiator or corrugate material damage must be repaired at the factory or at a qualified repair ship.

Hairline cracks or creases in the tank exterior can be field repaired by applying an epoxy patch or by welding. Depending on size or location of the damaged area, lowering the internal liquid level before the repair may not be necessary. Consult Square D Company for information on repair kits or specific welding applications.

Fluid Leaks

Liquid coolant leaks are rare, but if detected, must be repaired at once to avoid the liquid level dropping below energized parts, creating a possibility of flashover or tank overheating. If required, the transformer must be refilled to its proper operating level (refer to "Liquid Level Gauge" on page 21 and "Draining and Filling" the tank on page 23 of this bulletin).

Small pin-hole leaks in the exterior metal, weld seam, etc., that result in slow dripping can be repaired with a life-time durable epoxy patch kit. De-energizing the transformer is recommended while even working on the outside tank wall or radiators. Apply a temporary oil stick before the epoxy; this may eliminate the need for a vacuum pump to stop the fluid leak while the epoxy is curing. If a vacuum pump is used, the transformer must be de-energized first. Detailed instructions are included with the epoxy repair kit (see Figure 13).

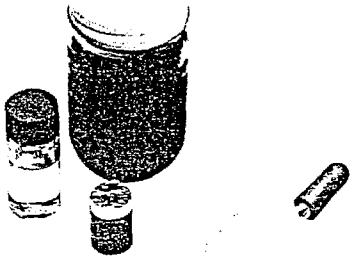

Figure 13 Epoxy Repair Kit

Welding of small leaks can also be accomplished in the field on de-energized transformers, although care must be taken to avoid penetrating the metal, thus creating a more serious leak. Welding on radiator metal is not recommended due to the thinner gauge material. To stop a leak during the welding process, apply a vacuum pump to the one inch filter press connection located inside the low voltage compartment.

Some bushing leaks at the tank wall may be corrected by tightening the external bushing clamp bolts. Verify that the bushing gasket material is aligned properly and that all clamping bolts are tightened evenly. If a leak is observed at the tip of a high voltage bushing, correct the leak by tightening the metal terminator part of the bushing.

⚠ CAUTION

EXCESSIVE TORQUE MAY CRACK BUSHING MATERIAL.

Do not exceed 40–60 inch–pounds torque on bushing clamp bolts or terminals.

Cracked bushing clamp bolts or terminals can result in personal injury or equipment damage.

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Electrical Connections

Cable terminals on high and low voltage bushing, if not initially tightened to the proper torque or if subjected to unusual stresses, can become loose over time and changing temperatures. Loose connectors, particularly on higher current, low voltage spades, can create overheating that results in permanent cable or bushing damage. Periodically check the terminals to ensure the cables are rigidly installed. Proper torque values are recommended by the connector manufacturer and are normally found printed on the lug carton or an accompanying instruction sheet.

Bushings

Inspect the bushing porcelain periodically and keep it free from dust and dirt. Locations with abnormal conditions such as sand storms, salt deposits, cement dust, acid fumes, etc., create special hazards. Regularly wipe clean the bushing and other porcelain insulation material to ensure the internal pressures, liquid level and temperature are within the design limits described in the following paragraphs.

Accessories (Optionally Supplied)

Maintenance accessories such as the liquid temperature and level indicators, pressure vacuum gauge, pressure relief valve and pressure relief diaphragm, and drain and sampler valve, require no maintenance except to be replace if accidentally damaged. Monitor each gauge regularly to ensure internal pressures, liquid level and temperature are within design limits described in the following paragraphs.

Dial Thermometer

The liquid temperature indicator is a dual-type precision instrument with an indicator pointer coupled to a bi-metallic element. The bi-metallic element fits into a sealed dry well located under the fluid level in the low voltage compartment. This device can be installed or removed easily from the dry well without exposing the transformer fluid.

The dial is calibrated in degrees centigrade and has a red maximum indicating pointer that shows the maximum temperature reached since the last resetting. The indicator pointer is reset by turning the middle knob on the dial face.

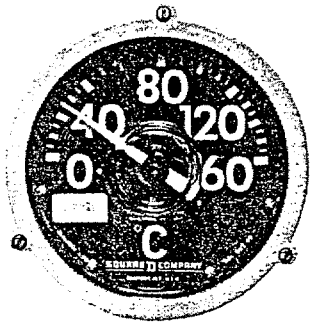

Figure 14 Dial-Type Thermometer With Maximum Temperature Indicator

Temperature limits for any specific condition of loading should be in accordance with ANSI C57.91, *Guide for Loading Immersed Distribution Transformers*. The maximum average value of temperature reading for any 24-hour period is 95°C and if this temperature is not exceeded, ensures a normal transformer life.

A variety of contact arrangements is available. Consult Square D for each specific application.

Liquid Level Gauge

The liquid level gauge is a precision dial instrument with the indicating pointer magnetically coupled to an internal float arm. The level gauge is located in the low voltage compartment at the normal 25°C fill line. This complete device including the gauge and float arm, can be installed or removed in the field, although removing the tank cover or hand hole may be necessary.

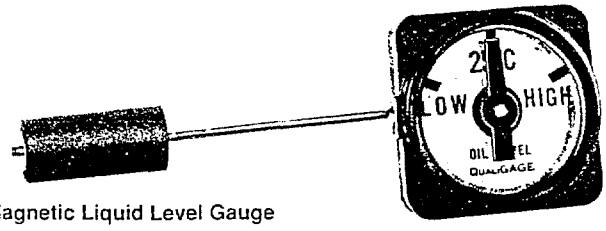

Figure 15 Magnetic Liquid Level Gauge

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Liquid Level Gauge (continued)

The liquid level rises and falls around the 25°C level mark depending on the ambient temperature and transformer loading conditions. On an energized transformer, a liquid level reading of "LOW" is *not* acceptable and may result in a dangerous flashover condition on internal parts. Refer to "Draining and Filling the Tank" on page 23 concerning filling the transformers with liquid coolant.

A liquid level reading of "HIGH" indicates an abnormally high level of fluid in the tank that is most likely a result of an abnormally high ambient temperature. If the reading does not return to normal when the ambient temperature is reduced, consult Square D Company.

If contacts are provided, they operate when the liquid level drops to the "LOW" setting or below. Contact Square D for each specific application.

Pressure Vacuum Gauge

The pressure vacuum gauge is a dial-type precision instrument calibrated in pounds per-square-inch (psi) and has a dial reading of ±10psi maximum. This gauge is located in the low voltage compartment near the top above the liquid level. To install or replace the gauge, tighten or loosen the gauge from its pipe fitting support.

The internal air pressure varies with the liquid level and ambient conditions. Pressure readings between ±5psi are considered normal as long as there is some variation of readings between changing liquid levels or ambient temperatures.

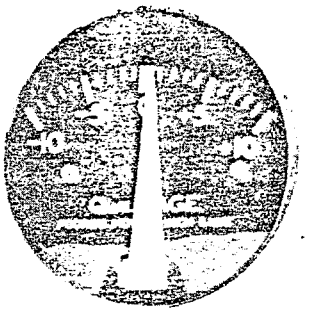

Figure 16 Pressure Vacuum Gauge

A "flat" or unchanging pressure reading indicates a defective gauge or a pressure leak. A pressure leak must be corrected to avoid intake of external moist air. This condition, over time, can destroy the dielectric strength or insulating properties of the liquid coolant. Refer to "Locating and Repairing Pressure Leaks" on page 23 of this bulletin for more detail on finding and correcting a pressure leak. Pressure in excess of ±5psi can be lowered by releasing the relief valve.

Pressure Relief Valve

The relief valve is located in the low voltage compartment near the top above the liquid level. The device is threaded into the tank wall to facilitate installation and removal. The valve automatically opens on a build up of internal tank pressure of 9–11psi. Once pressure is relieved, the device automatically resets. To manually relieve internal pressure, catch the valve pull ring with a hook stick and pull gently.

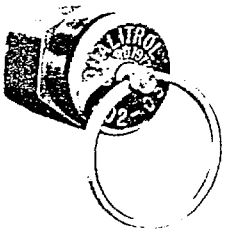

Figure 17 Pressure Relief Valve

Drain Valve with Sampler

The one inch drain valve and drain plug with a side-mounted 3/8 inch sampler fitting is located at the bottom of the tank wall in the low voltage compartment. Replacing or adding this valve to a tank filled with liquid is possible although not recommended. Consult Square D for this procedure. See "Draining and Filling the Tank" on page 23 for instructions on how to sample and drain liquid from the tank.

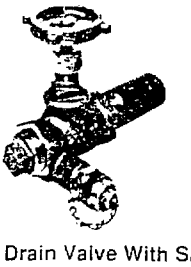

Figure 18 Drain Valve With Sampler

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Maintenance of Internal Features

General

The transformer normally requires no internal maintenance throughout its life except for periodic sampling of the liquid coolant. The unit is shipped from the factory with the tank pressure sealed. If inspection or repair of internal tank parts is necessary, then care must be taken to reseal the openings properly on completion of the work.

Locating and Repairing Pressure Leaks

Each transformer is pressure tested at the factory to ensure a pressure-tight seal and prevent moisture from contaminating the liquid coolant. Review "Internal Inspection" on page 8 for instructions on how to initially inspect the transformer and verify the pressure seal. If the seal is broken due to mishandling or other adverse conditions, locate the leak and repair as follows:

1. Apply nitrogen through the filling hole in the low voltage compartment.
2. Apply a solution of soap and glycerin to all seams and joints above the liquid level.

   As the pressure rises up to +5psi, any bubbling of the soap solution pinpoints the location of a pressure leak.
3. Patch the leak by conventional means such as tightening devices at the point of the leak, applying epoxy patches, or welding.

Sampling the Fluid

When sampling the fluid, use a clean, dry, dark glass bottle or jar that holds at least a quart and has a cork stopper. Do not use rubber stoppers or sealing lids with rubber gaskets. Wash the bottle with non-leaded gasoline. Then, wash again with a strong soap solution. Finally, rinse the bottle with distilled water and dry completely.

Flush out the drain and plug by opening the drain valve or plug and releasing a small amount of liquid coolant. Take a quart sample of the liquid, leaving space in the jar for expansion. Seal the jar and forward it to the nearest facility for testing in accordance with ANSI standards.

Testing should include the following: dielectric strength (must be 26kV or higher), acidity, color, interfacial tension, density, and sediment.

Draining and Filling the Tank

Only qualified personnel should drain and fill the transformer tank. If draining or filling the tank is necessary, take precautions to avoid contaminating the stored fluid. Use only chemically-cleaned dry barrels or storage containers. The service work must be performed in a dry environment. Before opening storage containers, allow them to reach ambient temperature to avoid condensation. Use only hoses and fittings that are oil resistant to avoid sulphur contamination.

Drain the tank into the storage containers from the drain valve and plug. While draining, remove the fill plug to equalize tank pressure. Properly seal the storage containers when filled.

Before refilling the tank, all fittings must be tightly sealed. The tank can be filled through the upper fill plug, or to avoid aeration of the fluid, through the bottom drain valve and plug. When filling the tank, remove the liquid level plug to observe when the proper fill level is reached and to provide venting. Use of a filter is recommended when filling to ensure the fluid is free of moisture, air, or solid contaminates. After this procedure, test the fluid quality and tank pressure seal.

Tank covers are welded on with a bolted maintenance hole cover. Regardless of the cover style, do not allow moisture or other contaminants to enter into the tank fluid or internal parts.

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Removing and Replacing the Tank Cover

Review "Inspecting" on page 7 of this bulletin before removing the tank cover. To remove the maintenance hold cover, first remove the nuts holding it in place, then lift it off the weld studs attached to the tank top. The gaskets are made of resilient nitrile material that does not require replacement. Before replacing the cover, clean the contact surfaces of both the gasket and cover. Align the cover to the tank and tighten the bolts evenly to 40–60 inch-pounds of torque. After this procedure, test the tank pressure seal.

Welded covers can be removed and reinstalled in a repair shop by qualified personnel. Consult Square D Company for this procedure.

TRADEMARKS

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PLEASE NOTE:

Electrical equipment should be serviced only by qualified electrical maintenance personnel, and this document should not be viewed as sufficient instruction for those who are not otherwise qualified to operate, service or maintain the equipment discussed. Although reasonable care has been taken to provide accurate and authoritative information in this document, no responsibility is assumed by Square D for any consequences arising out of the use of this material.

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Molded Case Circuit Breakers

Square D molded case circuit breakers are designed and manufactured as totally sealed units requiring minimal periodic maintenance.

Exercise circuit breakers periodically to ensure proper operation. This period should not exceed one year.

1. **General maintenance:**
   A. Manually open and close the circuit breaker two or three times.
   B. Trip the circuit breaker by pushing the yellow *Push To Trip* button located on the face of the circuit breaker (figure 17). This tests alarm switches if they are built into the circuit breaker, or electrical interlocks between two circuit breakers. This also exercises the trip mechanism, ensuring proper operation.

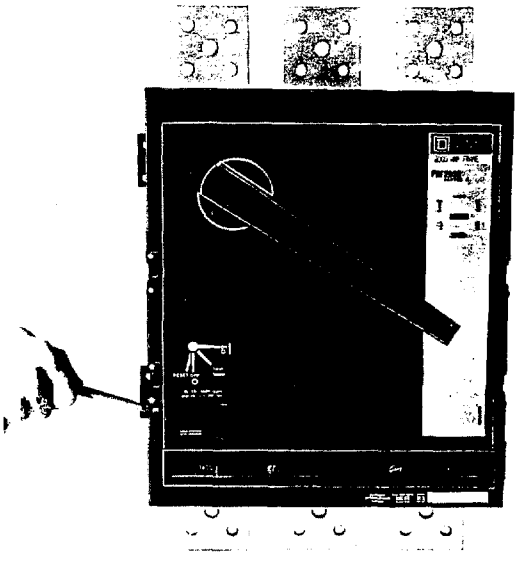


Figure 17: Molded Case Circuit Breaker

NOTES:

- Square D Bulletin #SD 363, *Field Testing Industrial Molded Case Circuit Breakers*, provides more information. Contact your local Square D field office to obtain this bulletin.
- See the individual circuit breaker instruction manuals shipped with the switchboard for additional maintenance information, such as changing rating columns or adjustable settings and removing circuit breakers. If the instruction manual is not available, see pages 31–32 of this manual for the appropriate number, and contact your local Square D distributor to obtain this manual.

Molded Case Circuit Breakers (cont.)

DANGER: Hazard of electrical shock or burn.

- If circuit breaker settings are adjusted, do not set the long time trip rating at a higher ampacity than the rating of the bus bar or load cables it supplies; overheating can occur. See the label attached to the circuit breaker for the maximum rating.
- Before energizing the switchboard, all unused I-LINE breaker mounting spaces ***must*** be filled with blank fillers and/or extensions as listed below.

Breaker Mounting Blank Fillers & Extensions		
	Height (Inches)	**Catalog Number**
Blank Fillers	1.5 4.5	HNM1BL HNM4BL
Blank Extensions	1.5 4.5	HLW1BL HLW4BL

CAUTION: Hazard of equipment damage.

Do not remove the protective lubricant on the jaws. If additional lubrication is required, apply a coating of electric joint compound, catalog number PJC-7201, to the jaw contact surfaces.

2. The universal test set, catalog number UTS, is available to test all Square D circuit breakers equipped with MICROLOGIC® trip units. It runs trip unit tests automatically, with prompts to the user for initial information. Test modules for each breaker frame are used to store data necessary for automatic tests. MICROLOGIC trip units require test module CBTM4, which is included in UTS.

   Tests can be conducted with a breaker installed in the switchboard; breaker removal is not required.

QMB Fusible Switches

Refer to the QMB instruction manual for complete maintenance information. If the instruction manual is not available, see pages 31–32 of this manual for the appropriate number. Contact your local Square D distributor to obtain the manual.

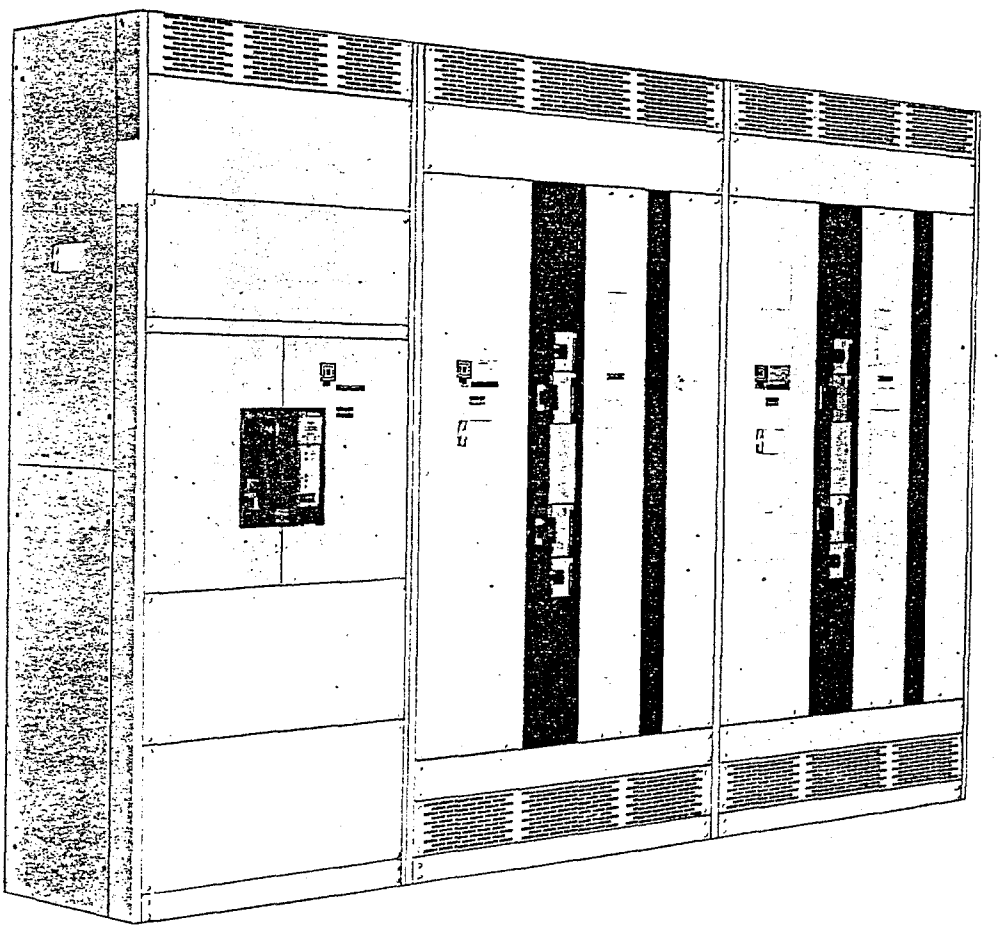
1. Switch Maintenance:
   A. Periodically exercise the switch to ensure proper operation. This period should not exceed one year.
   B. Check the cover interlock with the switch on. The cover should not open using normal hand force.
   C. Inspect the switch interior for any broken or cracked parts and replace as necessary.
   D. Check the fuse mounting clips or bolted contact area for corrosion or discoloration (indicating overheating). Replace them if necessary.
   E. For additional maintenance instructions, see the inside of the cover door.

2700IM9103
July, 1991
Replaces Manual 2700-1 Rev A
Dated Septem

Instruction and Maintenance Manual

POWER-STYLE®

QED Switchboards



SQUARE D

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NOTICE

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this manual to warn of potential hazards and to call attention to additional information which clarifies or simplifies a procedure.

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

The addition of this lightning bolt symbol to a "DANGER" or "WARNING" notice indicates the danger of a potentially fatal high-voltage electrical shock if instructions are not followed.

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

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

NOTE: Provides additional information to clarify or simplify a procedure.

Work on this equipment must be performed by qualified personnel who have training in the operation and maintenance of electrical power systems. Work on these devices requires training and experience with high capacity circuits and equipment and an understanding of the hazards involved.

FEDERAL COMMUNICATIONS COMMISSION
RADIO FREQUENCY INTERFERENCE STATEMENT

WARNING: This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for Class A computing devices pursuant to Sub-part J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

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SECTION 1—INTRODUCTION

This manual contains instructions for the proper installation, operation, and maintenance of POWER-STYLE® QED switchboard equipment manufactured by Square D Company. The purchaser's engineering, installation, and operating staff supervisors should familiarize themselves with this manual and become acquainted with the appearance and characteristics of each piece of equipment mounted or contained in the switchboard.

These instructions and procedures apply to all Square D switchboard installations. When special features or non-standard components are incorporated in the switchboard, detailed instructions for these components are included in the instruction material holder.

Every POWER-STYLE switchboard is carefully inspected and packaged at the assembly plant. Construction is checked, both structurally and electrically, for compliance with all specifications, codes, and standards. After a complete inspection, the switchboard is prepared for shipment. **Each section is shipped separately** for easier handling prior to installation. The factory order number, an identification number, and the shipping weights are plainly marked on each shipping section. A list of the contents of each section is included with the shipping papers.

SECTION 2—SAFETY PRECAUTIONS

DANGER: Hazard of bodily injury or equipment damage.

- Only qualified persons familiar with the construction and operation of switchboards should perform work described in this set of instructions. Such work should be performed only after reading this complete set of instructions.
- The successful operation of switchboards is dependent upon proper handling, installation, operation, and maintenance. Neglecting fundamental installation and maintenance requirements may lead to personal injury, as well as damage to electrical equipment or other property.
- Follow safety related work practices, as described in NFPA 70E, part II, at all times.
- 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.
- Hazardous voltages in electrical equipment can cause severe personal injury or death. Unless otherwise specified, inspect and perform preventive maintenance only 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.
- Some types of electrical equipment will cause harmonics in the electrical system which may result in overheating. Consider this condition when determining switchboard loading, as possible de-rating of equipment may be necessary.

SECTION 3—INITIAL SWITCHBOARD PREPARATION

Receiving

Upon receipt, check the packing list against the equipment received to ensure the order and shipment are complete. Claims for shortages or other errors must be made in writing to Square D within 30 days after receipt of shipment. Failure to do so constitutes unqualified acceptance and a waiver of all such claims by the purchaser.

Also upon receipt, immediately inspect switchboard sections for any damage which may have occurred in transit. If damage is found or suspected, file a claim with the carrier immediately and notify the nearest Square D Company representative. Delivery of the equipment to a carrier at any of the Square D plants or other shipping point constitutes delivery to the purchaser and, regardless of freight payment, title and all risk of loss or damage pass to the purchaser at that time.

Handling

Properly handle the switchboard to avoid injury to personnel and damage to equipment. Have equipment adequate for handling the switchboard available at the installation site. *Verify the lifting capacity of the crane or other equipment available.* The shipping weight of each shipping section is marked on the packing list.

When lifting straps are provided, Square D recommends using the straps to handle the switchboard. This method and alternative handling methods are discussed in this section.

1. HANDLING WITH LIFTING STRAPS

Square D provides lifting straps as standard equipment when a switchboard shipping section's weight does not exceed 2400 lbs. Instruction labels on each shipping section include drawings and written instructions outlining the proper use of the lifting straps (figure 1). Use rigid spreaders or a spanner bar to provide vertical lift on the lifting straps. This will avoid damaging the frame or finish.

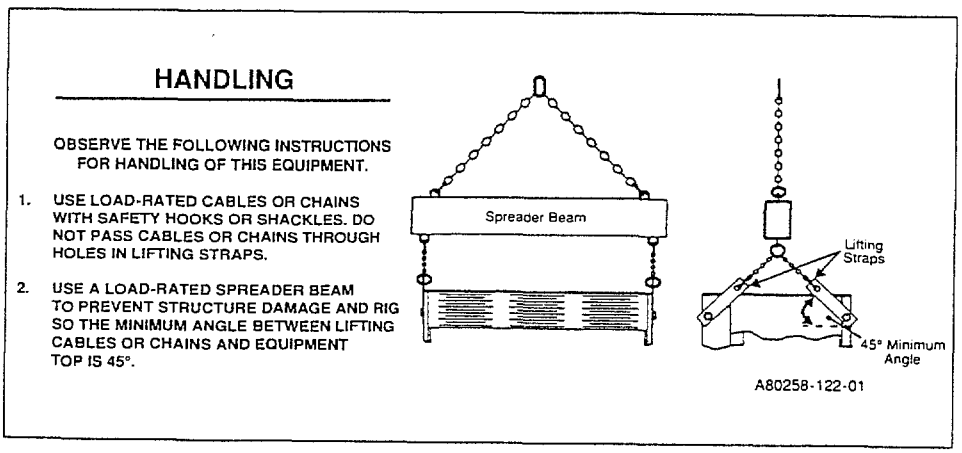

Figure 1: Lifting Methods

Handling (cont.)

Rainproof switchboards: To prevent damage to the drip hood and the door, use care when handling the section with lifting straps. Both the left and right top caps must be removed before rotating lifting straps into position for lifting.

> **CAUTION: Hazard of equipment damage.**
>
> Do not lift the switchboard from the front edge as sheet metal damage may occur. The label below (figure 2) is attached to the front of the switchboard for additional warning.

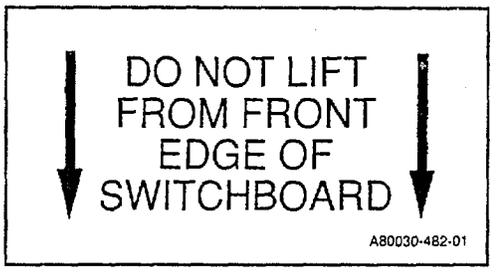

Figure 2: Warning Label, Rainproof Switchboards

2. HANDLING WITHOUT LIFTING STRAPS

Lifting straps are not furnished on shipping sections weighing over 2400 lbs. Rollers, slings, or other means must be used to handle the shipping section. The label below (figure 3) is affixed to each of these sections.

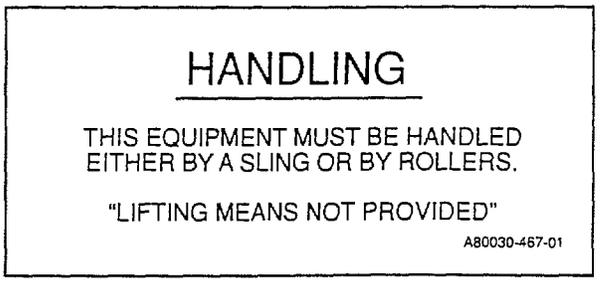

Figure 3: Warning Label, Switchboards Without Lifting Straps

When elevating a shipping section not equipped with lifting straps to another level, a crane equipped with chain arranged in a sling, or wire cable with safety hooks and shackles can be used. Wrap the sling completely around the switchboard and shipping stringers as shown in figure 4.

A forklift truck is an alternate method of handling the switchboard. *Always check the fork lengths to ensure that the forks extend under the entire switchboard. Carefully balance the load and always use a safety strap when handling or moving a switchboard with a forklift (figure 5).*

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Handling (cont.)

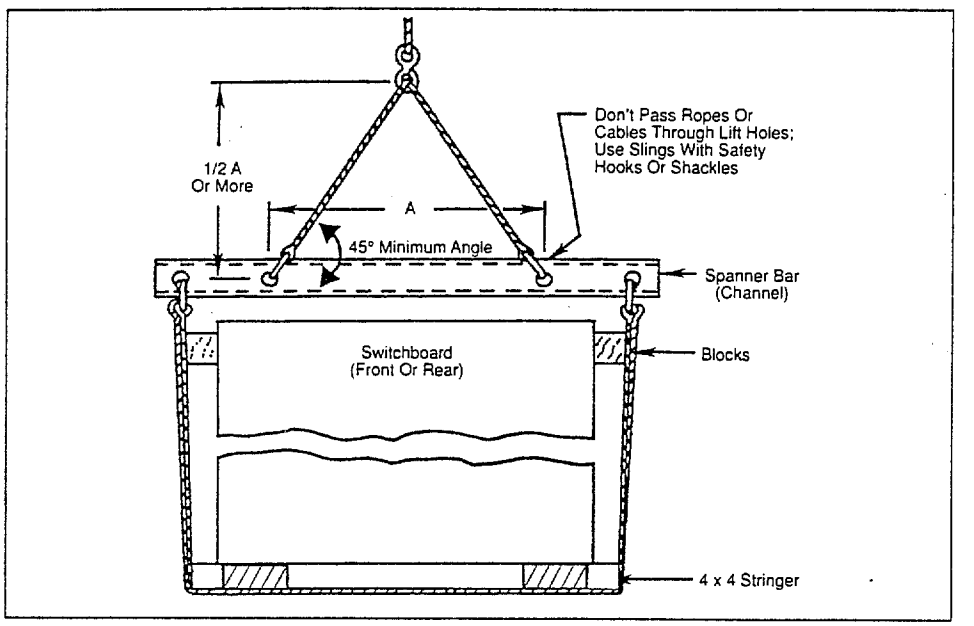

Figure 4: Switchboard In Sling Rigging

CAUTION: Hazard of equipment damage.

Steady the shipping section to prevent tipping.

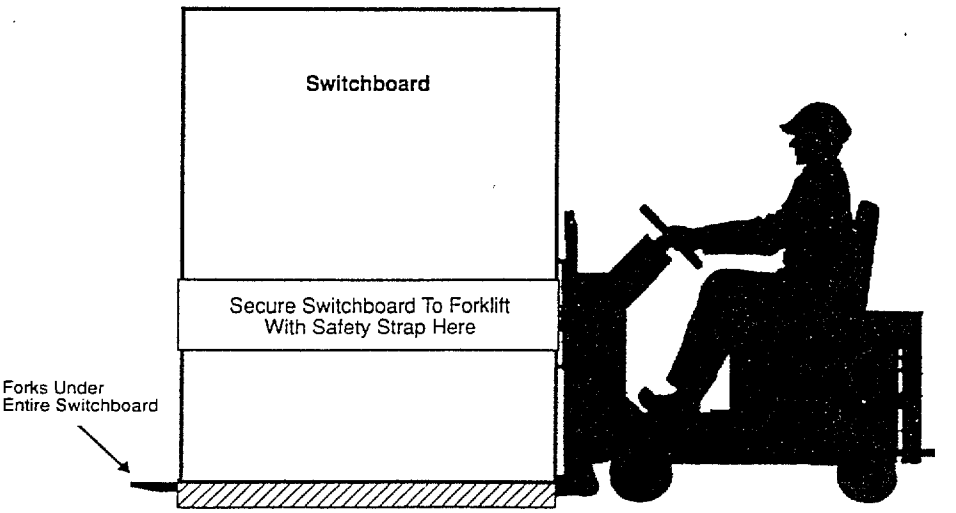

Figure 5: Forklift Safety Strap

Storage

When storing the switchboard prior to installation, replace the packing for protection during that period. Where conditions permit, leave the packing intact until the switchboard is at its final installation site. If the switchboard is at a construction site and its packing is removed, cover the top and openings of the equipment during the construction period to protect the switchboard from dust and debris.

Store the switchboard indoors if at all possible. Storing the switchboard outdoors may cause harmful condensation inside the switchboard. It is mandatory **that portable electric heaters of approximately 250 watts per vertical section be installed in both indoor-type and rainproof-type switchboard enclosures for adequate protection.** Before energizing the space heaters, remove all loose packing or flammable materials inside the switchboard. Cover the indoor-type enclosure with a tarp or plastic to keep out rain and dust.

SECTION 4—INSTALLATION

Proper installation of POWER-STYLE QED Switchboards is essential to proper operation of all switchboard components. Study the associated instruction books and all drawings carefully. In most cases, all drawings are sent to the purchaser before a switchboard is shipped to enable adequate advance planning.

Location

Find the designated area on the building floor plan where the switchboard will be installed. If this area is not specified, the location chosen for installation should provide working clearances complying with article 110-16 of the National Electrical Code. Front-accessible switchboards require that field connections including mains, branches, ground bus, and neutral bus are accessible and maintainable from the front. Equipment drawings identify switchboards requiring rear access.

For damp indoor locations, shield the switchboard to prevent moisture and water from entering and accumulating.

Foundation Preparation

The floor or foundation must be strong enough to support the weight of the switchboard without sagging. A concrete floor is preferred, with a level mounting pad raised about two or three inches above the general floor level. The surrounding floor area should gently slope toward a drain.

POWER-STYLE QED Switchboards are assembled on true and level floors at the assembly plant. Therefore, to assure correct bus bar alignment, it is imperative that the mounting pad or final installation site is smooth and level. If parallel steel floor channels will be imbedded for mounting the switchboard, take extra care to ensure the floor channels are level over their entire length to avoid distortion of the switchboard structure. Each channel should be level with the finished floor.

When pouring the foundation, make provisions for conduits entering the switchboard from below and carrying the main cables, control wiring, and ground cable. The bottom view in the equipment drawing shows the available conduit area for correct layout. Conduits should project above the finished floor approximately two inches. However, to simplify moving the shipping sections into place, install the conduits flush with the concrete and, after the sections are in their final position, add the appropriate extension sleeves. Otherwise, raising the shipping section on timbers or lifting it by a crane to clear the conduit hubs will be necessary.

Before pouring the foundation, consider installing additional conduits for future circuits.

Switchboard Preparation

After the switchboard has been moved to its final installation site, take each shipping section off its shipping stringers. Remove all packing materials. If the switchboard is equipped with a bottom closure plate in each vertical section, remove these and temporarily set them aside.

General Installation Instructions

Install the switchboard into its final position by progressively leveling each section and bolting the frames together, if separated. After installation is complete, make the through bus splice connection. Details on positioning, joining, and anchoring the switchboard are as follows:

Positioning Shipping Sections

1. Before moving the switchboard into final position, clean dirt and debris from the foundation and surrounding area.
2. Maneuver each shipping section into the desired position using the procedures under "Handling" (pages 3–5).
3. Carefully lower the section over the conduit stubs to comply with the "available conduit area" as shown in the bottom view of the equipment drawings. Otherwise, there may not be sufficient cable bending space to allow proper clearance to other live parts.
4. Level the shipping section.

DANGER: Hazard of bodily injury or equipment damage.

Adjacent shipping sections must be leveled and aligned with one another. Poor alignment of the horizontal main through bus and improper splice bus connections can result in an electrical explosion and/or fire.

Joining Shipping Sections

OUTDOOR SWITCHBOARDS

1. Remove the center top cap (figure 6) from the left hand section and retain all hardware for re-use.
2. When possible, open or remove the front and rear doors and panels, providing access for bolting adjacent shipping sections together.
3. Remove three 1/2" diameter knockouts from the front vertical corner channel and three from the rear vertical corner channel (a total of six per frame side) as indicated by arrows in figure 6.
4. Position each adjacent section, carefully leveling it and aligning it with the previous section. If lifting straps are provided, completely remove the straps from the sides being bolted together so the sections can be joined flush. (Note: Leave the other lifting straps on the switchboard if their removal is not required to join adjacent sections flush).
5. Six 3/8–16 x 1 bolts are provided. Place them through the holes created in step 3 to join adjacent sections.
6. Replace the center top cap removed in step 1.
7. Replace and secure the front and rear doors and panels removed in step 2.

Joining Shipping Sections (cont.)

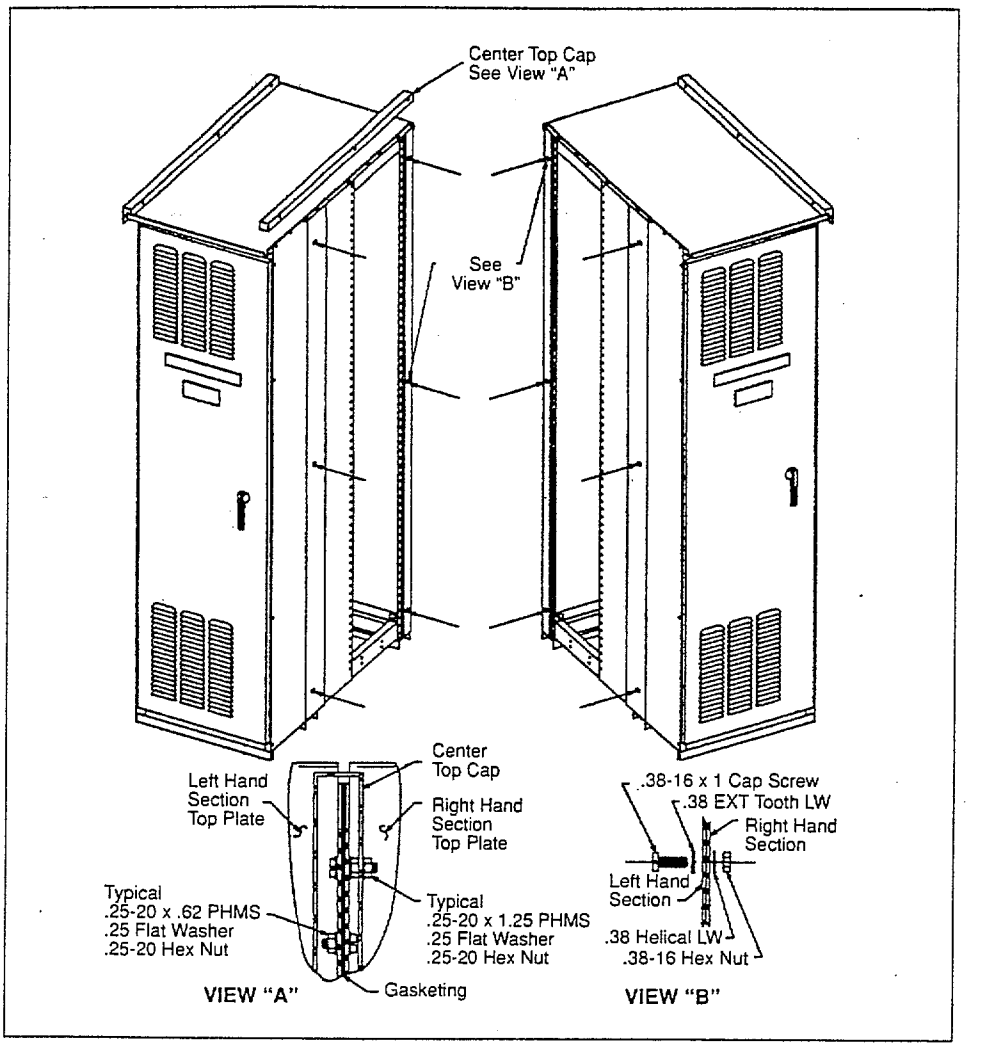

Figure 6: Joining Adjacent Sections—Outdoor Switchboards

INDOOR SWITCHBOARDS

1. Position each adjacent section, carefully leveling it and aligning it with the previous section. If lifting straps are provided, completely remove them from the sides being bolted together so the sections can be joined flush. (Note: Leave the other lifting straps on the switchboard if their removal is not required to join adjacent sections flush.)
2. When possible, open or remove the front and rear doors and panels, providing access for bolting adjacent shipping sections together.
3. Six 3/8–16 x 1 bolts are provided. Place them through the existing holes in the front and rear vertical corner channels to join adjacent sections (figure 7).
4. Replace and secure all front and rear doors and panels removed in step 2.

Joining Shipping Sections (cont.)

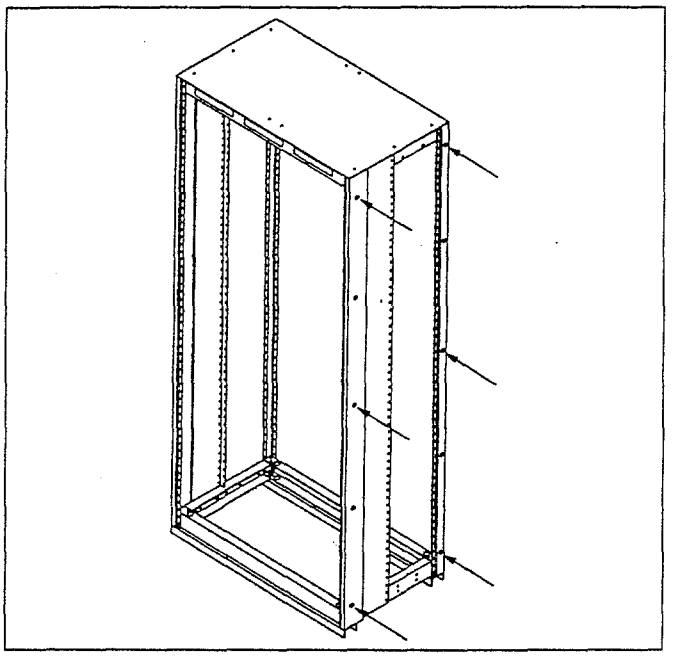

Figure 7: Indoor Switchboards

Anchoring The Switchboard

Although sections are free-standing, a hard bump or shifting movement can result in damage to the splice joints between sections and conduit hubs connected to the sections. Therefore, each vertical section must be anchored to the floor.

Formed steel base channels run the width of the shipping section. The channels have 1-1/8" diameter holes for fastening the section to the floor (figure 8). Anchor each section to the floor with 3/4" bolts with flat washers and expansion anchors (not furnished).

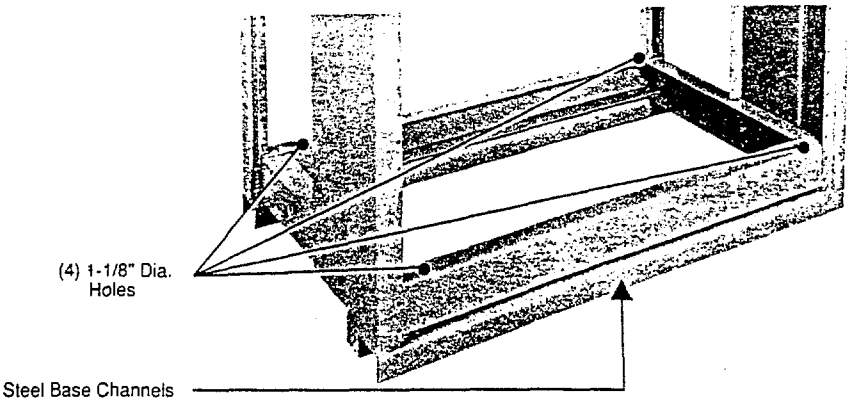

Figure 8: Switchboard Base Channels

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Anchoring The Switchboard (cont.)

After all switchboard sections are properly joined together and the entire structure is bolted to the floor, install the incoming service conductors and load side cables.

Through Bus Splice Connections

NOTE: If the switchboard consists of only one shipping section, proceed to Grounding And Bonding procedure on page 12.

Through bus splice kits with installation instructions sheets are provided for each shipping split.

DANGER: Hazard of electrical shock or burn.

Do not install through bus splice connectors with the switchboard energized. Energized equipment will expose personnel to hazardous voltages which can cause severe personal injury or death.

If fully insulated through bus bars are furnished in the switchboard (they will be wrapped with a black protective insulating material), the splice connections must also be insulated.

Ground Bus Splice Connections

Align and secure the ground bus splice connection between shipping sections. Torque connections to 100 in lbs (figure 9).

NOTE: Proper installation is essential for safe and proper operation of ground fault protection systems (when provided).

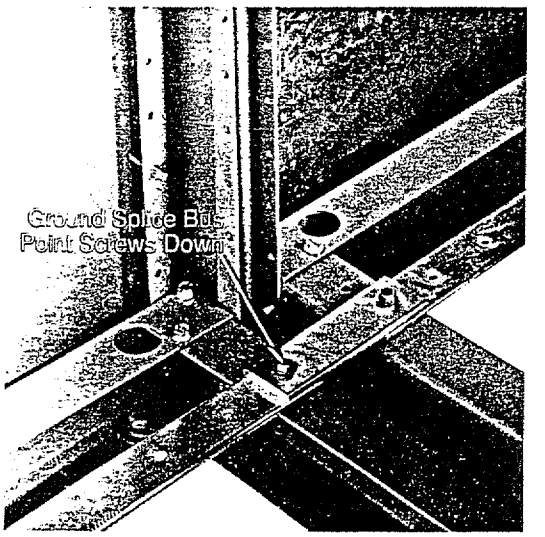

Figure 9: Ground Bus Splice Connection

Grounding And Bonding

1. For grounded systems used as service equipment or as a main switchboard on a separately derived system, follow the steps below:

   A. Run a grounding electrode conductor from the grounding electrode at the installation site to the ground lug located on the switchboard ground bus (figure 10). Select the proper material and size the grounding electrode conductor to comply with sections 250-91(a) and 250-94 of the National Electrical Code. Install the grounding electrode conductor as specified in section 250-92(a) of the National Electrical Code.

   B. Install the main bonding jumper between the neutral bus and the ground bus (figure 11). ~~Refer to Table 1 (page 29)~~ for torque values.

> NOTE: If the switchboard is fed from multiple sources (for example, double-ended systems), there are two or more main bonding jumpers to install.

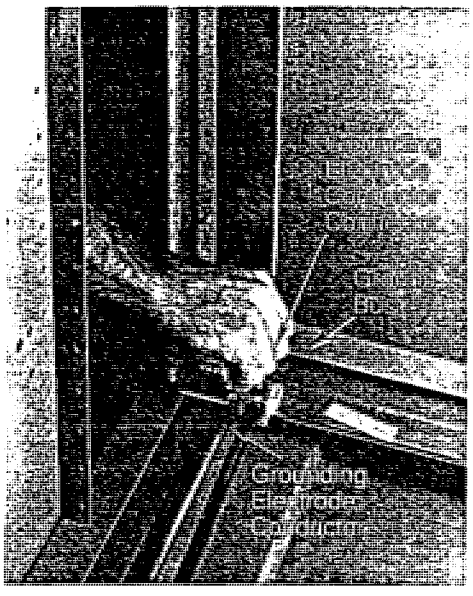

Figure 10: Grounding Electrode Connector

Figure 11: Main Bonding Jumper

2. For ungrounded systems used as service equipment, or as a main switchboard on a separately derived system, follow the steps below:

   A. Run a grounding electrode conductor exactly as described in part 1-A of the Grounding And Bonding section above.

   B. If the system is grounded at any point ahead of the switchboard, the grounded conductor must be run from that point and connected to the ground bus as described in paragraph 250-23(b) of the National Electrical Code.

3. For a switchboard not used as service equipment or as a main switchboard on a separately derived system:

   A. Use equipment grounding conductors sized according to paragraph 250-95 of the National Electrical Code to ground the switchboard frame and ground bus to the service ground.

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Busway Connections

Square D switchboards are manufactured with two different styles of busway connections. Qwik Flange is used on indoor switchboards only.

The second style of busway connection is the "dummy" flanged end. This style is used on some indoor switchboards, but primarily on outdoor units. If the connection for busway is required, the busway "dummy" flanged end must be removed. However, the switchboard can be energized with this flanged end in place.

The following section describes installation procedures for Qwik Flange and "dummy" flanged end.

1. QWIK FLANGE BUSWAY CONNECTION-UL TYPE 1 (INDOOR) ONLY (figures 12, 13).

DANGER: Hazard of electrical shock or burn.

Turn off all power supplying the switchboard or busway before installing connections.

A. Remove the insulating cover from the switchboard.

B. Slip the busway joint into the switchboard connectors.

C. Check joint bolt alignment; the centerline of the joint bolt to switchboard surface should be 0.95" as shown in figure 12 below.

D. Attach the side closing plates using two 5/16" bolts. Make sure the insulator on the side closing plates slides into the opening in the switchboard. Properly aligned, the holes in the side closing plates will align with the holes in both the switchboard and busway.

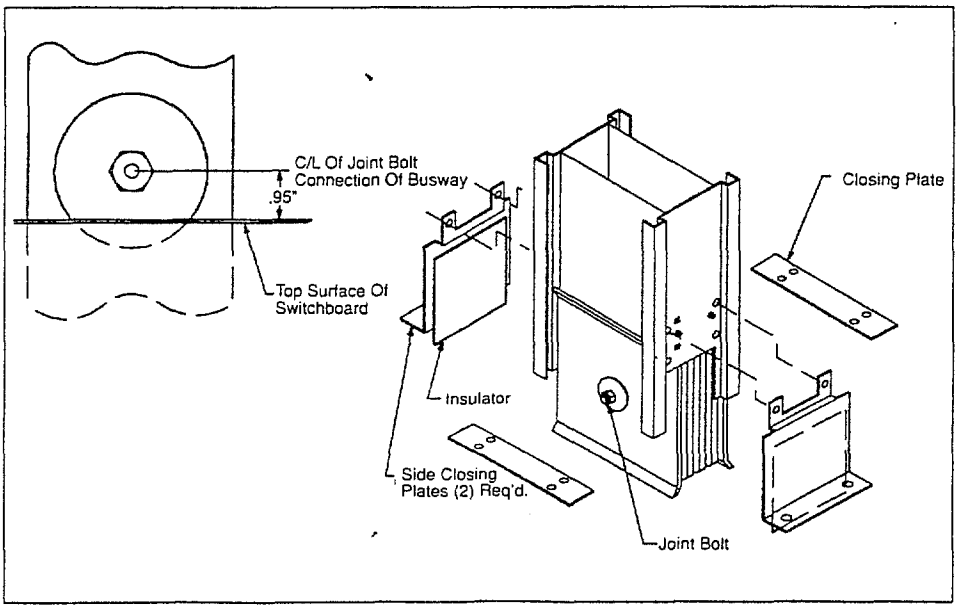

Figure 12: Qwik Flange Installation

Busway Connections (cont.)

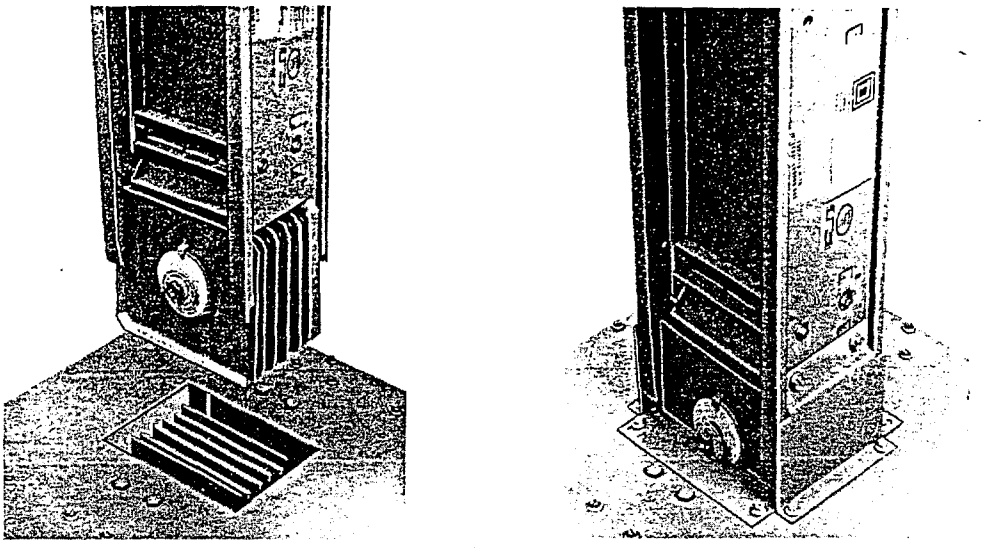

Figure 13: Qwik Flange

E. Use an 18" or longer wrench to torque the joint bolt until the break-away head twists off. **Do not let the break-away bolt head or red warning disc drop into the switchboard.**

F. Slip the remaining two small covers into position by aligning with the holes in the switchboard. Use four 1/4–20 screws to secure.

2. BUSWAY CONNECTIONS: UL TYPE 1 (NON-QWIK FLANGE) AND UL TYPE 3R (figure 14).

If this style of connection for busway is furnished, the busway "dummy" flanged end must be removed before installing busway.

DANGER: Hazard of electrical shock or burn.

Turn off all power supplying the switchboard or busway before installing connections.

A. From inside the switchboard, remove the 1/2" bolts that fasten the switchboard bus to the busway dummy masonite flanges.

B. Remove all screws securing the busway dummy flanged end to the switchboard enclosure.

C. Remove the busway dummy flanged end.

D. Install the actual busway flanged end to the switchboard bus connectors provided in the switchboard (figure 14). Insert the flanges between the switchboard bus connectors so that the mounting holes in the collar of the flanged end are aligned with the pre-drilled holes in the switchboard enclosure.

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Busway Connections (cont.)

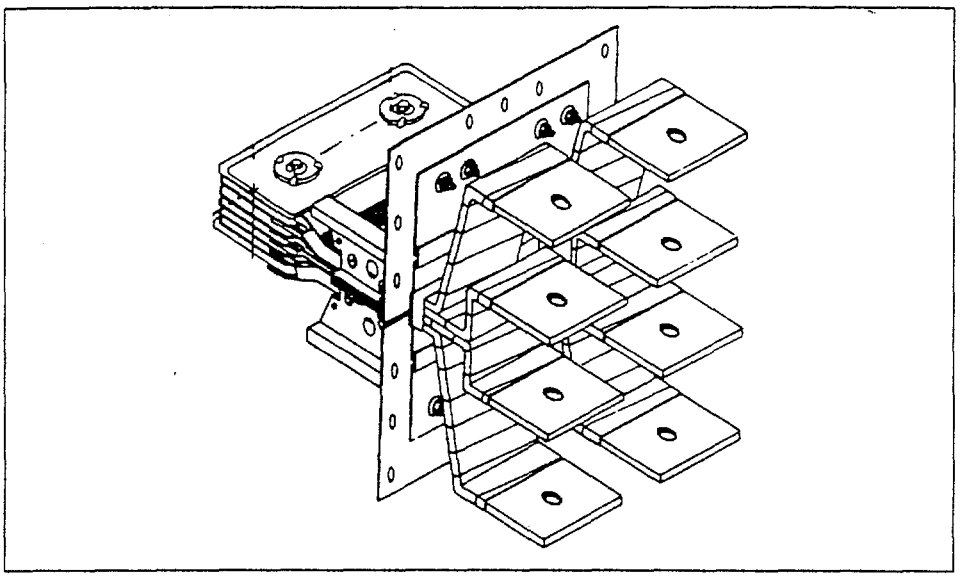

Figure 14: Flanged-End Connections

E. Line up the holes in the bus bar flanges and insert the 1/2" diameter bolts removed in step A.

> NOTE: Assemble conical washers with the convex (top) side of the washer next to the bolt head.

F. Torque the bolts inserted in step E to 70 ft lbs.

G. Assemble busway collar to the switchboard enclosure with the screws provided.

Conduit Area

1. Locate and terminate all conduit in the switchboard enclosure in the "available conduit area" designated on the equipment drawing.
2. Install the conduit properly. Use hubs and ring connectors to protect the cables and to prevent condensation on the conduit from entering the switchboard.

> NOTE: If bottom closure plates are furnished, holes for any conduit entering the bottom of the switchboard must be made by the customer. After making the holes, re-install the plate.

3. Bond all conduit, stubs, and ring connectors to the switchboard enclosure with approved electrical connections.

Cable Pulling

POWER-STYLE® QED Switchboards are constructed to customer specifications for the service entrance cable arrangement (for example, top or bottom feed). The various switchboard components are arranged to give power cable clearance and bending space for both line and load cables. Therefore, pull all cables entering the switchboard and arrange them as specified on the wiring diagram provided with the equipment drawing.

Cable Pulling (cont.)

1. Use only cable sizes suitable for a proper fit with the corresponding lugs.
2. Pull the proper number of line side and load side cables as per the load served.
3. Position the cables inside the switchboard so that they are not subject to physical damage.
3. Maintain the maximum possible bending radii and proper clearance to bus bars and grounded parts. If any cables are lying or bearing on structural members, support them to relieve this condition or place suitable protective material at the bearing point to protect the cable insulation.
5. Where cables enter or leave the switchboard, or pass through any metal which has magnetic properties, be certain to run all phase conductors, including the neutral, through the same opening. Otherwise, overheating can result. See section 300-20(a) of NEC.

Cable Terminations

1. Strip a length of insulation from the end of the cable sufficient to fit into the full length of the lug barrel, being careful not to nick or ring the strands. Use a proper insulation stripping tool.
2. Thoroughly clean aluminum cable contact surfaces with a wire brush or scrub them with an abrasive cloth to remove oxides and foreign matter.
3. Immediately apply an acceptable joint compound to the bare aluminum surfaces.
4. If **compression-type lugs** are furnished on any switch or circuit breaker, or as the main incoming power lugs, unbolt and remove them. Otherwise, there may be insufficient room to use the crimping tool to crimp the lugs to the cables.
   A. Insert the cable into the lug barrel and, using the crimping tool, make the specified number of crimps.
   B. Wipe excess sealant from the connector and insulation.
   C. With the cables connected, remount the lugs onto the bus bars, switches, or circuit breakers. Torque the bolts to the values given in table 1 on page 29.
5. Set screw type lugs may be furnished as main incoming lugs and are standard on molded case circuit breakers and QMB fusible switches. Torque these lugs **to, but do not exceed,** the specified values. Torque values for circuit breaker and switch lugs are marked on these units. Torque values for other switchboard lugs are marked on the switchboard (see table 2, page 29).

Ground Fault Protection Systems

According to section 230-95(c) of the National Electrical Code, "The ground-fault protection system shall be performance tested when first installed....A written record of this test shall be made and shall be available to the authority having jurisdiction."

Square D Company tests all of its Ground Fault Protection systems before leaving the factory. Acknowledgment of this test is recorded on a chart located behind or on the front of a door near the relay monitor panel. This chart has testing instructions and a log to record test results on. For further details, see the Ground Fault Protection Equipment instruction bulletin. This bulletin is in the instructional material holder in the switchboard.

SECTION 5—PRE-ENERGIZING CHECK-OUT PROCEDURE

Conduct a complete inspection **before** the switchboard is energized to assure that all components function and operate properly. **Complete every step of the check-out procedure listed below before energizing the switchboard.**

1. Check all field-installed bus bar connections. Refer to table 1 (page 29) for torque values.
2. Check all accessible connections for tightness.
3. Check all factory and field-installed lug terminations for tightness.
4. Check the rigidity of all bus bar bracing.
5. Check the switchboard enclosure for dents or other damage that reduces electrical clearances inside the switchboard.
6. Remove all foam blocks, or other temporary cushioning or retaining material, from the electrical devices.
7. Manually open and close all switches, circuit breakers, and other operating mechanisms, checking for correct alignment and free operation.
8. Electrically operate all electrically operated switches, circuit breakers, and other devices equipped with remote operators (not under load). An auxiliary source of control power may be necessary to accomplish this.
9. Check all relays, meters, and instrumentation to verify that all wiring connections are "good" and the devices operate freely.
10. Factory-installed molded case circuit breakers have an adjustable magnetic trip which is shipped on the "LO" setting. The markings between "LO" and "HI" settings represent a range of instantaneous magnetic trip values of five to ten times the circuit breaker's continuous current rating. Properly adjust this magnetic trip to provide coordinated operation during a fault. All poles are adjusted simultaneously, using a screwdriver, by the single setting (figure 15).

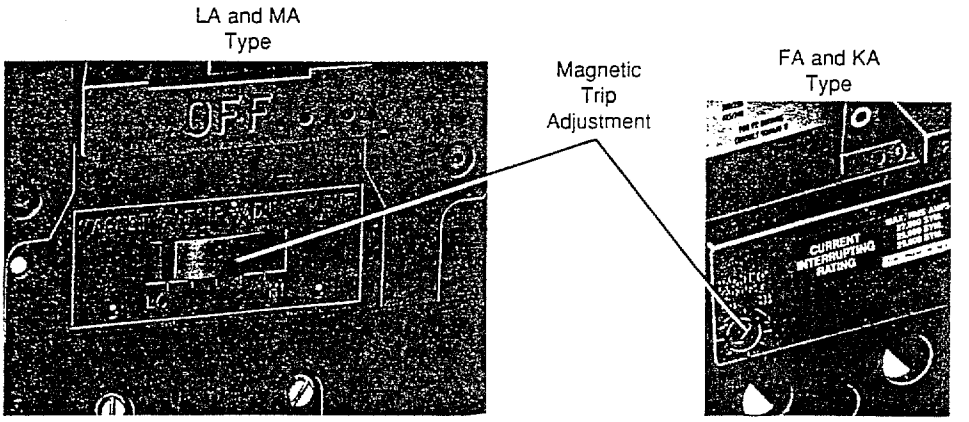

Figure 15: Instantaneous Trip Setting

Pre-Energizing Check-Out Procedure (cont.)

11. On switchboards containing an electronic trip circuit breaker, set the tripping characteristic curve of the adjustable electronic trip unit as outlined in the respective operating manual.
12. If ground fault protection is furnished, adjust the relay to the desired ground current pick-up setting. The relay is shipped from the factory at the "LO" setting of 100 amperes for the Type GC relay. The relay pick-up range is from 100 to 1200 amperes for the Type GC relay (see Molded Case Circuit Breakers section on page 23 for circuit breaker adjustment information).
13. Check the torque on all bolts of the fuses mounted in BOLT-LOC® switches (40–45 ft lbs.) and in QMB switches (as marked on the device).
14. Check for firm spring tension in the fuse clips of the QMB fusible switches (where applicable).

> **CAUTION: Hazard of equipment damage.**
>
> Do not pry open or spread the fuse mounting clips. A loose connection can occur, resulting in overheating and nuisance fuse blowing.

15. Check all QMB fusible switches, verifying that the proper fuses with the required interrupting rating and continuous current rating are installed. **Do not use renewable link fuses in Square D fusible switches.**
16. Verify that all grounding connections are correctly made. If the switchboard is used as a service entrance, double check to see that the main bonding jumper is connected (figure 11).
17. Conduct an insulation resistance (megger) test on the switchboard. Insulation resistance between phases, and between each phase and neutral, should not be less than one megohm with all switches and circuit breakers open. If less, consult your local Square D field office to help you correct any problems.
18. Check all field-installed wiring. Make certain it is clear of all live parts and secured, where necessary, to withstand fault currents.
19. Use a vacuum cleaner to remove any dust, scrap wire, or other debris.

> **CAUTION: Hazard of equipment damage.**
>
> Do not use an air hose to blow out the switchboard. The dust may settle inside relays and current devices, causing overheating and improper operation.

20. Replace all front, side, and rear cover plates and close the doors. Check for any pinched wires and make certain all cover plates are aligned and fastened securely.

SECTION 6—ENERGIZING THE SWITCHBOARD

DANGER: Hazard of electrical shock or burn.

Hazardous voltage 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.

1. Have qualified electrical personnel present when equipment is energized for the first time. If short circuit conditions caused by damage or poor installation practices have not been detected during the checkout procedures described in the Pre-Energizing Check-Out Procedure section (page 17), serious personal injury and damage can result when the switchboard is energized.
2. There should be no load on the switchboard when it is energized. Turn off all downstream loads.
3. Energize the switchboard in the following sequence:
   A. Close the main device(s).
   B. Close each branch circuit breaker or branch fusible switch.
   C. Proceed to each panelboard and other downstream load.
4. After all overcurrent protective devices are safely closed, turn on all loads (for example, lighting circuits, contactors, heaters, and motors).

SECTION 7—MAINTAINING THE SWITCHBOARD

DANGER: Hazard of electrical shock or burn.

Hazardous voltages in electrical equipment can cause severe personal injury or death. Unless otherwise specified, inspect and perform preventive maintenance only 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.

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

Periodic maintenance on the switchboard includes cleaning, lubrication, and exercising component parts. The interval between maintenance checks can vary depending upon the amount of usage and environmental conditions of each installation. The maximum recommended inspection interval is one year. This definition for periodic maintenance applies throughout this manual, unless otherwise noted.

Always inspect the switchboard after a fault (see the Adverse Circumstances section on page 27). Service bulletins for the various disconnecting and overcurrent devices mounted in the switchboard are available through your local Square D distributor.

General Inspection

1. Vacuum the switchboard interior to remove any dirt or dust deposits.

CAUTION: Hazard of equipment damage.

Do not use an air hose to blow out the switchboard. The dust may settle inside relays and over current devices, causing overheating and improper operation.

2. Check the switchboard interior carefully for moisture, condensation buildup, or signs of any previous wetness. Moisture can cause insulation failures and rapid oxidation of current carrying parts. Inspect all conduit entrances and cracks between the enclosure panels for dripping leaks. Condensation in conduits may be a source of moisture and must not be allowed to drip onto live parts or insulating material. Take the necessary steps to eliminate the moisture and seal off all leaks.
3. The temperature of non-conducting parts within the enclosure should never exceed 80°C (176°F). The temperature of conducting parts should not exceed 90°C (194°F). If overheating occurs, be sure that all conditions which caused the overheating have been corrected.
4. Check for signs of rodent nesting in the switchboard. If required, use a good exterminating technique in the general area of the switchboard.

NOTE: Do not place or use exterminating substances and chemicals inside the switchboard. Some of these products attract rodents.

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General Inspection (cont.)

5. Carefully inspect all devices for any visibly worn-out, cracked, or missing parts.
6. Manually open and close switches and circuit breakers several times to ensure they are working properly.
7. Check all key interlocks and door interlocking provisions, ensuring they are working properly.

Bus Bar Joints And Lug Terminations

1. Bus bar joints are maintenance-free. Do not re-tighten them after the pre-energizing check-out procedure is complete.

> **CAUTION: Hazard of equipment damage.**
>
> Hydrocarbon spray propellants and hydrocarbon-based sprays or compounds cause degradation of certain plastics. Before using these products to clean, dry, or lubricate components during installation or maintenance, contact Square D field sales.

2. Check all bus bar joints and terminal lugs for any pitting, corrosion, or discoloration resulting from high temperatures or subjection to high fault conditions. If any damage has occurred, replace the bus bars or lugs. If cleaning is required, use CRC Electra-Clean.
3. Inspect all insulating materials. Before re-energizing the switchboard, replace insulators with any visible damage (such as cracks).

> **CAUTION: Hazard of equipment damage.**
>
> Do not sand or remove the plating on any aluminum bus bar, splice bar or terminal lug. Replace any damaged aluminum part. Contact Square D Technical Service Division (1-800-634-2003).

Automatic Transfer Switches

Consult the service bulletins for these devices for all installation, operation, and maintenance instructions.

BOLT-LOC® Bolted Pressure Contact Switch Maintenance (800–4000A)

1. Exercising operating mechanism:

   Periodically exercise the operating mechanism to ensure proper operation. This period should not exceed one year.
2. Lubrication:

   The type BP switch is shipped from the factory properly lubricated. Periodic cleaning and lubrication of the switch is required. The maintenance interval between lubrications depends on factors such as usage and ambient conditions. The maximum recommended maintenance interval is one year for current carrying parts and five years for operating mechanisms.

BOLT-LOC® Bolted Pressure Contact Switch Maintenance (800–4000A) (cont.)

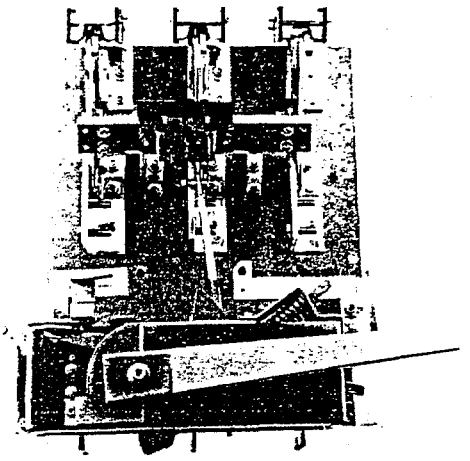

Figure 16: BOLT-LOC® Switch

3. Fuse replacement:

DANGER: Hazard of electrical shock or burn.

Hazardous voltages can cause severe personal injury or death. Always check line and load ends of the fuses for voltage before starting the replacement procedure. The BP switch can be part of a multiple source system in which the fuses can be energized when the BP switch is in the "open" position.

   A. Open the switch before opening the fuse door.
   B. Open the fuse door, releasing the interlock per instructions on the door.
   C. Observe the switch blades to confirm the switch is "open."
   D. Check the line and load ends of fuses for voltage, using a properly rated voltage sensing device.
   E. Remove the fuse(s).
   F. Using a non-abrasive cleaner such as CRC Electra-Clean, wipe clean the fuse mounting pads on the switch and the terminals of each new fuse. Be sure to check the alignment of fuse terminals before installing the new fuse(s).
   G. Install the new fuse(s), using the same hardware removed in step E, and tighten to 40–45 ft lbs.

4. Check the cover interlock with the switch on. The cover should not open using normal hand force.

Refer to the BOLT-LOC switch installation and maintenance manual for complete information (manuals were included in the switchboard when shipped). If the manual is not available, see pages 31–32 of this manual for the appropriate number, and contact your local Square D distributor to obtain the BOLT-LOC switch installation and maintenance manual.

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Molded Case Circuit Breakers

Square D molded case circuit breakers are designed and manufactured as totally sealed units requiring minimal periodic maintenance.

Exercise circuit breakers periodically to ensure proper operation. This period should not exceed one year.

1. **General maintenance:**
   A. Manually open and close the circuit breaker two or three times.
   B. Trip the circuit breaker by pushing the yellow *Push To Trip* button located on the face of the circuit breaker (figure 17). This tests alarm switches if they are built into the circuit breaker, or electrical interlocks between two circuit breakers. This also exercises the trip mechanism, ensuring proper operation.

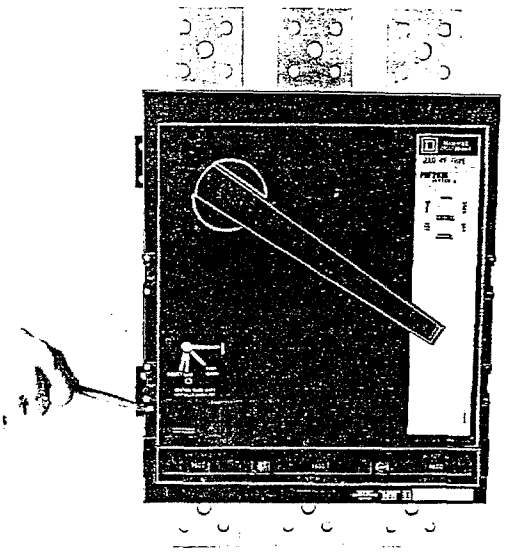


Figure 17: Molded Case Circuit Breaker

NOTES:

- Square D Bulletin #SD 363, *Field Testing Industrial Molded Case Circuit Breakers*, provides more information. Contact your local Square D field office to obtain this bulletin.
- See the individual circuit breaker instruction manuals shipped with the switchboard for additional maintenance information, such as changing rating columns or adjustable settings and removing circuit breakers. If the instruction manual is not available, see pages 31–32 of this manual for the appropriate number, and contact your local Square D distributor to obtain this manual.

Molded Case Circuit Breakers (cont.)

DANGER: Hazard of electrical shock or burn.

- If circuit breaker settings are adjusted, do not set the long time trip rating at a higher ampacity than the rating of the bus bar or load cables it supplies; overheating can occur. See the label attached to the circuit breaker for the maximum rating.
- Before energizing the switchboard, all unused I-LINE breaker mounting spaces ***must*** be filled with blank fillers and/or extensions as listed below.

Breaker Mounting Blank Fillers & Extensions		
	Height (Inches)	Catalog Number
Blank Fillers	1.5 4.5	HNM1BL HNM4BL
Blank Extensions	1.5 4.5	HLW1BL HLW4BL

CAUTION: Hazard of equipment damage.

Do not remove the protective lubricant on the jaws. If additional lubrication is required, apply a coating of electric joint compound, catalog number PJC-7201, to the jaw contact surfaces.

2. The universal test set, catalog number UTS, is available to test all Square D circuit breakers equipped with MICROLOGIC® trip units. It runs trip unit tests automatically, with prompts to the user for initial information. Test modules for each breaker frame are used to store data necessary for automatic tests. MICROLOGIC trip units require test module CBTM4, which is included in UTS.

   Tests can be conducted with a breaker installed in the switchboard; breaker removal is not required.

QMB Fusible Switches

Refer to the QMB instruction manual for complete maintenance information. If the instruction manual is not available, see pages 31–32 of this manual for the appropriate number. Contact your local Square D distributor to obtain the manual.

1. Switch Maintenance:
   A. Periodically exercise the switch to ensure proper operation. This period should not exceed one year.
   B. Check the cover interlock with the switch on. The cover should not open using normal hand force.
   C. Inspect the switch interior for any broken or cracked parts and replace as necessary.
   D. Check the fuse mounting clips or bolted contact area for corrosion or discoloration (indicating overheating). Replace them if necessary.
   E. For additional maintenance instructions, see the inside of the cover door.

QMB Fusible Switches (cont.)

2. Fuse Replacement:

DANGER: Hazard of electrical shock or burn.

Hazardous voltages can cause severe personal injury or death. Always check line and load ends of the fuses for voltage before starting the fuse replacement procedure.

A. Turn the switch "OFF" before opening the door.

B. Observe the switchblades' position to confirm that the switch is in the "OFF" position.

C. Observe all warning labels specifying which type of fuse to use. Do not substitute a non-current limiting fuse, or attempt in any way to defeat the rejection feature of the fuse clips furnished with the switch. **Do not use renewable link fuses in Square D fusible switches.**

CAUTION: Hazard of equipment damage.

Do not pry open or spread the fuse mounting clips. This can cause a loose connection, resulting in overheating and nuisance fuse blowing.

3. Installing QMB fusible switches (30–1200A):

DANGER: Hazard of electrical shock or burn.

- The main disconnecting device for these sections must be "OFF" before installing or removing QMB switches.
- Do not use a main as a branch unit or a branch as a main. Misapplication of QMB switches can result in electrical shock or burn.

A. Turn off the main power.

B. Turn switch handle(s) "OFF" and position unit plug-on connectors onto the bus bars.

C. Start all unit mounting screws that mount to the QMB panel mounting rails.

D. Tighten the screws evenly. The unit mounting flange and plug-on connectors must be seated securely.

DANGER: Hazard of electrical shock or burn.

All unused spaces ***must*** be filled with blank fillers before energizing the switchboard. See the following chart for sizes and catalog numbers.

QMB Fusible Switches (cont.)

QMB Fusible Switch (30–1200A) Blank Fillers	
Height (Inches)	Catalog Number
1.5	QMB1BLW
3	QMB3BLW
6	QMB6BLW
15	QMB15BLW

4. Removing QMB Fusible Switches (30–1200A):
   A. Turn off the main power.
   B. Disconnect the load wires.
   C. Turn switch handle(s) "OFF."
   D. Remove mounting screws holding the switch to the mounting rail.
   E. Unplug the switch.

Ground Fault Protection Systems

Check the terminal connections on the Ground Fault Protection system at least once a year for tightness and corrosion. If the system can be tested with or without tripping the main or branch device, directions for testing the system are on the nameplate. Otherwise, testing the Ground Fault Protection System will trip the main or branch device it is connected to. If the Ground Fault Relay does not operate properly or is physically or electrically damaged, replace it.

Refer to the Ground Fault Field Test instruction manual for additional testing information. If the manual is not available, see pages 31–32 of this manual for the appropriate number, and contact your local Square D distributor to obtain the manual.

SECTION 8—ADVERSE CIRCUMSTANCES

Short Circuits

IMPORTANT: Contact Technical Service Division (1-800-634-2003) after any fault for special instructions before attempting to re-energize the switchboard.

High mechanical stress developed by short circuit currents may damage conductors and insulation. After any fault, make a thorough inspection of the entire system, verifying that no damage to conductors or insulation has occurred.

During a fault, some organic insulating materials carbonize when subjected to the intense heat of an electrical arc. Completely clean away these carbon deposits before the switchboard is re-energized.

Follow the steps below to clean a switchboard:

DANGER: Hazard of electrical shock or burn.

Do not work on the switchboard while it is energized.

1. Turn off the power feeding the switchboard.
2. Open the entire switchboard and thoroughly vacuum all components. Do not use compressed air because it may blow dust and carbon deposits into the components, causing overheating and improper operation.

CAUTION: Hazard of equipment damage.

Do not allow paint, chemicals, or petroleum-based solvents to contact switchboard interiors.

3. Wipe all bus bars, insulators, cables, and so forth, with a clean, dry, lint-free cloth. Also wipe clean all current-carrying parts. Although cleaning solvents are available, their use is not recommended because some types of solvents tend to dissolve or break down the insulating properties of certain materials. If grease is removed from BOLT-LOC or QMB switch blades, replace it with a light coating of **Mobilith 21 grease**.
4. Clean ground fault relays, shunt trips, solenoids, or other electrical control devices with CRC Electra-Clean. Meters may also be sprayed with this cleaner.
5. Remove I-LINE® circuit breakers, vacuum them, and wipe them clean. Clean all connectors and busing as described in step 3. Field test circuit breakers per Service Bulletin SD363. However, it is very possible that all circuit breakers still should be replaced due to internal contaminations. Contact your Square D field office or Technical Services Division for further instructions.

DANGER: Hazard of electrical shock or burn.

Before energizing the switchboard, all unused breaker mounting spaces ***must*** be filled.

ok

Water-Soaked Switchboards

Do not clean or repair a switchboard which has been exposed to large volumes of water or submerged at any time. Current carrying parts, insulation systems, and electrical components may be damaged beyond repair. *Do not energize the switchboard.* Contact Square D Technical Service Division.

Water-Sprayed/Splashed Switchboards

If no physical damage is apparent and the switchboard has not been submerged or exposed to the water for long periods of time, follow the steps below:

DANGER: Hazard of electrical shock or burn.

Do not work on the switchboard while it is energized.

1. Completely de-energize the switchboard.
2. Wipe off all moisture from the bus bars, insulators, and insulating material with a clean, dry, lint-free cloth.
3. Prepare the switchboard for insulation resistance testing by disconnecting all lineside supply connections and all loadside cable connections to isolate the switchboard from the wiring system.
4. Turn all circuit breakers or switches to their "ON" position.
5. Use a megohmeter with a capacity of 500–1000 volts DC and apply voltage from:
   A. Each phase-to-ground with breaker "ON".
   B. Phase-to-phase with breaker "ON".
6. Record resistance values on the chart on page 30.
7. If resistance measurements are less than 0.5 megohm, call Technical Service Division for recommendations.
8. If resistance measurements are greater than 0.5 megohm, the equipment can be energized using the procedures in the Energizing The Switchboard section on page 19.

Document Replacement

Contact your Square D field office to replace lost or damaged wiring diagrams and instruction sheets. Use the factory order number as a reference.

SECTION 9—TORQUE VALUES

Table 1: Electrical Joint Hardware Torque Values

HARDWARE SECURING ELECTRICAL JOINTS MUST BE TORQUED TO VALUES SHOWN IN TABLE

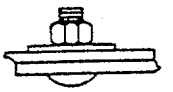
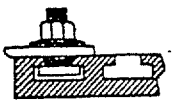
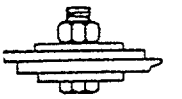
JOINT CONFIGURATION									
DESCRIPTION OF HARDWARE	CARRIAGE BOLT GRADE 5, STANDARD OR HEAVY HEX NUT, ONE CONICAL WASHER		CARRIAGE BOLT GRADE 5, NUT AND CONICAL WASHER ASSY.	SQUARE HEAD BOLT GRADE 5			HEX BOLT GRADE 5, STANDARD OR HEAVY HEX NUT, TWO CONICAL WASHERS		
	WASHER O.D.			NUT AND CONICAL WASHER ASSY.	STANDARD OR HEAVY HEX NUT, ONE CONICAL WASHER		WASHER O.D.		
BOLT DIAMETER (INCHES)	(INCHES)	INCH–LBS	INCH–LBS	INCH–LBS	(INCHES)	INCH–LBS	(INCHES)	INCH–LBS	
.25 (1/4)			50–75						
.31 (5/16)			80–125				.90	145–160	880030-422-01
.38 (3/8)			175–225	175–225	.87	250–280	.87	250–280	
					1.00	130–150	1.00	130–150	
.50 (1/2)	1.25 2.25 3.00	840 (70 FT–LBS)	250–350	250–350	1.25 2.25	500 (42 FT–LBS)	1.25 2.25 3.00	840 (70 FT–LBS)	

Table 2: Wire Binding Screw Torque Values

RECOMMENDED WIRE BINDING SCREW TORQUE VALUES FOR FIELD INSTALLED WIRING

TERMINAL	SOCKET SIZE ACROSS FLATS (INCHES)	TORQUE (INCH–POUNDS)
INCOMING LUGS	1/4	180
BRANCH LUGS	5/16	250
NEUTRAL LUGS	3/8	340
	1/2	450

MULTIPLE CONDUCTOR NEUTRAL AND/OR GROUND BAR		CONDUCTOR SIZE	TORQUE (INCH–POUNDS)
SCREW TYPE	LUG WIRE RANGE		
SLOTTED HEAD	#14-4	#14-10 CU, #12-10 Al	20
		#8 CU-Al	25
		#6-4 CU-AL	35
	#14-1/0	#14-8 CU-AL	36
		#6-1/0 CU-AL	45
SOCKET HEAD	#14-1/0	ALL	100
	#6-300 kcmil	ALL	275

ALUMINUM LUGS ARE SUITABLE FOR USE WITH COPPER OR ALUMINUM CONDUCTORS. COPPER LUGS ARE SUITABLE FOR USE WITH COPPER CONDUCTORS ONLY.

CONDUCTOR TEMPERATURE RATING (UNLESS OTHERWISE NOTED).

110 A OR LESS AND ALL BRANCH NEUTRAL TERMINALS—SUITABLE FOR USE WITH 60°C OR 75°C RATED COPPER OR ALUMINUM CONDUCTORS. OVER 110 A—SUITABLE FOR USE WITH 75°C RATED COPPER OR ALUMINUM CONDUCTORS.

SECTION 10—SWITCHBOARD INSULATION RESISTANCE CHART

DANGER: Hazard of electrical shock or burn.

Disconnect all power to the switchboard before testing. Use a 500 or 1000VDC megohmeter.

	Phase-To-Phase			Phase-To-Ground		
	All Disconnects Open					
Date	a-b	b-c	c-a	a-ground	b-ground	c-ground
	All Disconnects Closed					
Date	a-b	b-c	c-a	a-ground	b-ground	c-ground

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SECTION 11—SERVICE BULLETINS

The following Square D publications are available through your local Square D distributor. These include device replacement procedures and spare parts listings to make ordering and servicing of replacement parts quick and convenient. Any maintenance procedure or device not listed below, such as an I-LINE panel, is not customer serviceable. Refer to the nearest Square D field office for information.

INSTALLATION INSTRUCTIONS:	PUBLICATION NUMBER
FA, FH, FC, FY, KA, KH, KC, IF IK, LA, Q2, Q4, SFA, SFH, SFC, SFI, SKA, SKH, SKC, SKI, SLA, SLH, or SQ I-LINE Circuit Breakers	48040-008-07
IL I-LINE Circuit Breaker	48040-008-05
MA, ME I-LINE Circuit Breakers	48040-033-08
NA, NC I-LINE Circuit Breakers	48040-797-03
LI, LC I-LINE Circuit Breakers	48040-732-01
FA-M01 & KA-M01 Motor Operator	48040-033-05
LA-M01 & MA-M01 Motor Operator	48040-033-07
KA-M02 Motor Operator	48040-330-06
LA-M02 Motor Operator	48040-330-05
MA-M02 Motor Operator	48040-330-04
PA-M02 Motor Operator	48040-884-03
SE (Spring Charging Motor)	48040-841-02
Ground Fault Module (GFM)	48040-756-02
Ground Fault Protection System—Type GC	40268-292-01
BOLT-LOC Switches—Series II	9810-10A
QMB Fusible Switches	40269-698-01

INSTRUCTION/MAINTENANCE MANUALS:	
ME, NE, & PE Electronic Trip Circuit Breakers	48040-712-02
MX, NX, & PX Electronic Trip Circuit Breakers	48040-890-01
NE, NX Drawout Circuit Breakers	2744-1 or 80258-146-01
SE Electronic Trip Circuit Breaker	48040-495-03
PowerLogic Circuit Monitor (CM-100, 200, 108, 208, 144, 244)	63210-142-01
PowerLogic Circuit Monitor With Digital Display (CM-150, 250)	63210-130-01
PowerLogic System Display	63210-150-01
BOLT-LOC Switches—Series II	9810-10

GROUND FAULT FIELD TEST INSTRUCTIONS:	
Ground Fault Module (GFM)	48040-757-02
ME/NE/PE & MX/NX/PX Electronic Trip Circuit Breakers	48040-604-01
Type GC—Ground Fault Protection System	80043-054-01
SE Electronic Trip Circuit Breaker	48040-517-03

Service Bulletins (Cont.)

DISTRIBUTION PRODUCTS CATALOG:

Molded Case Circuit Breakers ..... Section 600
QMB Fusible Switches ..... Section 4620
QMB Circuit Breaker Adapter Units ..... Section 4620
Class 6030-2 PZ-3 Switchgear ..... Section 6030-2
Class 6030-2 PZ-3 Parts Manual For DS Breaker ..... Section 6030-3

OTHER USEFUL LITERATURE INCLUDES:

NEMA Publication PB2.1	General instructions for proper installation, operation, and maintenance of switchboards rated 600 volts or less.
NEMA Publication AB-4	Circuit Breakers
NEMA Publication KS-1	Enclosed And Miscellaneous Distribution Switches
NFPA 70B-1990	Electrical Equipment Maintenance
Square D Part No. SD363	Field Testing Industrial Molded Case Circuit Breakers

For information on obtaining NEMA documents, write to:

National Electrical Manufacturers Association
2101 L St. NW
Suite 300
Washington, DC 20037-1581

Technical Service Division

1-800-634-2003

Troubleshooting • Start-Up Service • Testing
Maintenance • Retrofit • Consultation

SECTION 12—INSTALLATION AND MAINTENANCE LOG

Installation And Maintenance Log
(cont.)

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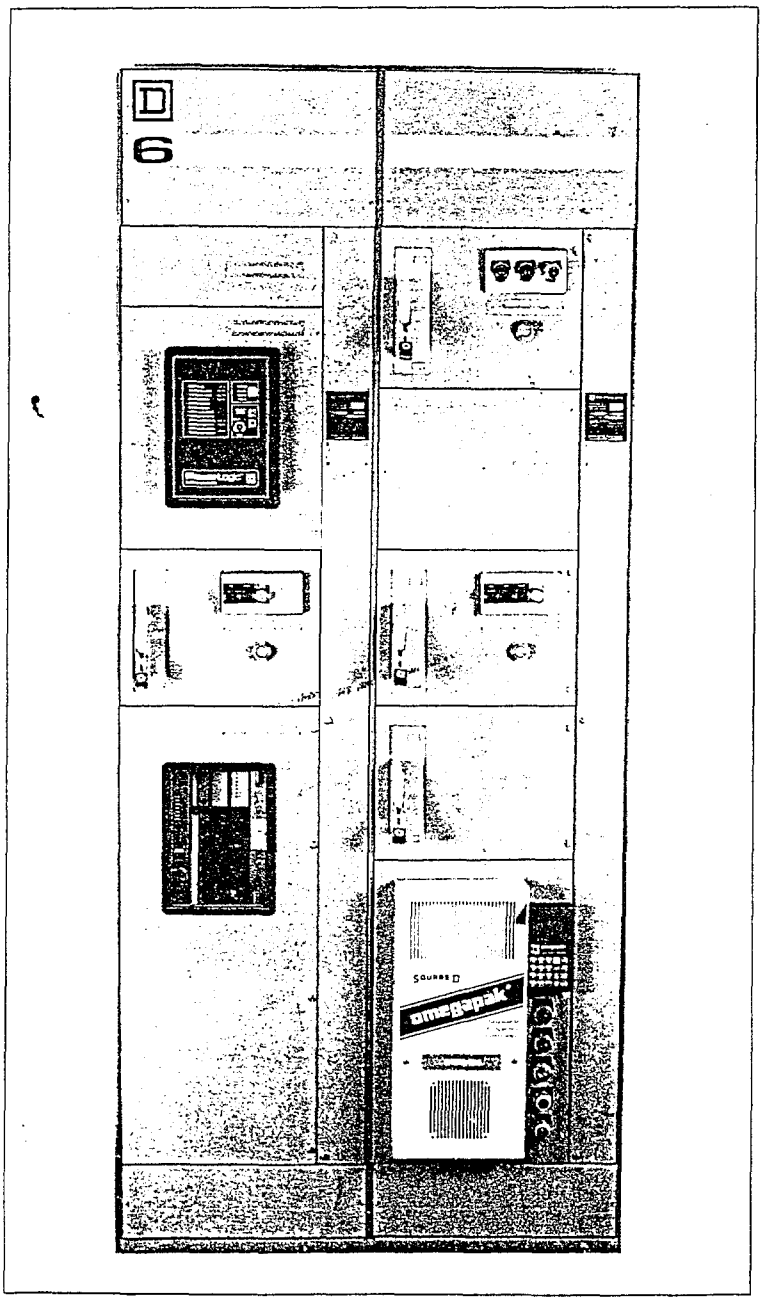
SQUARE D
Instruction Bulletin

Bulletin 8998IM9201R1/93
February 1994
Replaces 8998IM9201 dated 11/92
Seneca, SC, U.S.A.

MODEL 6 INDUSTRIAL

Model 6
Motor Control Center



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NOTICE

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this bulletin to warn of potential hazards and to call attention to additional information which clarifies or simplifies a procedure.

⚠ DANGER

Used where there is a hazard of severe bodily injury or death. Failure to follow a "DANGER" instruction *will* result in electric shock, ***severe*** bodily injury, or death.

⚠ WARNING

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

⚠ CAUTION

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

NOTE

Provides additional information to clarify or simplify a procedure.

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SECTION 1—INTRODUCTION

Motor control centers provide the most suitable method for grouping electrical motor control and other related devices in a compact, economical, free-standing installation. A motor control center (MCC) is made of standardized vertical sections consisting of totally enclosed, dead front, free-standing structures bolted together. These sections support and house control units, a common bus bar for distributing power to the control units, and a network of wire trough and conductor entrance areas to accommodate outgoing load and control wires.

The control units consist of components such as combination motor starters, branch feeder devices, and lighting panelboards. Each is mounted in an individual, isolated compartment having its own cover. When front-of-board unit arrangement is selected, all units are mounted on the front side of the control center. A 15" (381 mm) or 20" (508 mm) deep section is provided for front-of-board mounting. Standard motor control center width is 20" (508 mm) with a 4" (102 mm) wide vertical wireway. An optional 25" (635 mm) wide section with a 9" (229 mm) wide wireway is also available. Larger sections are available for mounting larger equipment. When a back-to-back arrangement is selected, the units are mounted on both the front and rear of a 31" (787 mm) or 41" (1041 mm) deep structure. There is approximately 1" (25 mm) between back-to-back sections. The standard height of all motor control center structures is 91-1/2" (2324 mm).

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SECTION 2—SAFETY PRECAUTIONS

⚠ DANGER

HAZARD OF BODILY INJURY OR EQUIPMENT DAMAGE.

- Equipment *must* be de-energized during all installation and maintenance operations. Failure to de-energize equipment will expose personnel to live parts which may result in electrical shock and/or burn.
- There is a hazard of electric shock, burn, or explosion whenever working in or around electrical equipment. Turn *off* power supplying the equipment before working inside motor control centers.
- The operation of motor control centers depends upon proper handling, installation, operation, and maintenance by qualified personnel. Failure to follow the fundamental installation and maintenance requirements described in this document could lead to personal injury and failure of the motor control center, as well as damage to other property.
- For the purpose of this guide, a qualified person is one who is familiar with the installation, construction, and operation of the equipment and the hazards involved. That person should be:
  - trained and authorized to energize, de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices
  - trained in the proper use of protective equipment such as rubber gloves, hard hats, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices

Failure to observe these precautions will result in severe personal injury, death, or damage to the motor control center and other property!

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SECTION 3—RECEIVING, HANDLING, AND STORAGE

General

Motor control centers are constructed in shipping blocks of up to three vertical sections. This allows for ease of handling during transportation and installation. The main horizontal bus of all shipping blocks is spliced together at the job site with the use of integral splice bars.

Before shipment from the factory, the motor control center is inspected visually, electrically, and mechanically by a professional quality control analyst. Certification of quality control testing is available upon request.

After leaving Quality Control, each shipping block is carefully packaged and attached to a skid (figure 1).

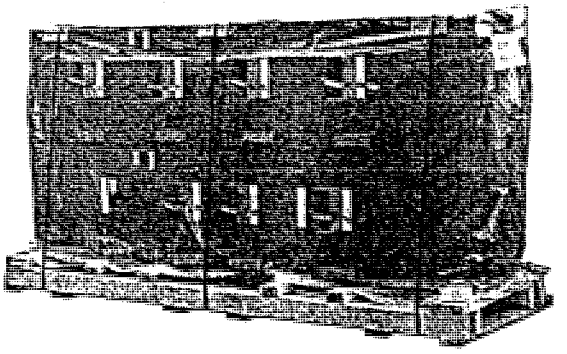

Figure 1: Packaged motor control center

Receiving

Inspect the motor control center for damage as soon as it is received. Delivery of the equipment to a carrier at any of the Square D plants or other shipping point constitutes delivery to the purchaser. Title and all risk of loss or damage in transit shall pass to the purchaser at that time, regardless of freight payment. All claims for loss and damage must be made by the purchaser to the carrier.

If the packaging material is removed, replace it for protection until installation.

Handling

Adequate equipment for handling the motor control centers such as fork truck, crane, or rods and pipe rollers must be available. The Approximate Shipping Weights table (page 4), shows approximate weights of single sections full of typical units; use it to determine the type of handling equipment needed. Weights vary by enclosure type and depth. Up to three vertical sections are shipped on a single skid. To minimize the risk of injury and equipment damage while moving the motor control centers, follow these instructions:

1. Use caution when moving heavy equipment.
2. Verify that the moving equipment is rated to handle the weight.

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Handling (cont.)

3. Fork trucks, when available, provide a convenient method of moving motor control centers (figure 2). When handling or moving a motor control center, or when removing an MCC from a shipping pallet, carefully balance the MCC and secure it using a safety strap.
4. Lifting angles are provided on each shipping block for handling the motor control center by overhead cranes. Take the following precautions when using a crane:
   a. Handle in the upright position only.
   b. Select rigging lengths to compensate for any unequal weight distribution.
   c. Do not exceed the 45° maximum angle between the vertical and lifting cables (figure 3).
   d. Use only slings with safety hooks or shackles. Do not pass ropes or cables through the holes in the lifting angle.

⚠ WARNING

HAZARD OF BODILY INJURY OR EQUIPMENT DAMAGE.

Use extreme caution when moving sections. There is a tendency for the control center to tilt due to its high center of gravity.

Failure to observe this precaution can result in personal injury or equipment damage!

After the shipping section is in place, its lifting angle may be removed and discarded. To prevent the entrance of foreign matter, replace all hardware which secured the lifting angle.

⚠ CAUTION

HAZARD OF EQUIPMENT DAMAGE.

Do not attempt to attach lifting means to sections equipped with pull boxes, or to lift sections equipped with pull boxes.

Failure to follow this precaution can result in equipment damage.

Table 1: Approximate Shipping Weights

Enclosure Type	Number Of Sections		
	1	2	3
NEMA 1, 1A, 12: 15" (381 mm) Deep	600 lbs (272 kg)	1,200 lbs (544 kg)	1,800 lbs (816 kg)
NEMA 3R Non-Walk-In: 20.5" (521 mm) Deep	900 lbs (408 kg)	1,800 lbs (816 kg)	2,700 lbs (1,225 kg)
NEMA 1, 1A, 12: 20" (508 mm) Deep	750 lbs (340 kg)	1,500 lbs (680 kg)	2,250 lbs (1,021 kg)
NEMA 3R, Non-Walk-In: 25.5" (648 mm) Deep	1,050 lbs (476 kg)	2,100 lbs (953 kg)	3,150 lbs (1,429 kg)

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Handling (cont.)

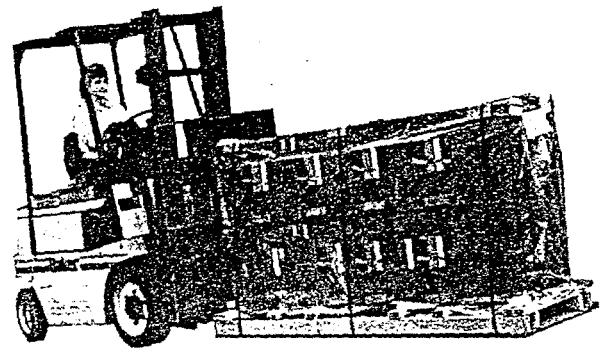

Figure 2: Moving motor control center with fork truck

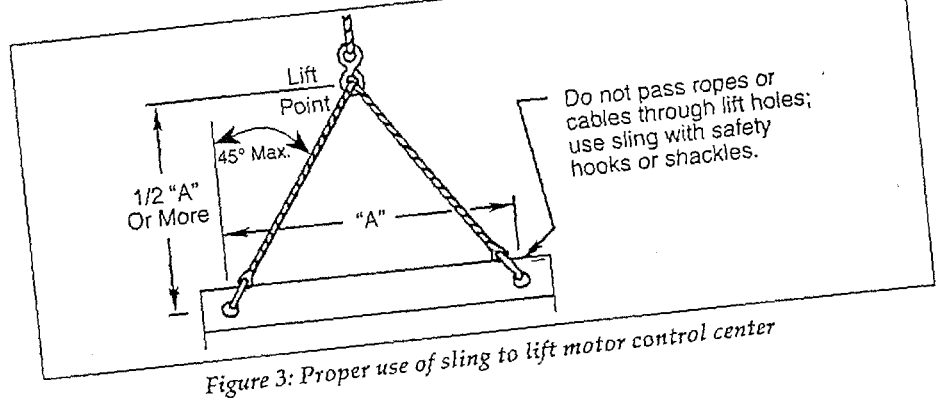

Figure 3: Proper use of sling to lift motor control center

Storage

If the motor control center cannot be placed into service upon receipt, store it in a clean, dry, ventilated building free from temperature extremes. Acceptable storage temperatures are from 0°C (32°F) to 40°C (104°F).

If the storage area is cool and/or damp, provide enough heat to prevent condensation inside the motor control center. Contact your local Square D field office for specific requirements.

⚠ CAUTION

HAZARD OF EQUIPMENT DAMAGE.

Never store motor control centers outdoors. Outdoor storage is inadequate, even with the protection of a tarpaulin.

Failure to follow this precaution can result in equipment damage.

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SECTION 4—INSTALLATION

Location

Motor control centers are not designed for use in hazardous locations. Choose an installation location that is well ventilated and free from excess humidity, dust, and dirt. The temperature of the area should be no less than 0°C (32°F) and no greater than 40°C (104°F). The enclosure *must* be protected from water or any moisture entering it.

Install motor control centers in an area with a minimum of 3 feet (914 mm) of free space in front of front-of-board construction. An additional 3 feet (914 mm) is necessary in the rear of back-to-back construction. This free space provides adequate room to remove and install units. (More space may be required for some applications; refer to applicable national standards.) Provide at least 1/2" (13 mm) of space between the back of front-of-board motor control centers and a wall (6" [152 mm] for damp locations).

When selecting a location for the installation of a motor control center, carefully consider accessibility, overhead clearances, and future expansions. Considering these factors will eliminate many difficulties during the installation of this and future motor control centers.

Motor control centers are assembled in the factory on a smooth, level surface to ensure proper alignment of all sections. A similar smooth, level surface should be provided for installation. An uneven foundation may cause misalignment of shipping blocks, units, and doors. The surface under a motor control center must be of a non-combustible material, unless bottom plates are installed in each vertical section.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION.

A hazard of electric shock, burn, or explosion exists whenever working in or around electrical equipment. Turn off power supplying the equipment before working on it.

Failure to observe this precaution will result in electric shock, severe personal injury, or death!

Joining Sections

Before positioning the motor control center sections (figure 4), check for damaged bus bars and insulators. If the bus is bent or insulators are broken, do not install the motor control center. Report any damage to the carrier.

To mount and splice a new motor control center section to an existing Model 6 section, or to join factory shipping splits, follow these steps:

1. Remove the horizontal wire trough covers in all sections, providing access to the ground bus and section splicing bolts (figure 5).
2. Remove the two-piece bus barriers (figure 6) in the sections adjacent to a splice connection (section *L* and section *R*).

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Joining Sections (cont.)

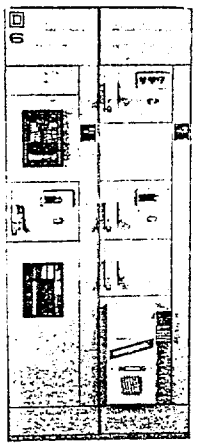


Figure 4: Motor control center

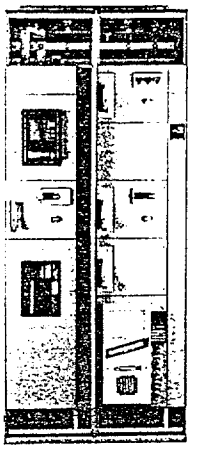
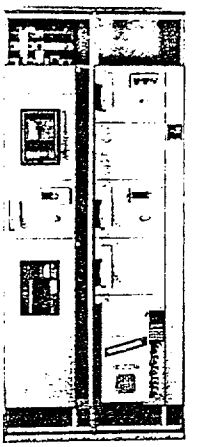


Figure 5: Horizontal wire trough covers removed



Section *L* Section *R*

Figure 6: Two-piece bus barriers removed from sections adjacent to splice connection

3. Make provisions for fastening the structure(s) to the floor. See steps 8 and 9, page 8, for layout of fastener locations.

⚠ WARNING

HAZARD OF BODILY INJURY OR EQUIPMENT DAMAGE.

Use extreme caution when moving sections. There is a tendency for the control center to tilt due to its high center of gravity.

Failure to observe this precaution can result in personal injury or equipment damage!

4. Supporting the motor control center by its base channels and/or lifting angles, lift it into place. The front edges of the base channels must be aligned to form a continuous front. Using the notches in the base channels, gradually move the sections into alignment with a crowbar (figure 7).

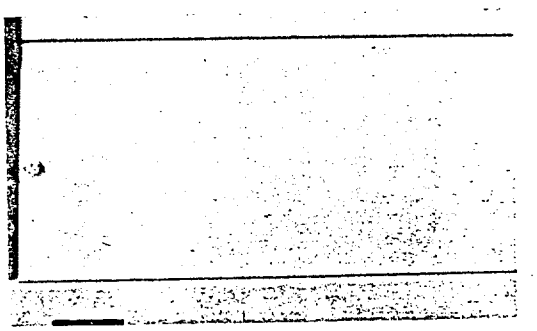


Figure 7: Base channel notch

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Joining Sections (cont.)

5. A joining hardware kit is provided in the top horizontal wireway cover on the right side of each shipping split. Captive splice bars are pre-assembled on the horizontal bus on the left side of each shipping split.
6. Open the wire trough door on section *L* (figure 8, page 9).
7. Locate the six rectangular notches on the inside surface of either the left or right corner channels (figure 8, page 9).

   Using six of the 3/4" x 1/4-20 hex head thread-forming screws supplied in the hardware kit, join the front vertical corner channels. To do so, insert the screws through the clearance holes located within the rectangular notches and into the mating thread-forming hole. Insert the screws from either the left or right, depending on ease of access to the holes due to equipment configuration; either side will join properly.
8. The method used to connect rear channels of adjoining sections differs depending on the equipment configuration; follow the instructions below for the appropriate configuration:
   a. **15" deep (381 mm) with vertical bus** (figure 8)
      Locate the four middle rectangular notches on the front corner channel of section *L*. Reach to the back of the structure, around the back flange, and locate the screw-clearance hole closest to the flange. Directly adjacent, on section *R*, is a small square opening with a spring nut installed. The spring nut provides the thread-forming hole. Using the 3/4" x 1/4-20 screws, join the sections.
   b. **All 15" deep (381 mm) or 20" deep (508 mm) without vertical bus** (figure 9)
      Locate the four middle rectangular notches on the front corner channel. Reach back to locate the notches on the rear corner channels. Join the structures, using the procedure in step 7.
   c. **15" deep (381 mm)—one section with vertical bus and one without** (figure 10)
      Locate the four middle rectangular notches on the front corner channel of Section *L*. Reach to the back of the structure, around the flange, and locate the screw-clearance hole closest to the flange. Using the 3/4" x 1/4-20 thread-forming screws, join the structures.
9. Fasten each section to the floor (figure 11), using 3/4" or 1/2" grade 5 or higher bolts and flat washers (furnished by the installer). The two 0.88" (22 mm) diameter base channel mounting holes provide clearance for bolt expansion anchors for 1/2" bolts.

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Joining Sections (cont.)

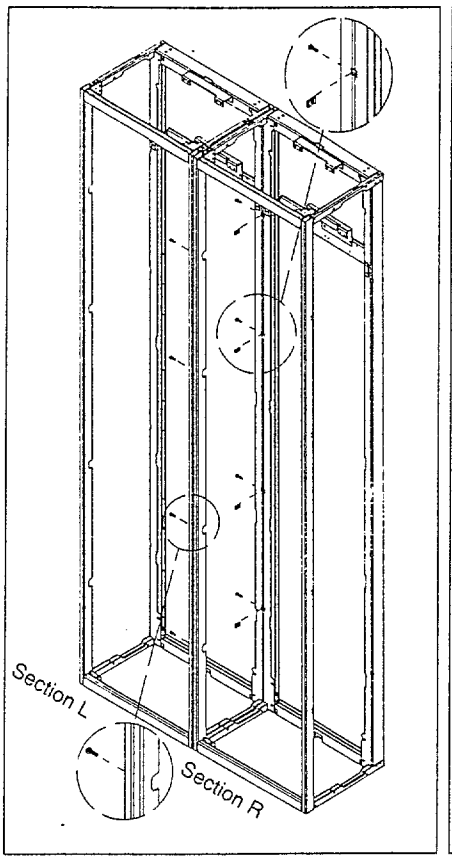

Figure 8: 15" (381 mm) deep with vertical bus

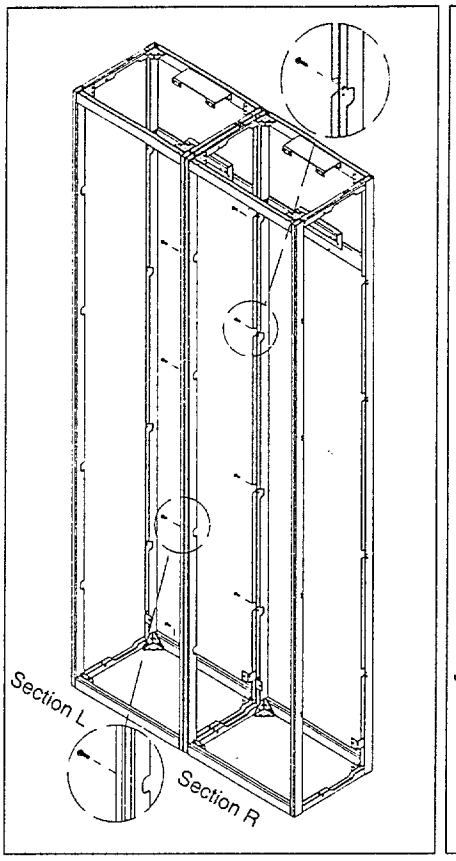

Figure 9: All 15" (381 mm) or 20" (508 mm) deep without vertical bus

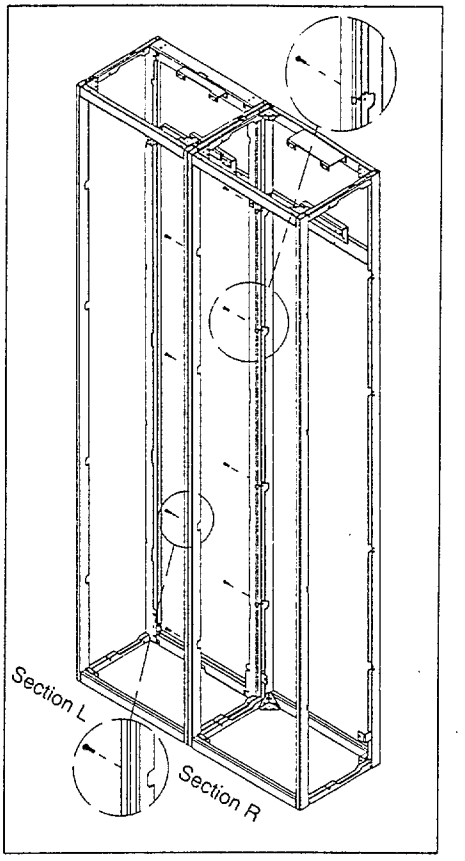

Figure 10: 15" (381 mm) deep; one section with vertical bus, one without

NOTE

Although sections are free-standing, floor fastening prevents movement, thereby preventing conduit connection damage.

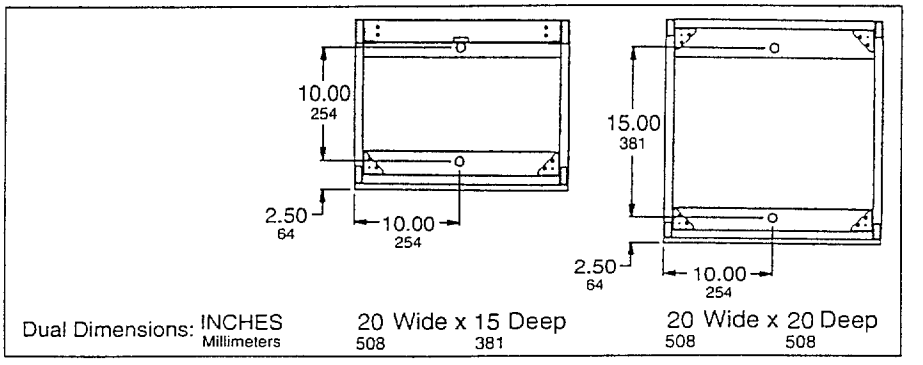

Figure 11: Base channel mounting

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Power Bus Splicing

To splice the power bus, follow these steps:

1. Remove the horizontal bus access covers from sections L and R (figure 12).
2. On the integral splice assembly, located on the left side of each phase bus, the number of bus links is one greater than the number of horizontal bus laminations. This creates a sandwich splice. The rear-most splice link contains the captive nuts.
3. Remove the two left bolts. Loosen, but do not remove, the two right bolts on the splice assembly (figure 13).

NOTE

Do not remove the two right bolts from the splice assembly. Doing so will permit bus spacers to fall from the splice assembly.

4. Grasping the bottom of the splice assembly, slide the bus links to the left until the two left holes are in line with the corresponding holes in the horizontal bus on the left section (figure 14).

   Reinstall the two left bolts through the splice links and into the horizontal bus; make sure the original washers are reinstalled (figure 15). Torque all bolts, on both ends, to 31–32 lb-ft (41.87–43.22 N•m).
5. Repeat steps 1–4 for all phases and the neutral bus (if supplied).

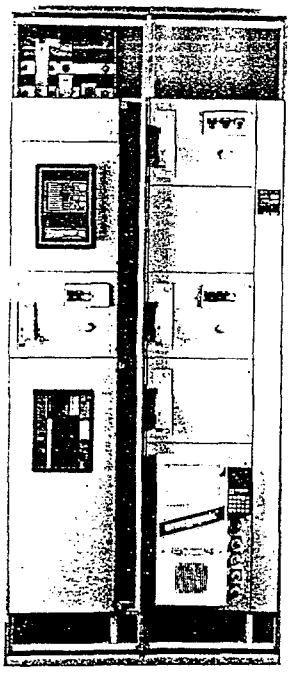

Figure 12: Horizontal bus covers removed

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Power Bus Splicing (cont.)

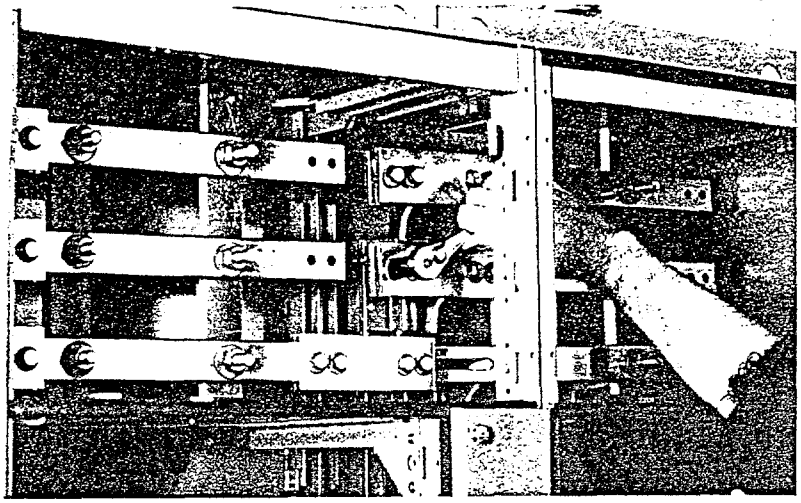

Figure 13: Loosening right bolts on splice assembly

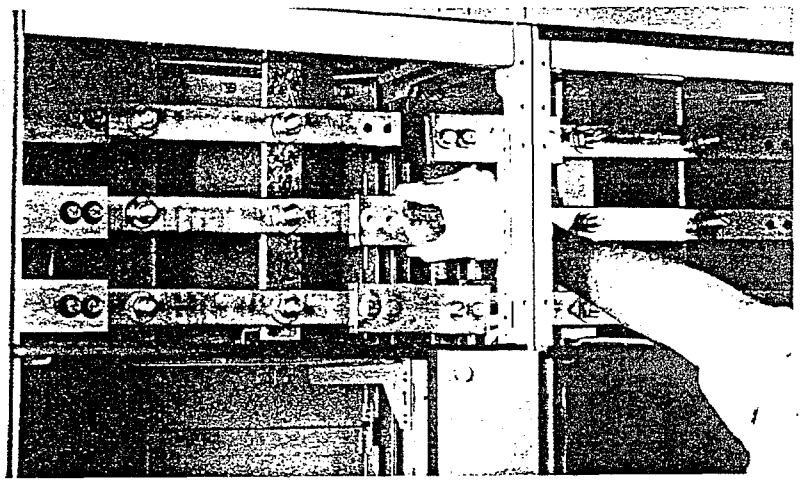

Figure 14: Aligning splice and bus holes

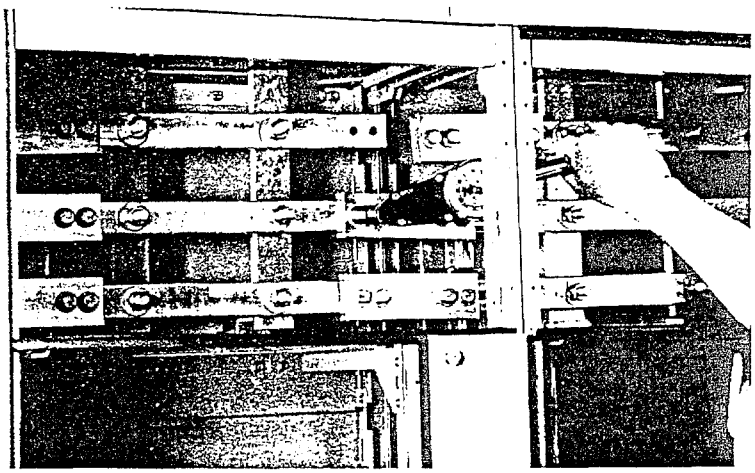

Figure 15: Torquing bolts

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Ground Bus Splicing

To splice the ground bus, follow these steps:

1. Remove the ground bar bolt from section *R* and loosen the bolt in section *L* (figure 16).
2. Rotate the ground splice bar into section *R*, aligning the mounting holes (figure 17).
3. Replace the ground bar bolt (figure 18). Torque both bolts to 60–75 lb-in (6.75–8.44 N•m).
4. Replace all covers and barriers and close all doors.

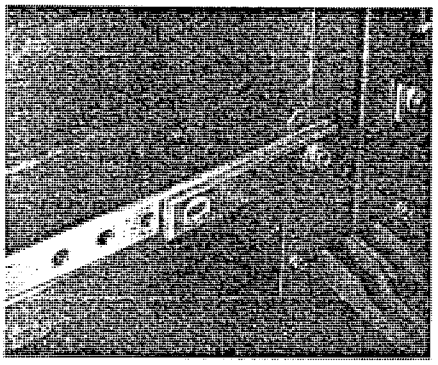

Figure 16: Ground bar bolt removed

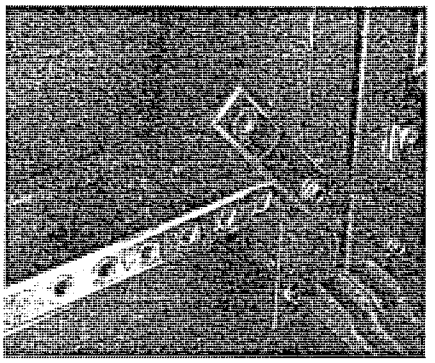

Figure 17: Rotating ground splice bar

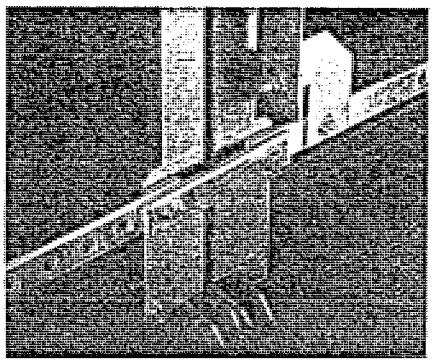

Figure 18: Ground bar bolt replaced

Conductor Entry

Access to the main lug, main circuit breaker, or main switch compartment is gained through a hinged door. In some cases, removal of the horizontal wire trough cover is also required. The top plates (and closing plates in bottom, if present) are removable for convenience in wiring and cutting conduit openings (figure 19).

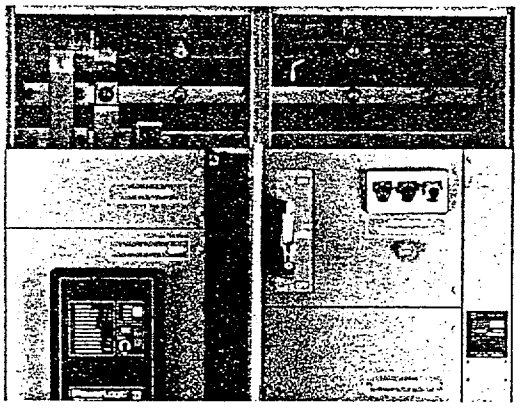

Figure 19: Top plate removed

If the cable is routed through the top of the motor control center, the cable can be supported at the entry point and the top plate; see NOTE on page 13.

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Conductor Entry (cont.)

When cable is routed through the bottom, and the cable goes to lugs at the bottom of the section, support the incoming line cables at the entry point; see NOTE below.

NOTE

For maximum available fault current, the customer must support and restrain the incoming power wiring when specified. Refer to the label inside the main compartment door.

If additional wiring space is required, extra pullboxes can be ordered.

For available fault currents over 42,000 amperes rms symmetrical, further support can be added by restraining cables with a tight lacing of 3/8" (10 mm) hemp rope or a material of equal strength. Begin lacing cables together as close as possible to lug connection points in the incoming line compartment. Continue lacing to the conduit entry point. Anchor the first and last ties securely to the motor control center frame to prevent slipping. The label inside the main compartment door specifies what spacing to use for any required lacing.

⚠ CAUTION

HAZARD OF EQUIPMENT DAMAGE.

Cables *must* be properly supported and restrained as detailed above.

Failure to follow this precaution can result in equipment damage.

Cable connection torque values are listed in table 2 on page 14.

Where more than one main lug compartment is approved for required ampacity, make sure the total current is equally divided between all incoming line cables.

Load and Control Wiring

The top (figure 20) and bottom horizontal wire troughs and the vertical wire trough are convenient areas to run load and control wires. Openings between sections permit wire to pass from one section into the next for interwiring.

Control and unit wires are routed to each unit via grommeted wire ports. The H-shaped cut pattern is pre-scored for easy opening. Using a small knife, cut through the center tabs and complete the H-shaped slice (figure 21). Make sure wires near the grommet being cut are not damaged by the cutting.

Pull-apart control terminals (figure 22) are mounted on a 35 mm DIN-rail located adjacent to the wiring ports toward the front of the unit. Terminate field control wiring on the removable portion of the block.

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Load and Control Wiring (cont.)

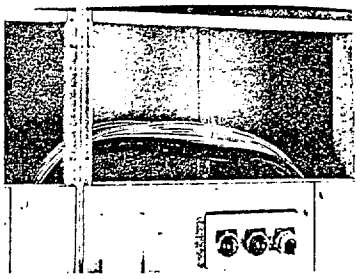

Figure 20: Wiring in top horizontal wire trough

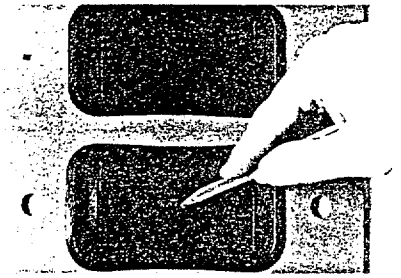

Figure 21: Cutting vertical wire trough grommet

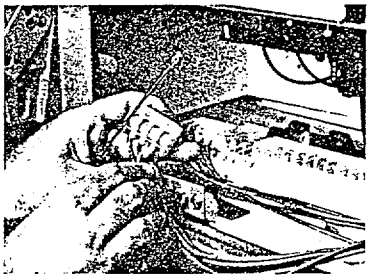

Figure 22: Pull-apart terminals

Cable Connection Torque Values

Table 2
Main Lug Compartment, Main And Branch Feeders
Connection Torque Values

Main Lug Compartments		
Socket Size Across Flat		Torque
3/8"		375 lb in (42.21 N•m)
Main And Branch Feeders		
Frame Size	Ampere Rating	Torque
FA	15–30A 35–100A	35 lb-in (3.94 N•m) 80 lb-in (9.00 N•m)
FC	20–30A 40–100A	35 lb-in (3.94 N•m) 65 lb-in (7.32 N•m)
KA	70–225A	250 lb-in (28.14 N•m)
KC	110–250A	250 lb-in (28.14 N•m)
LA	125–400A	200 lb-in (22.51 N•m)
MA	200–400A 450–1000A	300 lb-in (33.76 N•m) 300 lb-in (33.76 N•m)
PA	800–2000A	300 lb-in (33.76 N•m)

Instructional Information

Instructional information, including thermal overload selection data, is listed on the inside of the vertical wire trough door of each section. This information is also listed in this bulletin; see sections 11 and 12, beginning on page 39. Select proper thermal overloads from the applicable starter size tables.

Standard Motor Circuit Protector (MAG-GARD®) Circuit Breaker Application

The National Electrical Code (NEC) and Canadian Electrical Code (CEC) require that magnetic starters, used in combination with adjustable magnetic trip-only circuit breakers, have an overload relay in each conductor.

The adjustable magnetic trip setting is factory-set at *Lo*. This setting may have to be adjusted for proper motor start-up (figure 23). Refer to magnetic trip setpoint limits outlined in the applicable national standards.

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Standard Motor Circuit Protector (MAG-GARD) Circuit Breaker Application (cont.)

After obtaining the motor FLC from the motor nameplate, select an adjustable trip setpoint to test-start the motor. Further adjustments may be required because of motor load characteristics. Refer to applicable national standards for permissable setpoints.

NOTE

Select MAG-GARD® circuit breakers from the MAG-GARD selection table in the Square D Digest. These circuit breakers are suitable for motors with locked-rotor indicating code letters per the applicable national codes and standards. For other motors, consult your local Square D/Schneider Canada representative.

Fuse Clip Location

Install 30 and 60 amp fuse bases for the proper fuse class and maximum voltage. The base pan of the switch has five sets of mounting holes for this purpose. Mount the lower fuse base in the proper mounting holes per figure 24.

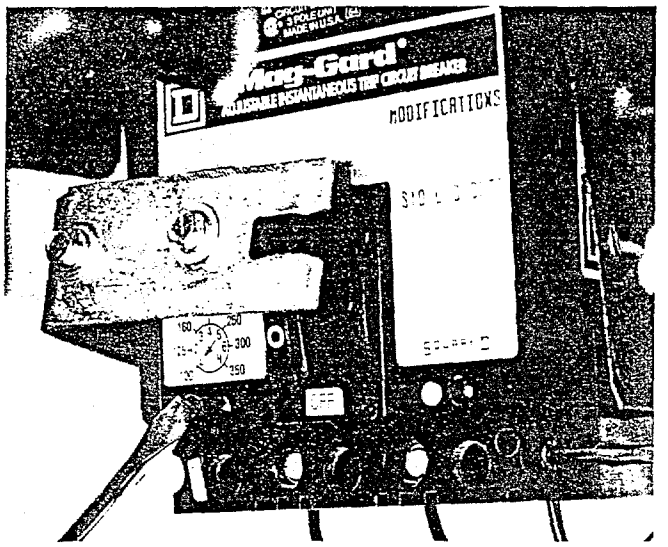

Figure 23: Adjusting MAG-GARD magnetic trip setting

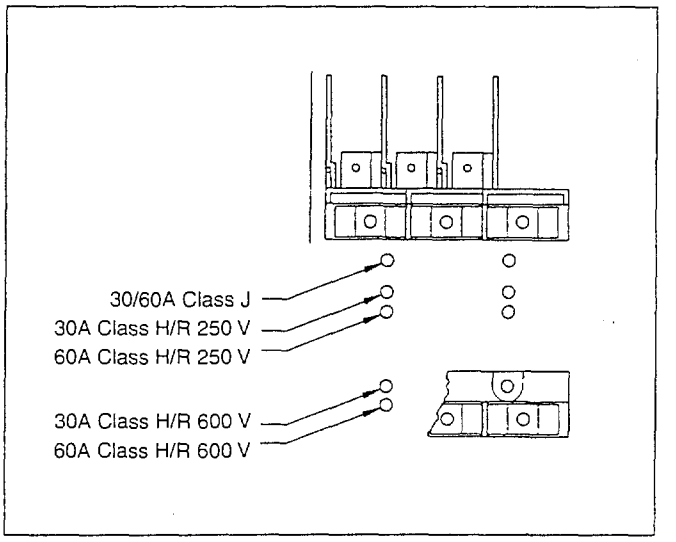

Figure 24: Fuse clip location

NOTE

For Form II Class C fuse spacing, contact your Schneider Canada representative.

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Pre-Operational Checklist

To ensure proper operation of the motor control center, check the items listed below *before energizing the motor control center*:

- ❑ 1. Complete the maintenance procedures, beginning on page 18 and continuing up to **Insulation Test** on page 26. This initial maintenance is necessary to detect any shipping damage or loose connections. Do not energize the motor control center until initial maintenance is complete.
- ❑ 2. Perform an insulation test on the motor control center (see **Insulation Test**, page 26).
- ❑ 3. If the motor control center is equipped with ground fault protection, properly adjust and test the ground fault protective device before energizing.
- ❑ 4. Remove all blocks or other temporary holding means from the electrical devices.
- ❑ 5. Remove the secondary shunt bar from the current transformers. Do not operate a current transformer with its secondary open-circuited.
- ❑ 6. Manually exercise all switches, circuit breakers, and other operating mechanisms to ensure they are properly aligned and operate freely.
- ❑ 7. Electrically exercise all electrically-operated switches, circuit breakers and other mechanisms (but not under load) to ensure that the devices operate properly. An auxiliary source of control power may be required.
- ❑ 8. Check timers for the proper interval and contact operation.
- ❑ 9. Check overload selection tables against motor full load current to ensure that proper overload units are installed.
- ❑ 10. Make certain all load and remote control connections have been made and that they agree with wiring diagrams provided.
- ❑ 11. Make certain all ground connections are made properly.
- ❑ 12. Install covers and close doors; ensure all are properly tightened.

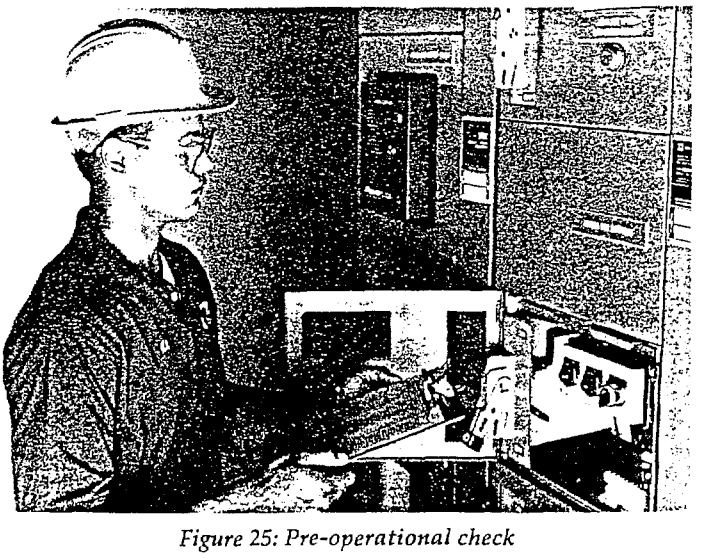

Figure 25: Pre-operational check

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SECTION 5—ENERGIZING EQUIPMENT

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION.

Energizing a motor control center for the first time is potentially dangerous; therefore, only qualified personnel should energize the equipment. If faults caused by damage or poor installation practices are not detected in the Pre-Operational Checklist on page 16, personal injury and serious equipment damage may result when the power is turned on.

Failure to observe these precautions will result in electric shock, severe personal injury, or death!

To minimize the risk of personal injury and equipment damage, make certain there is no load on the motor control center when it is energized. Turn off all downstream loads, including distribution equipment and other devices which are remote from the motor control center. Energize the equipment in sequence by starting at the source end of the system and working toward the load end. Specifically, energize the main devices first, then the feeder devices, and then the branch-circuit devices. With barriers in place (if applicable) and unit doors closed and latched, turn on the devices with a firm, positive motion. Protection devices that are not quick-acting should not be slowly moved into the closed position.

After all disconnect devices are closed, loads such as lighting circuits, starters, contactors, heaters, and motors may be energized.

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SECTION 6—MAINTENANCE

Before energizing any new motor control center equipment, perform the maintenance described in this section. Perform regular maintenance at least annually, or more frequently if indicated by service conditions and your established maintenance policy. Also perform maintenance following any service electrical fault or unusual occurrence.

Enclosure

Examine the interior and exterior of the motor control center for moisture, oil, or other foreign material. Eliminate all foreign material and clean the motor control center.

Clean the interior and exterior of the motor control center with a vacuum cleaner. *Do not use compressed air; it will redistribute contaminants to other surfaces.* Check the enclosure for damage that might reduce electrical clearances.

Examine the finish of the enclosure. Touch up the paint if necessary. Replace any badly corroded or damaged enclosure parts.

Bus Bars And Incoming Line Compartments

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION.

A hazard of electrical shock, burn, or explosion exists whenever working in or around electrical equipment. Turn off power supplying the equipment before working on it.

Failure to observe this precaution will result in electric shock, severe personal injury, or death!

Perform maintenance of bus and incoming line lug connections at least annually, or more frequently if indicated by service conditions and your established maintenance policy. Follow the steps below at the time of installation to locate and tighten any connections which may have loosened during shipment and handling:

1. Remove the top horizontal wire trough covers in each section.
2. Expose the bus and bus connections by removing the two-piece bus barrier in each section.
3. Examine all bus bars and connectors. Replace any parts that are badly discolored, corroded, or pitted. Also replace parts subjected to excessive temperatures.

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Bus Bars And Incoming Line Compartments (cont.)

⚠ CAUTION

HAZARD OF EQUIPMENT DAMAGE.

- Never brush or use sandpaper on the bus; doing so will remove plating and cause oxidation. Use a cleaning fluid approved for such use. Do not use cleaning fluid on insulators.
- Do not attempt to clean bus bars or connectors which are damaged in any way. Replace them with new parts.

Failure to observe these precautions can result in equipment damage.

4. Check, and tighten if necessary, all bolts at the bus connection points indicated by a hexagon in figure 26. Although one specific type of compartment or bus is shown in figure 26, perform this maintenance on all bolted connections. Refer to table 3 below for torque values.

Table 3
Bus Connection Torque Values

Bolted Connection Location	Torque Range
Horizontal Bus (All Locations)	68–70 lb-ft (92.29–94.54 N•m)
Splice Bars—0.375" Dia. Bolts	31–32 lb-ft (41.64–43.33 N•m)
Horizontal Ground Bus (All Locations)	5–6 lb-ft (6.75–8.44 N•m)

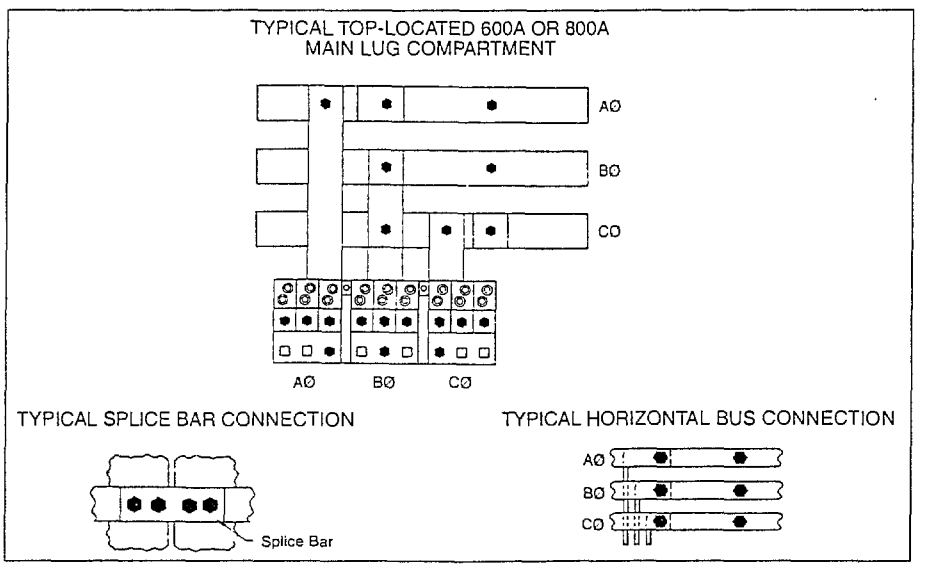

Figure 26: Typical bus connection points

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Bus Bars And Incoming Line Compartments (cont.)

5. Check, and tighten if required, all main lug set screws holding incoming conductors in main lugs (figure 27). Using a torque wrench and a 3/8" allen bit, torque the lug set screws to 375 lb-in (42.21 N•m). This applies to both aluminum and copper conductors.

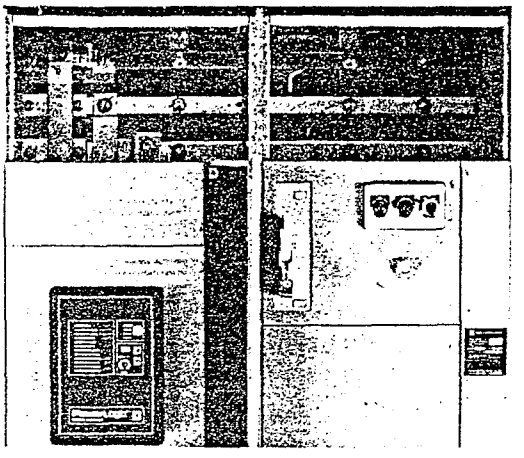

Figure 27: Top-located main lug compartment

6. Inspect all insulators, braces, and barriers; replace any showing signs of arcing damage, tracking, excessive heat, or cracking.

Control Units

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION.

Control units *must* be de-energized before maintenance is performed. Check for live circuits using a voltmeter. De-energize any sources of voltage found.

Failure to observe these precautions will result in electric shock, severe personal injury, or death!

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Control Units (cont.)

Perform maintenance on control units at least annually, or more frequently if indicated by service conditions and your established maintenance policy. During installation, locate and tighten any connections which have loosened during shipment and handling, using the following procedures. If the control unit (figure 28) is being removed from the motor control center for maintenance, begin with **Control Unit Removal**, below. If maintenance is performed with the control unit installed, begin with **Circuit Breaker or Disconnect Switch**, page 24.

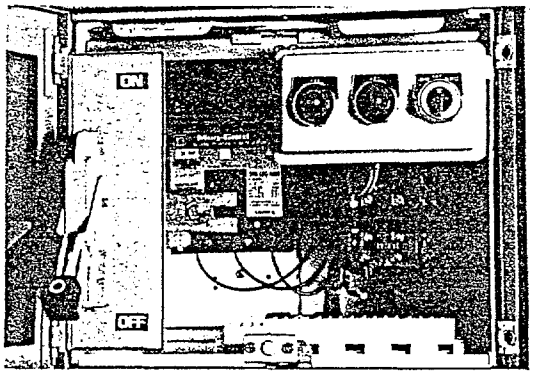

Figure 28: Control unit

Control Unit Removal—The Model 6 Motor Control Center is designed for convenient and quick control unit removal and replacement. Follow these steps to remove control units:

1. Move the operating mechanism to the *off* position (figure 29).
2. Loosen the captive quarter-turn fasteners (figure 30) on the door and open it. Check for live circuits using a voltmeter. De-energize any voltage sources.

NOTE
To clear the door cutout on circuit breaker disconnect units, fully depress the handle operator while opening.

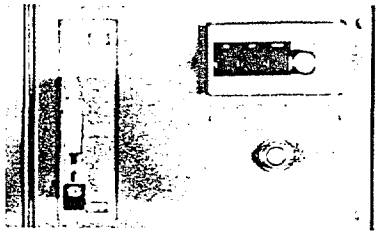

Figure 29: Operating mechanism in off position

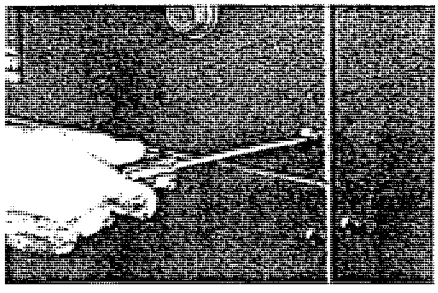

Figure 30: Loosening captive quarter-turn fasteners

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Control Units (cont.)

⚠ DANGER

HAZARD OF BODILY INJURY OR EQUIPMENT DAMAGE.

The control unit is interlocked with the motor control center structure to prevent the unit from being withdrawn while the disconnect is in the *On* position. Do not attempt to remove the unit from the structure with the disconnect in the *On* position.

Failure to observe this precaution will result in severe personal injury, death, or equipment damage!

4. Release the lock-in device located at the bottom front of the unit by loosening the screw on the front of the device until the locking pawl is parallel to the bottom of the unit (figure 31).
5. Disconnect the power wiring from the starter terminals or, if provided, the power terminal blocks. Tag the terminations for re-installation (figure 32).

   Remove the top portion of the pull-apart control terminal blocks to which field wiring is connected.

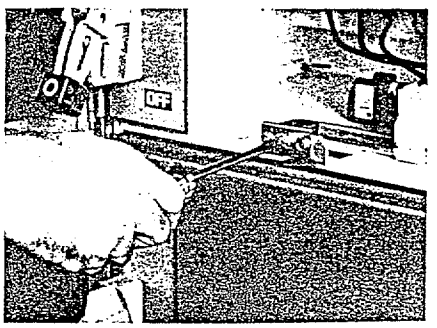

Figure 31: Releasing lock-in device

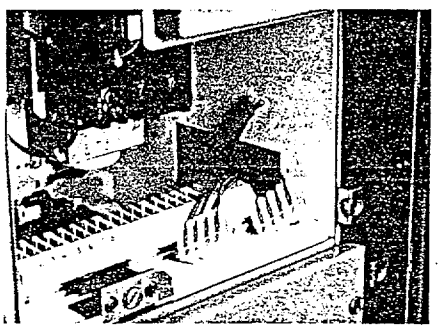

Figure 32: Disconnected terminal blocks

6. Push the power leads and the top portion of the control pull-apart terminal blocks through the grommeted wiring port and into the vertical wire trough (figure 33).
7. Pull forward on the twin-handle cam mechanism located at the top front of the unit to rack the unit partially out of the structure (figure 34). This

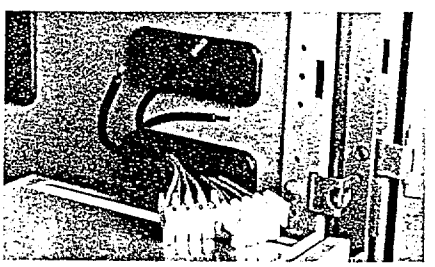

Figure 33: Power leads and top of terminal blocks fed through flap

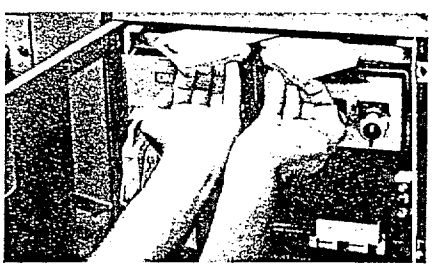

Figure 34: Pulling twin-handle cam mechanism forward

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Control Units (cont.)

action disconnects the power stabs from the vertical bus. Continue pulling forward until the handles are fully extended.

8. The operating mechanism-to-structure interlock prevents the control unit from being withdrawn with the handle in the *on* position (figure 35).
9. If the withdrawn unit is left in the structure, use a padlock to prevent non-authorized personnel from re-loading it (figure 36).
10. Remove the control unit from the structure for servicing. To prevent damage to the stab assembly, place the unit flatly on its bottom plate (figure 37).

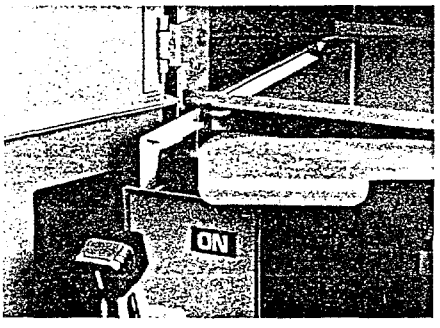

Figure 35: Operating mechanism-to-structure interlock

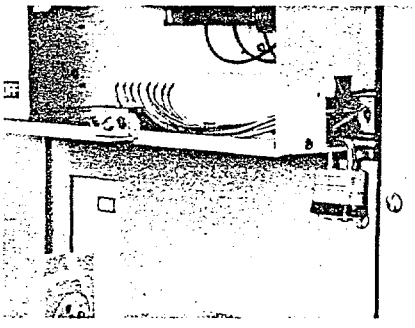

Figure 36: Padlocked

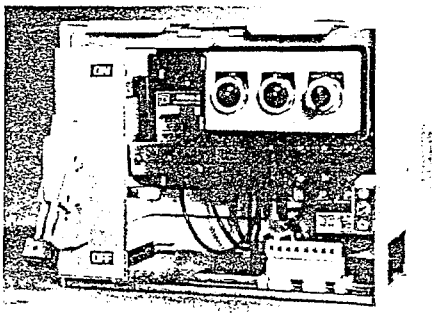

Figure 37: Control unit removed

11. If necessary, the door can be taken off its hinges without removing the unit. To do so, drive the hinge pins out of the hinge collars, using a small flat-bladed screwdriver or small punch (figure 38). Remove the bottom hinge pin first. One end of each pin is knurled to secure it into the hinge collar.
12. After driving the knurled section of the hinge pin out of the collar, use needle-nose pliers to grip the pin and remove it (figure 39).
13. When reinstalling, make certain that the knurled end of the hinge pin is fully engaged into the hinge collar. The taper line on the knurled end should be flush with the end of the hinge collar.

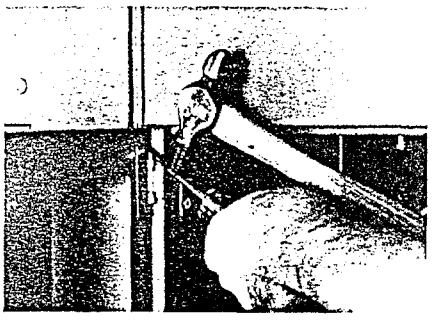

Figure 38: Driving out hinge pin

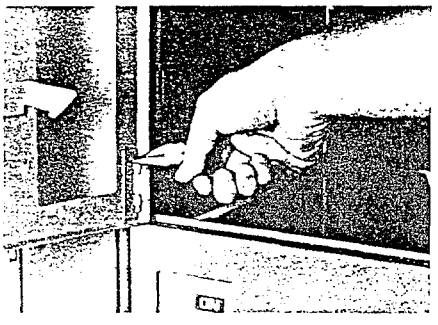

Figure 39: Removing hinge pin

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Control Units (cont.)

Once the control unit is removed, perform the following tests and maintenance:

Stab Assemblies—Check stab assemblies (figure 40) for signs of arcing or overheating; Replace the disconnect assembly immediately if overheating has occurred.

NOTE

If the stab assembly is badly pitted, the vertical bus may also need to be replaced.

See Circuit Breaker And Fusible Switch Selection table, page 38, for replacement disconnect assemblies.

⚠ CAUTION

HAZARD OF EQUIPMENT DAMAGE.

Do not remove the protective lubricant from the stabs. If additional lubricant is required, order Square D electrical joint compound #PJC-7201.

Failure to observe this precaution can result in equipment damage.

Circuit Breaker or Disconnect Switch—Check the circuit breaker or disconnect switch for proper operation. Check switch blades; if there is evidence of arcing or excessive heat, replace the switch assembly. Exercise the *push-to-trip* feature on circuit breakers.

Operator Mechanism—Check for proper operation of the operator mechanism. Test for proper *on, off, trip,* and *reset* indication (figure 41). Check for proper door interlock operation.

Fuses—Check all fuses and fuse clips (figure 42). Replace any parts showing signs of overheating or arcing.

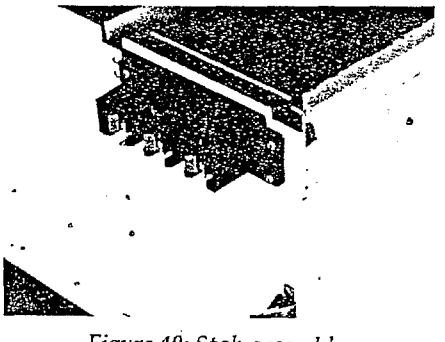

Figure 40: Stab assembly

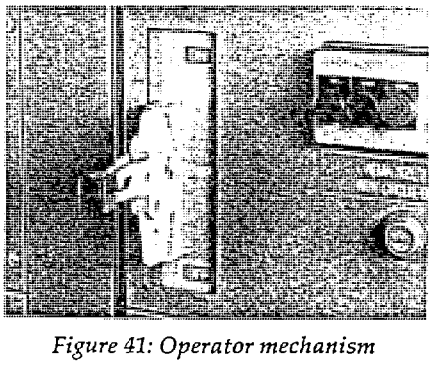

Figure 41: Operator mechanism

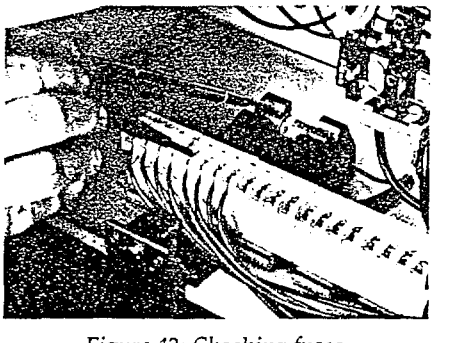

Figure 42: Checking fuses

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Control Units (cont.)

Starter Contacts—Check the starter contacts (figure 43). Replace any that are badly worn or pitted.

Control Devices—Check for proper operation of starters, relays, timers, and other control devices (figure 44).

Starter Interlocks—Check mechanical interlocks on reversing, multi-speed, or reduced voltage starters.

Overload Relay—Manually trip the overload relay to ensure proper operation (figure 45). Check that the thermal unit is the proper size for the application. Refer to thermal unit selection tables on the inside of the vertical wire trough doors.

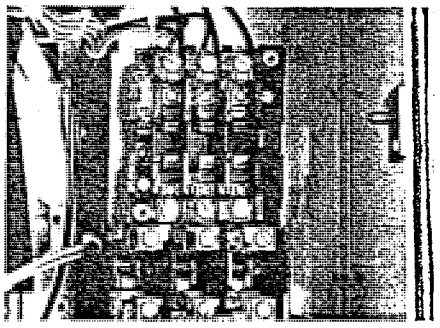

Figure 43: Starter contacts

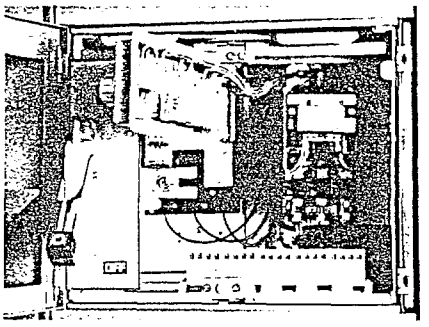

Figure 44: Control devices

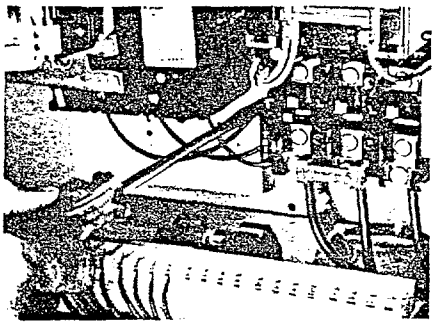

Figure 45: Tripping overload relay

Wiring And Electrical Connections—Check all electrical connections; tighten if necessary (figure 46). Also inspect all power and control wire, replacing any wire that has worn insulation or shows signs of overheating or cracking.

Barriers/Insulators—Inspect all insulators, braces, and barriers (figure 47); replace any showing signs of arcing damage, tracking, excessive heat, or cracking.

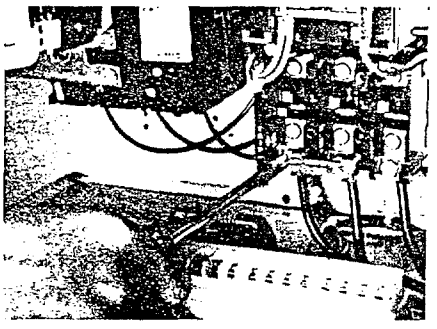

Figure 46: Tightening electrical connections

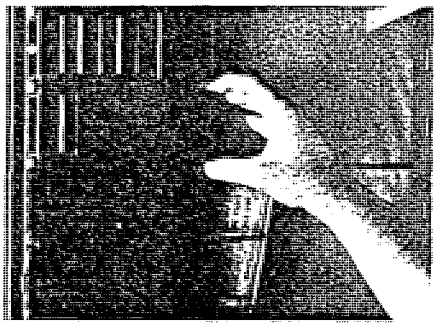

Figure 47: Checking manual bus shutter

Special Units—Follow the manufacturer's recommended maintenance procedures for special units (automatic transfer switches, controllers, etc.).

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Control Units (cont.)

Reassembly—To reassemble the motor control center after testing and maintenance, follow the steps below:

> **⚠ CAUTION**
>
> **HAZARD OF EQUIPMENT DAMAGE.**
>
> Do not remove the protective lubricant from the stabs. If additional lubricant is required, order Square D electrical joint compound #PJC-7201.
>
> **Failure to observe this precaution can result in equipment damage.**

1. Reinstall all units. For unit replacement, reverse steps 1–13 under **Control Unit Removal**, pages 21–23.
2. Replace all barriers and cover plates.

Insulation Test

> **⚠ DANGER**
>
> **HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION.**
>
> A hazard of electric shock, burn, or explosion exists whenever working on or around electrical equipment. Turn *off* power supplying this equipment before working inside motor control centers.
>
> **Failure to observe this precaution will result in electric shock, severe personal injury, or death!**

> **⚠ CAUTION**
>
> **HAZARD OF EQUIPMENT DAMAGE.**
>
> Do not megger solid state devices, capacitor units, or any devices which are not designed to withstand megger voltage. Disconnect these devices before testing the rest of the motor control center.
>
> **Failure to observe these precautions can result in equipment damage.**

Before a motor control center is placed into service (after installation or regular maintenance), take resistance measurements. Use an insulation tester (megger) with a potential of 500–1000 volts.

Take readings between each phase and from each phase to ground, with the branch disconnects *off* and *on*. Make sure the main disconnect is *off* during all megger tests.

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Insulation Test (cont.)

Megger readings with all disconnects *off* will typically be 5–20 megohms. On new equipment which has been stored in a damp area, lower readings occur during start-up. If the readings are below one megohm, a few branch units may be energized to help dry out the motor control center. If additional readings are above one megohm, additional units can be energized. After the equipment has been in operation for 48 hours, readings should be in the 5–20 megohm range.

When megger readings are taken with the disconnects *on* (except for the main), disconnect all devices completing circuits between phases or between phases and neutral (e.g., control transformers). Although readings may be slightly different, observe the one megohm lower limit during start-up.

Record all megger readings on the Insulation Resistance Chart, page 48. Any sudden change in resistance values (even within the acceptable range) may indicate potential insulation failure. Early detection and replacement of faulty insulating components helps avoid equipment damage.

If megger readings are below 5 megohms (one megohm during start-up) consult your local Square D field office.

Return the motor control center to service. Energize the main first; then energize the branch units, one at a time. (See **Energizing Equipment**, page 17).

Maintenance After A Fault Has Occurred

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION.

To prevent accidental contact with live parts, all equipment *must* be de-energized, disconnected, and isolated. Check for voltage on all control terminals and on all line and load terminals of circuit breakers, disconnect switches, and starters or contactors before working on this equipment. Only qualified personnel should be involved in the inspection and repair procedure, and all safety procedures must be observed.

Failure to observe these precautions will result in electric shock, severe personal injury, or death!

Excessive currents occurring during a fault may result in structure, component, and/or bus and conductor damage. This damage is due to mechanical distortion, thermal damage, metal deposits, or smoke caused by fault currents. After a fault, locate and correct the cause of the fault. Inspect all equipment, and make any necessary repairs or replacements before putting the equipment into service again. Make sure all replacement parts are of the proper rating and are suitable for the application. If in doubt, consult your local Square D field office.

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Maintenance After A Fault Has Occurred (cont.)

After any fault, perform all maintenance procedures, starting on page 18 and continuing up to **Insulation Test** on page 26. Also perform the following procedures after a fault:

1. If the fault occurred downstream from the motor control center, perform appropriate maintenance on all equipment involved.
2. Examine the enclosure. External evidence of enclosure damage usually indicates damage within. Extensive damage requires replacement of the enclosure parts and the enclosed equipment.
3. Replace any parts that are damaged or deformed. Pay particular attention to door hinges and door closing hardware. Inspect the area around any damaged units (both inside and out) for displaced parts from the damaged unit. See **Enclosure**, page 18.
4. Examine bus bars and incoming line compartments; tighten all electrical connections to their proper torques. Replace any deformed bus bars or connectors, as well as any showing signs of arcing damage. Inspect all insulators for cracks or burn marks; replace any displaying these characteristics.
5. Follow maintenance procedures for control units. Begin with **Control Units**, page 20, and continue up to **Insulation Test**, page 26. Also perform the steps listed below:
   a. Examine the disconnect means for evidence of possible damage. Ensure that the operator mechanism properly turns the disconnect *on* and *off*. Exercise the *push-to-trip* feature on circuit breakers. Make sure that the operator mechanism properly resets the circuit breaker.
   b. Check that the door interlock prevents the unit door from opening while the disconnect is in the *on* position. See step 8, page 23, for interlock operation. (If the unit door *must* be opened while the unit is energized, *authorized* personnel must operate an interlock defeat mechanism [figure 48]).
   c. Check the motor starters for damage. Replace contacts and contact springs if the contacts are welded or show heat damage. If deterioration extends beyond the contacts, replace the entire contactor or starter.
   d. Replace the complete overload relay if the thermal units are burned out, or if there are any indications of arcing or burning on the relay.
   e. Inspect all fuses and fuse clips. Replace all fuses in a set, even if only one or two are open-circuited.
   f. Check all conductors and other devices within the units for signs of damage.
6. Complete an insulation test (page 26) before placing the motor control center back into service.
7. Complete the **Pre-Operational Checklist** on page 16.
8. Re-energize the equipment. See **Energizing Equipment**, page 17.

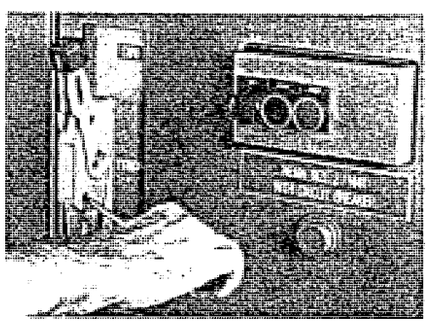

Figure 48: Operating door interlock defeat mechanism

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SECTION 7—EXPANSION

The modular design of motor control centers permits easy expansion to keep pace with an expanding electrical system.

When space is available in the existing motor control center, starter units can easily be added. When no more starter unit mounting space is available, vertical sections can be added to provide additional space.

Starter units may be rearranged or replaced with larger units. In most cases, a Size 2 starter unit can replace a Size 1 starter with no change in mounting space requirements.

Ordering Information

When ordering additional motor control center equipment, include the following information:

- Type of equipment being supplied
- Supply voltage, frequency, system type
- NEMA/EEMAC enclosure type
- Enclosure finish
- Control circuit voltage and frequency
- Optional control circuit components required (control transformers, push buttons, pilot lights, selector switches, etc.)
- Special features
- The factory order number of the original motor control center (the number is stamped into the structure nameplate on the vertical wire trough door; the unit label inside each control unit also contains the factory order number)

When ordering new vertical sections, also provide the following information:

- Horizontal and vertical bus capacity, material, and plating
- Bus bracing (or available fault current)
- Enclosure dimensions

Installing Additional Motor Control Center Control Units

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION.

A hazard of electric shock or burn exists whenever working on or around electrical equipment. Turn *off* power supplying this equipment before working inside motor control centers.

Failure to observe this precaution will result in electric shock, severe personal injury, or death!

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Installing Additional Motor Control Center Control Units (cont.)

Remove the manual bus shutter(s) (figure 49) to make room for the new control unit; slide out the top bus shutter.

If a control unit support shelf (figure 50) is not already present, install one at the top and/or bottom of the unit mounting space. The mounting feet at the rear of the shelf engage openings in the rear mounting plate. Secure the shelf in the front on the left and right, using the screws provided with the shelf.

Insert the hinges of the unit door into the slots on the left-hand side of the control unit compartment. Secure with the fasteners supplied (figure 51).

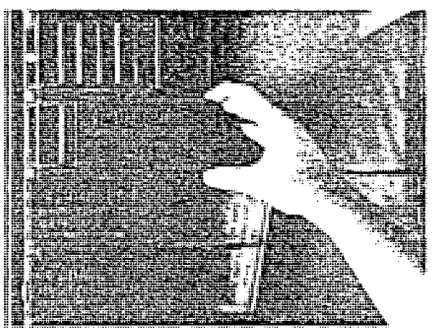

Figure 49: Removing manual bus shutter

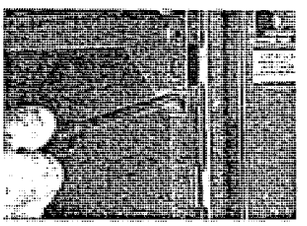

Figure 50: Securing control unit support shelf

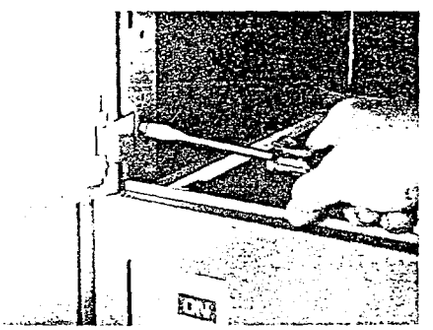

Figure 51: Securing control unit door hinge

Locate the vertical wire trough grommet (figure 52) nearest the bottom of the control unit. Cut the grommet, following the instructions on the grommet. See the second paragraph under **Load And Control Wiring**, page 13.

Make certain that the twin handles of the cam mechanism unit are extended fully forward (figure 53). Guide the control unit onto the hanging rails and slide the unit in until the twin handles engage the cam stud located on the support shelf.

Press the handles inward until they are flush with the face of the motor control center (figure 54).

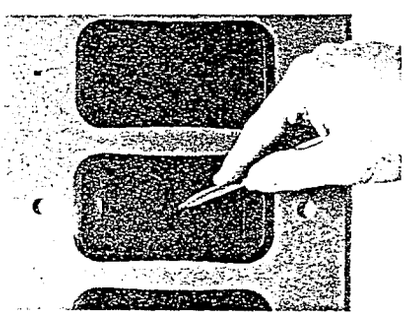

Figure 52: Cutting vertical wire trough grommet

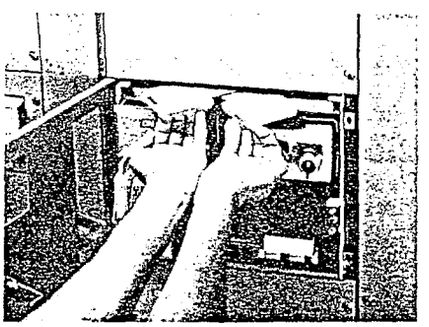

Figure 53: Pulling cam mechanism handles forward

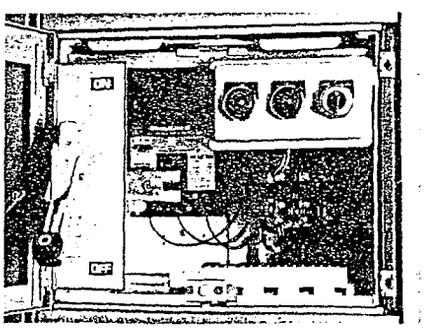

Figure 54: Handles flush with face of motor control center

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Installing Additional Motor Control Center Control Units (cont.)

Tighten the screw on the control unit lock-in panel (figure 55), located at the bottom front of the control unit, until the lock-in pawl is latched to the support shelf below the control unit. Continue until the screw is firmly tight; do not overtighten.

Pull the power leads from the vertical wire trough through the grommet and into the control unit; connect them to the power terminals in the control unit (figure 56).

Pull the control leads from the vertical wire trough through the grommet and connect them to the terminals of the top (removable) portion of the control pull-apart terminal blocks (figure 57).

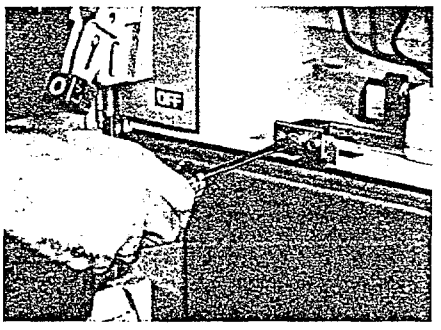

Figure 55: Tightening control unit lock-in panel

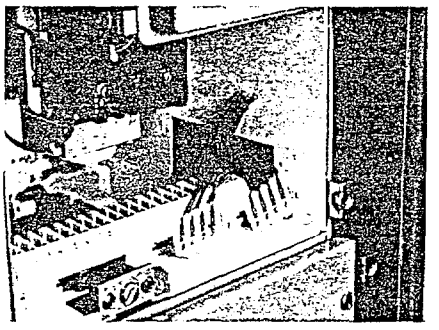

Figure 56: Power leads connected to power terminals

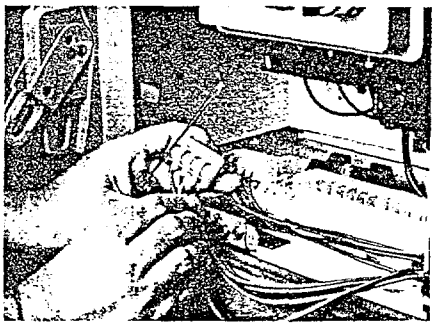

Figure 57: Connecting control leads to terminal blocks

Complete load and control wiring. See **Load and Control Wiring**, page 13.

Follow initial control unit maintenance procedures, starting with **Circuit Breaker or Disconnect Switch**, page 24, and continuing through **Special Units**, page 25.

Complete the **Pre-Operational Checklist**, page 16, on all new equipment.

Close all doors (figure 58) and close off all openings in the control center.

Return the motor control center to service (figure 59). See **Energizing Equipment**, page 17.

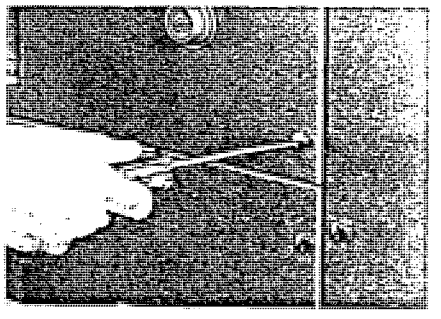

Figure 58: Securing door

Figure 59: Returning MCC to service

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Installing Additional Motor Control Center Sections

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION.

A hazard of electric shock or burn exists whenever working on or around electrical equipment. Before installing additional motor control center sections, turn *off* power supplying the existing motor control center. Check to ensure the existing motor control center is de-energized. Do not proceed until de-energization is confirmed.

Failure to observe these precautions will result in electric shock, severe personal injury, or death!

Adding new motor control center sections is similar to installing a new motor control center.

Remove the end closing plate from the end of the existing motor control center where the new section(s) are to be installed. Save the end closing plate and hardware for use on the end of the new section(s).

Follow the installation procedures under **Installation**, pages 6–16.

Follow maintenance procedures starting on page 18 and continuing up to **Insulation Test**, page 26.

Return the motor control center to service. See **Energizing Equipment**, page 17.

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SECTION 8—SPLICING

Offset Horizontal Bus (For Splicing On Left Side Of Structure Only)

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION.

Equipment must be de-energized before performing installation and maintenance procedures to prevent exposure of personnel to live parts.

Failure to observe this precaution will result in electric shock, severe personal injury, or death!

NOTE

In all structures with offset horizontal bus, splice bars are provided as a kit. This kit is packaged in a carton and shipped inside the structure. The kit contains all splice bars and mounting hardware necessary for horizontal bus splicing.

Use the splice kit only if splicing is to be done on the left (while facing the structure). If the splice is not on the left, remove the kit before energizing and retain for future expansion. If a structure is to be spliced to another structure on the right, follow splicing instructions provided for that structure application.

All splice connections have one more splice bar than laminations of horizontal bus (figure 60).

To splice horizontal bus on the left side of the structure, follow these steps:

1. Position structures to be spliced together; make sure the fronts are flush. This ensures proper alignment of the horizontal bus.
2. Position the rear splice bar (bar with clinch nuts, figure 60) against the back face of the rear horizontal bus bar.
3. Install a plain splice bar between each lamination of horizontal bus; install the last bar against the front face of the horizontal bus (figure 60).
4. Align the four mounting holes in the splice bus and the horizontal bus.
5. Install 3/8" mounting hardware (four bolts per splice); make sure the raised surface of each washer is positioned toward the bolt head.
6. *After* all hardware is installed, torque all bolts to 375 lb-in (42.21 N•m).
7. Repeat steps 1–6 for each of the three horizontal bus phases.
8. Before energizing equipment, replace all covers and barriers.

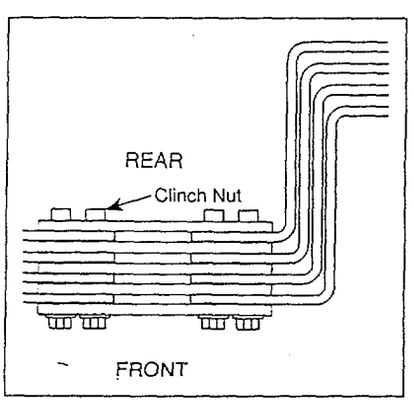

Figure 60: Splicing horizontal bus

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Splicing Type 3R Enclosures For Model 6

NOTE

Use the procedure shown in the illustrations on this page when adding to the right side of an existing Type 3R enclosure. When adding to the left side, follow the same procedure in mirror image (substitute *left* for *right* and *right* for *left*).

To install additional Type 3R sections to an existing motor control center, follow these steps:

1. Remove the back plate from the structure being added to the left side of the line-up. If the addition is a multi-section shipping split, remove only the left back plate.
2. Remove the end closing plate from the right side of the existing section.
3. Remove the mid deflector cap from the right side of the existing Type 3R enclosure (figure 61).
4. After placing the structures side by side, splice them together as described in section 8 of this bulletin.
5. Re-attach the back plate to the right section of structure , using the additional hardware supplied in the cloth bag. Attach the right side to the multi-section back bracket (figure 62).
6. Re-attach the mid deflector, ensuring that both top plate flanges are covered (figure 61).
7. Using the six 10-32 screws supplied in the cloth bag, secure the right front vertical channel of the existing Type 3R enclosure to the left front vertical channel of the additional Type 3R enclosure (figure 63).

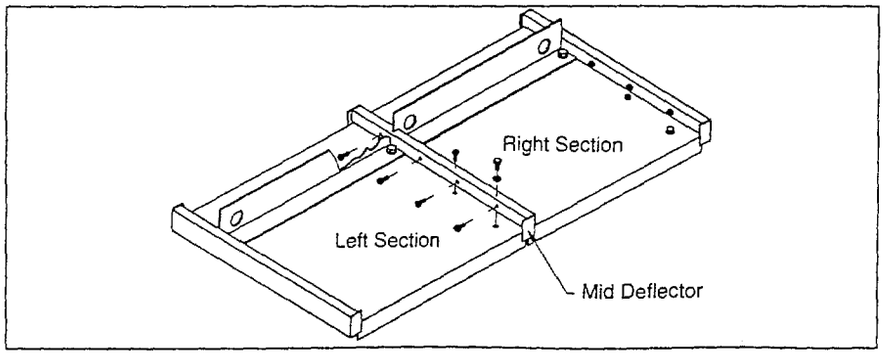

Figure 61: Removing mid deflector cap

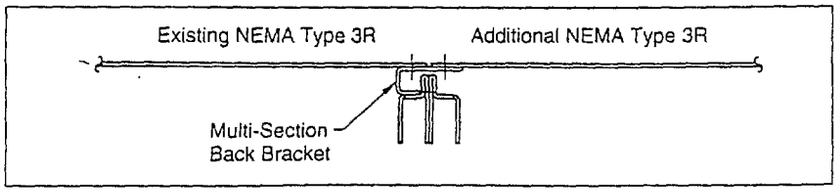

Figure 62: Attaching back plates to structure

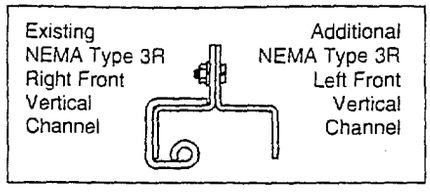

Figure 63: Securing vertical channels

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SECTION 9—TROUBLESHOOTING

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION.

A hazard of electric shock, burn, or explosion exists whenever working on or around electrical equipment. Turn *off* power supplying this equipment before working inside motor control centers.

Failure to observe this precaution will result in electric shock, severe personal injury, or death!

The following table lists problems encountered with motor control centers, their causes, and remedies. This table is of a general nature and covers only the main causes of problems.

Misapplication of a device can result in serious problems; however, rather than list this cause repeatedly below, note that misapplication is a major cause of motor control problems and must always be questioned when a device is not functioning properly.

Actual physical damage or broken parts can usually be quickly located and replaced. Damage due to water or flood conditions requires special treatment. Contact your local Square D/Schneider Canada field office.

Motor Control Center Troubleshooting Chart

Part	Problem	Cause	Remedy
CONTACTS	Contact Chatter (see Noisy Magnet also)	1. Poor contact in control circuit.	1. Replace the contact device or use holding circuit interlock (3-wire control).
		2. Low voltage.	2. Check coil terminal voltage and voltage dips during starting.
	Welding or Freezing	1. Abnormal inrush of current.	1. Check for grounds, shorts, or excessive motor load current; or use larger contactor.
		2. Rapid jogging.	2. Install larger device rated for jogging service.
		3. Insufficient tip pressure.	3. Replace contacts and springs; check contact carrier for deformation or damage.
		4. Low voltage, preventing magnet from sealing.	4. Check coil terminal voltage and voltage dips during starting.
		5. Foreign matter preventing contacts from closing.	5. Clean contacts with an environmentally safe (CFC-free) contact cleaner.
		6. Short circuit or ground fault.	6. Remove fault; ensure that fuse and circuit breaker size are correct.

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Motor Control Center Troubleshooting Chart (cont.)

Part	Problem	Cause	Remedy
CONTACTS (cont.)	Short Tip Life or Overheating of Tips	1. Filing or dressing.	1. Do not file silver tips; rough spots or discoloration do not harm tips or impair their efficiency.
		2. Interrupting excessively high currents.	2. Install larger device or check for grounds, shorts, or excessive motor currents.
		3. Excessive jogging.	3. Install larger device rated for jogging service.
		4. Weak tip pressure.	4. Replace contacts and springs; check contact carrier for deformation or damage.
		5. Dirt or foreign matter on contact surface.	5. Clean contacts with an environmentally safe (CFC-free) contact cleaner. Reduce entry of foreign matter into enclosure.
		6. Short circuits or ground fault.	6. Remove fault; ensure that fuse and circuit breaker size are correct.
		7. Loose connection in power circuit.	7. Clear and tighten.
		8. Sustained overload.	8. Check for excessive motor load current, or install larger device.
COILS	Open Circuit	1. Mechanical damage.	1. Replace coil; handle and store replacement coils carefully.
	Overheated Coil	1. Overvoltage or high ambient temperature.	1. Check coil terminal voltage, which should not exceed 110% of coil rating.
		2. Incorrect coil.	2. Install correct coil.
		3. Shorted turns caused by mechanical damage or corrosion.	3. Replace coil.
		4. Undervoltage; failure of magnet to seal in.	4. Check coil terminal voltage, which should be at least 85% of coil rating.
		5. Dirt or rust on pole faces.	5. Clean pole faces.
		6. Mechanical obstruction.	6. With power *off*, check for free movement of contact and armature assembly.
OVERLOAD RELAYS	Tripping	1. Sustained overload.	1. Check for excessive motor currents or current unbalance; correct cause.
		2. Loose or corroded connection in power circuit.	2. Clean and tighten connection.
		3. Incorrect thermal units.	3. Replace thermal units with the correct size for the application conditions.
		4. Excessive coil voltage.	4. Voltage should not exceed 110% of coil rating.
	Failure To Trip	1. Incorrect thermal units.	1. Check thermal unit selection table; Install proper thermal units.
		2. Mechanical binding, dirt, corrosion, etc.	2. Replace relay and thermal units.
		3. Relay previously damaged by short circuit.	3. Replace relay and thermal units.
		4. Relay contact welded or not in series with contactor coil.	4. Check circuit for a fault and correct condition. Replace contact or entire relay as necessary.

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Motor Control Center Troubleshooting Chart (cont.)

Part	Problem	Cause	Remedy
MAGNETIC AND MECHANICAL PARTS	Noisy Magnet	1. Broken shading coil. 2. Dirt or rust on magnet faces. 3. Low voltage	1. Replace magnet and armature. 2. Clean the magnet with a clean, dry cloth. 3. Check coil terminal voltage and voltage dips during starting.
	Failure To Pick Up And Seal	1. No control voltage. 2. Low voltage. 3. Mechanical obstruction. 4. Coil open or overheated. 5. Wrong coil.	1. Check control circuit wiring for loose connection or poor continuity of contacts. 2. Check for proper coil terminal voltage and voltage dips during starting. 3. With power ***off***, check for free movement of contact and armature assembly. 4. Replace. 5. Replace.
	Failure To Drop Out	1. Gummy substance on pole faces. 2. Voltage not removed. 3. Worn or corroded parts causing binding. 4. Residual magnetism due to lack of air gap in magnet path. 5. Contacts welded.	1. Clean pole faces with a clean, dry cloth. 2. Check coil terminal voltage and control circuit. 3. Replace parts. 4. Replace magnet and armature. 5. See **Contacts—Welding or Freezing,** page 35.
PNEUMATIC TIMERS	Erratic Timing	1. Foreign matter in valve.	1. Replace complete timing head, or return timer to factory for repair and adjustment.
	Contacts Do Not Operate	1. Maladjustment of actuating screw. 2. Worn or broken parts in snap switch.	1. Adjust per instruction in service bulletin. 2. Replace snap switch.
LIMIT SWITCHES	Broken Parts	1. Overtravel of actuator.	1. Use resilient actuator, or operate within tolerance of device.
MANUAL STARTERS	Failure To Reset	1. Latching mechanism worn or broken.	1. Replace starter.

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SECTION 10—CIRCUIT BREAKER AND FUSIBLE SWITCH SELECTION TABLE

Square D recommends replacing the entire disconnect assembly instead of replacing a circuit breaker or switch. The disconnect assembly includes the operating mechanism and the appropriate circuit breaker or switch. Replacing the entire assembly requires only the removal of four screws, a procedure that is much simpler and quicker than replacing an individual circuit breaker or switch. Always use replacement devices of the same type and rating as the device being removed. Using a different type of disconnect or one with a different rating may alter the short circuit ratings of the motor control center.

NEMA/EEMAC Size 1–4 combination starters with MAG-GARD® magnetic only circuit breakers. NEMA/EEMAC Size 5 combination starters with KA frame (225A maximum) MAG-GARD magnetic only circuit breakers:

To replace this circuit breaker:	Order this disconnect assembly:	To replace this circuit breaker:	Order this disconnect assembly:
FAP3600311M	M6DSAMG003M11*	FAP3610018M	M6DSAMG100M18*
FAP3600712M	M6DSAMG007M12*	KAP3625025M	M6DSAMG250M25*
FAP3601513M	M6DSAMG015M13*	KAP3625029M	M6DSAMG250M29*
FAP3603015M	M6DSAMG030M15*	KAP3625031M	M6DSAMG250M31*
FAP3605016M	M6DSAMG050M16*		

NEMA/EEMAC Size 1–4 combination starters with thermal-magnetic circuit breakers, NEMA/EEMAC Size 5 combination starters with KA frame (225A maximum) thermal-magnetic circuit breakers, main and branch feeder circuit breakers through 225A. For dual-mounted circuit breaker units, contact Square D or Schneider Canada representatives.

To replace this circuit breaker:	Order this disconnect assembly:	To replace this circuit breaker:	Order this disconnect assembly:
FAP36015	M6DSATM015M - -*	FAP36070TF	M6DSATM070M - -* U266
FAP36015TF	M6DSATM015M - -* U266	FAP36080	M6DSATM080M - -*
FAP36020	M6DSATM020M - -*	FAP36080TF	M6DSATM080M - -* U266
FAP36020TF	M6DSATM020M - -* U266	FAP36090	M6DSATM090M - -*
FAP36030	M6DSATM030M - -*	FAP36090TF	M6DSATM090M - -* U266
FAP36030TF	M6DSATM030M - -* U266	FAP36100	M6DSATM100M - -*
FAP36040	M6DSATM040M - -*	FAP36100TF	M6DSATM100M - -* U266
FAP36040TF	M6DSATM040M - -* U266	KAP36110	M6DSATM110M - -*
FAP36050	M6DSATM050M - -*	KAP36125	M6DSATM125M - -*
FAP36050TF	M6DSATM050M - -* U266	KAP36150	M6DSATM150M - -*
FAP36060	M6DSATM060M - -*	KAP36175	M6DSATM175M - -*
FAP36060TF	M6DSATM060M - -* U266	KAP36200	M6DSATM200M - -*
FAP36070	M6DSATM070M - -*	KAP36225	M6DSATM225M - -*

NEMA/EEMAC Size 1–4 combination starters with fusible switches

To replace this size switch:	Order this disconnect assembly:	To replace this size switch:	Order this disconnect assembly:
30A	M6DSAFS030M - -*†	100A	M6DSAFS100M - -*
60A	M6DSAFS060M - -*†	200A	M6DSAFS200M - -*

Main and branch feeder fusible switches through 200A (U266 denotes 9" [229 mm] branch fusible units)

To replace this size switch:	Order this disconnect assembly:	To replace this size switch:	Order this disconnect assembly:
30A	M6DSAFS030M - -*†	100A	M6DSAFS100M - -*
30A	M6DSAFS030M - -*U266†	200A	M6DSAAS250M - -*
60A	M6DSAFS060M - -*†		
60A	M6DSAFS060M - -*U266†		

Replacement of the operating mechanism is not required for NEMA/EEMAC Size 5 combination starters with LA frame (400A max.) circuit breakers, NEMA/EEMAC Size 5 combination fusible starters, NEMA/EEMAC Size 6 combination starters, main and branch circuit breakers over 225A, or for main and branch switches over 200A. Order a replacement circuit breaker or automatic molded case switch of the same type as the original device.

To order an FH/KH type high interrupting rating circuit breaker instead of the standard FA/KA type circuit breaker, add form Y532 to the disconnect assembly number.
Example: To replace an FHP36100, order an M6DSATM100M - - *Y532.
These modifications may also be added to disconnect assemblies when required:

Y74 Single pole interlock on operating mechanism
Y301 Current limiting module (for starter units Size 1–3)
Y303 Current limiting module (for 15–100A branch feeders)
Y312 Class R fuse clips
Y532 High interrupting circuit breaker
U203 Disconnect for NEMA/EEMAC Type 12 units

† Voltage form must be added:
U212 0–250 Volt
U213 above 250 Volt

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SECTION 11—MELTING ALLOY OVERLOAD SELECTION TABLES

Circuit Breaker Combination Starter Units

Select the proper thermal overload from the applicable starter size table below (see starter nameplate). For the selection procedure, refer to the **Thermal Unit Selection** section of the Square D *Digest.*

Size 1

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
0.56–0.63	B 0.81	3.23–3.49	B 4.85
0.64–0.68	B 0.92	3.50–3.85	B 5.50
0.69–0.77	B 1.03	3.86–4.11	B 6.25
		4.12–4.70	B 6.90
0.78–0.85	B 1.16		
0.86–0.97	B 1.30	4.71–5.21	B 7.70
0.98–1.09	B 1.45	5.22–5.53	B 8.20
1.10–1.21	B 1.67	5.54–6.17	B 9.10
		6.18–7.02	B 10.2
1.22–1.33	B 1.88		
1.34–1.53	B 2.10	7.03–7.92	B 11.5
1.54–1.73	B 2.40	7.93–8.61	B 12.8
1.74–1.89	B 2.65	8.62–9.17	B 14
		9.18–10.0	B 15.5
1.90–2.17	B 3.00		
2.18–2.53	B 3.30	10.1–11.0	B 17.5
2.54–2.87	B 3.70	11.1–11.8	B 19.5
2.88–3.22	B 4.15	11.9–13.5	B 22
		13.6–15.3	B 25
		15.4–17.4	B 28
		17.5–19.4	B 32
		19.5–22.2	B 36
		22.3–25.1	B 40
		25.2–27.0	B 45

Size 2

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
3.94–4.45	B 6.90	11.5–12.3	B 19.5
4.46–4.97	B 7.70	12.4–13.9	B 22
		14.0–15.8	B 25
4.98–5.28	B 8.20	15.9–17.9	B 28
5.29–5.97	B 9.10		
5.98–6.89	B 10.2	18.0–19.9	B 32
6.90–7.92	B 11.5	20.0–22.8	B 36
		22.9–25.4	B 40
7.93–8.71	B 12.8	25.5–28.9	B 45
8.72–9.27	B 14.0		
9.28–10.2	B 15.5	29.0–30.8	B 50
10.3–11.4	B 17.5	30.9–32.5	B 56
		32.6–34.9	B 62
		35.0–39.7	B 70
		39.8–44.7	B 79

Size 3

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
14.0–14.9	CC 20.9	34.1–36.8	CC 54.5
15.0–16.2	CC 22.8	36.9–39.8	CC 59.4
16.3–17.2	CC 24.6	39.9–42.3	CC 64.3
17.3–18.7	CC 26.3	42.4–45.7	CC 68.5
18.8–20.2	CC 28.8	45.8–49.2	CC 74.6
20.3–21.7	CC 31.0	49.3–52.8	CC 81.5
21.8–23.3	CC 33.3	52.9–56.8	CC 87.7
23.4–25.2	CC 36.4	56.9–61.2	CC 94.0
25.3–27.1	CC 39.6	61.3–66.1	CC 103
27.2–29.4	CC 42.7	66.2–71.2	CC 112
29.5–31.6	CC 46.6	71.3–76.7	CC 121
31.7–34.0	CC 50.1	76.8–82.9	CC 132
		83.0–90.0	CC 143

Size 4

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
44.0–46.8	CC 64.3	73.0–78.1	CC 112
46.9–50.6	CC 68.5	78.2–83.9	CC 121
50.7–54.5	CC 74.6	84.0–91.1	CC 132
54.6–58.4	CC 81.5	91.2–97.5	CC 143
58.5–62.9	CC 87.7	97.6–104	CC 156
63.0–67.7	CC 94.0	105–113	CC 167
67.8–72.9	CC 103	114–133	CC 180

Size 5

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
88.2–95.1	DD 112	171–180	DD 220
95.2–101	DD 121	181–197	DD 240
102–111	DD 128	198–204	DD 250
112–119	DD 140	205–213	DD 265
120–131	DD 150	214–237	DD 280
132–149	DD 160	238–243	DD 300
150–170	DD 185	244–266	DD 320

Size 5 (Form Y342)

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
40.8–45.5	B 1.03	105–114	B 2.65
45.6–49.9	B 1.16	115–128	B 3.00
51.0–57.5	B 1.30	129–140	B 3.30
57.6–65.9	B 1.45	141–160	B 3.70
66.0–73.1	B 1.67	161–193	B 4.15
73.2–81.5	B 1.88	194–209	B 4.85
81.6–92.3	B 2.10	210–232	B 5.50
92.4–104	B 2.40	233–248	B 6.25
		249–266	B 6.90

Size 6

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
133–148	B 1.30	272–308	B 2.65
149–174	B 1.45	309–348	B 3.00
175–195	B 1.67	349–397	B 3.30
196–219	B 1.88	398–429	B 3.70
220–239	B 2.10	430–495	B 4.15
240–271	B 2.40	496–520	B 4.85

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Melting Alloy Overload Selection Tables For Fusible Switch Combination Starter Units

Select the proper thermal overload from the applicable starter size table below (see starter nameplate). Size 5 (Form Y342) and Size 6 tables are at the top of page 41. For the selection procedure, refer to the **Thermal Unit Selection** section of the Square D *Digest*.

⚠ DANGER

HAZARD OF BODILY INJURY OR EQUIPMENT DAMAGE.

Do not exceed maximum fuse rating shown opposite the thermal unit selection. Time delay fuses may be necessary to permit motor starting. UL Class RK5/CSA Class R fuses are recommended.

Failure to observe this precaution will result in severe personal injury, death, or equipment damage!

Size 1

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)	Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)	
0.56–0.63	B 0.81	1.25	3.23–3.49	B 4.85	7.0	
0.64–0.68	B 0.92	1.40	3.50–3.85	B 5.50	7.0	
0.69–0.77	B 1.03	1.40	3.86–4.11	B 6.25	8.0	
			4.12–4.70	B 6.90	9.0	
0.78–0.85	B 1.16	1.60				
0.86–0.97	B 1.30	1.80	4.71–5.21	B 7.70	10.0	
0.98–1.09	B 1.45	2.0	5.22–5.53	B 8.20	10.0	
1.10–1.21	B 1.67	2.25	5.54–6.17	B 9.10	12.0	
			6.18–7.02	B 10.2	12.0	
1.22–1.33	B 1.88	2.5				
1.34–1.53	B 2.10	2.8	7.03–7.92	B 11.5	15.0	
1.54–1.73	B 2.40	3.2	7.93–8.61	B 12.8	17.5	
1.74–1.89	B 2.65	3.5	8.62–9.17	B 14	17.5	
			9.18–10.0	B 15.5	20.0	
1.90–2.17	B 3.00	4.0				
2.18–2.53	B 3.30	4.5	10.1–11.0	B 17.5	20.0	
2.54–2.87	B 3.70	5.6	11.1–11.8	B 19.5	20.0	
2.88–3.22	B 4.15	6.25	11.9–13.5	B 22	25.0	
			13.6–15.3	B 25	30.0	
					600V Max.	250V Max.
			15.4–17.4	B 28	30.	30.
			17.5–19.4	B 32	30.	35.
			19.5–22.2	B 36	30.	40.
			22.3–25.1	B 40	30.	40.
			25.2–27.0	B 45	30.	40.

Size 2

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Class Rating (Amperes)	Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Class Rating (Amperes)
3.94–4.45	B 6.90	8.0	11.5–12.3	B 19.5	25.0
4.46–4.97	B 7.70	10.0	12.4–13.9	B 22	25.0
			14.0–15.8	B 25	30.0
4.98–5.28	B 8.20	10.0	15.9–17.9	B 28	35.0
5.29–5.97	B 9.10	10.0			
5.98–6.89	B 10.2	12.0	18.0–19.9	B 32	40.0
6.90–7.92	B 11.5	15.0	20.0–22.8	B 36	45.0
			22.9–25.4	B 40	50.0
7.93–8.71	B 12.8	17.5	25.5–28.9	B 45	50.0
8.72–9.27	B 14.0	17.5			
9.28–10.2	B 15.5	20.0	29.0–30.8	B 50	60.0
10.3–11.4	B 17.5	20.0	30.9–32.5	B 56	60.0
			32.6–34.9	B 62	70.0
			35.0–39.7	B 70	70.0
			39.8–44.7	B 79	80.0

Size 3

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)	Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)	
14.0–14.9	CC 20.9	30.0	36.9–39.8	CC 59.4	80.0	
15.0–16.2	CC 22.8	30.0	39.9–42.3	CC 64.3	80.0	
16.3–17.2	CC 24.6	35.0	42.4–45.7	CC 68.5	90.0	
17.3–18.7	CC 26.3	35.0	45.8–49.2	CC 74.6	100.0	
18.8–20.2	CC 28.8	40.0				
					600 Volt Max.	250 Volt Max.
20.3–21.7	CC 31.0	45.0				
21.8–23.3	CC 33.3	45.0				
23.4–25.2	CC 36.4	50.0	49.3–52.8	CC 81.5	100	110
25.3–27.1	CC 39.6	50.0	52.9–56.8	CC 87.7	100	110
27.2–29.4	CC 42.7	60.0	56.9–61.2	CC 94.0	100	125
			61.3–66.1	CC 103	100	125
29.5–31.6	CC 46.6	60.0	66.2–71.2	CC 112	100	125
31.7–34.0	CC 50.1	70.0	71.3–76.7	CC 121	100	125
34.1–36.8	CC 54.5	75.0	76.8–82.9	CC 132	100	125
			83.0–90.0	CC 143	100	125

Size 4

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Class Rating (Amperes)	Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Class Rating (Amperes)
44.0–46.8	CC 64.3	90	73.0–78.1	CC 112	150
46.9–50.6	CC 68.5	100	78.2–83.9	CC 121	175
50.7–54.5	CC 74.6	110	84.0–91.1	CC 132	175
54.6–58.4	CC 81.5	110	91.2–97.5	CC 143	200
58.5–62.9	CC 87.7	125	97.6–104	CC 156	200
63.0–67.7	CC 94.0	125	105–113	CC 167	225
67.8–72.9	CC 103	150	114–133	CC 180	250

Size 5

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Rating (Amperes)	Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Rating (Amperes)
88.2–95.1	DD 112	175	171–180	DD 220	350
95.2–101	DD 121	200	181–197	DD 240	400
102–111	DD 128	225	198–204	DD 250	400
112–119	DD 140	250	205–213	DD 265	400
120–131	DD 150	250	214–237	DD 280	400
132–149	DD 160	250	238–243	DD 300	400
150–170	DD 185	300	244–266	DD 320	400

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Size 5 (Form Y342)

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)	Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)
81.6–91.1	B 1.03	90	230–257	B 3.00	250
91.2–101	B 1.16	100	258–281	B 3.30	250
102–115	B 1.30	110	282–321	B 3.70	300
116–131	B 1.45	125	322–387	B 4.15	350
132–146	B 1.67	125	388–419	B 4.85	400
147–163	B 1.88	150	420–465	B 5.50	400
164–184	B 2.10	175	466–497	B 6.25	400
185–209	B 2.40	200	498–532	B 6.90	400
210–229	B 2.65	225			

Size 6

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)	Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)
133–148	B 1.30	250	272–308	B 2.65	600
149–174	B 1.45	300	309–348	B 3.00	600
175–195	B 1.67	350	349–397	B 3.30	600
196–219	B 1.88	400	398–429	B 3.70	600
220–239	B 2.10	450	430–495	B 4.15	600
240–271	B 2.40	500	496–520	B 4.85	600

Melting Alloy Overload Selection Tables For Circuit Breaker Part Winding Combination Starter Units

Select the proper thermal overload from the applicable starter size table below (see starter nameplate). For the selection procedure, refer to the **Thermal Unit Selection** section of the Square D *Digest*.

Size 1

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
1.12–1.27	B 0.81	6.46–6.99	B 4.85
1.28–1.37	B 0.92	7.00–7.71	B 5.50
1.38–1.55	B 1.30	7.72–8.23	B 6.25
		8.24–9.41	B 6.90
1.56–1.71	B 1.16		
1.72–1.95	B 1.30	9.42–10.43	B 7.70
1.96–2.19	B 1.45	10.44–11.07	B 8.20
2.20–2.43	B 1.67	11.08–12.35	B 9.10
		12.36–14.05	B 10.2
2.44–2.67	B 1.88		
2.68–3.07	B 2.10	14.06–15.85	B 11.5
3.08–3.47	B 2.40	15.86–17.23	B 12.8
3.48–3.79	B 2.65	17.24–18.35	B 14
		18.36–20.1	B 15.5
3.80–4.35	B 3.00		
4.36–5.07	B 3.30	20.2–22.1	B 17.5
5.08–5.75	B 3.70	22.2–23.7	B 19.5
5.76–6.45	B 4.15	23.8–27.1	B 22
		27.2–30.7	B 25
		30.8–34.9	B 28
		35.0–38.9	B 32
		39.0–44.5	B 36
		44.6–50.3	B 40
		50.4–54.0	B 45

Size 2

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
7.88–8.91	B 6.90	23.0–24.7	B 19.5
8.92–9.95	B 7.70	24.8–27.9	B 22
		28.0–31.7	B 25
9.96–10.57	B 8.20	31.8–35.9	B 28
10.58–11.95	B 9.10		
11.96–13.79	B 10.2	36.0–39.9	B 32
13.80–15.85	B 11.5	40.0–45.7	B 36
		45.8–50.9	B 40
15.86–17.43	B 12.8	51.0–61.7	B 45
17.44–18.55	B 14.0		
18.56–20.5	B 15.5	61.8–65.1	B 50
20.6–22.9	B 17.5	65.2–69.9	B 56
		70.0–79.5	B 62
		79.6–89.4	B 70
			B 79

Size 3

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
28.0–29.9	CC 20.9	68.2–73.7	CC 54.5
30.0–32.5	CC 22.8	73.8–79.7	CC 59.4
32.6–34.5	CC 24.6	79.8–84.7	CC 64.3
34.6–37.5	CC 26.3	84.8–91.5	CC 68.5
37.6–40.5	CC 28.8	91.6–98.5	CC 74.6
40.6–43.5	CC 31.0	98.6–105.7	CC 81.5
43.6–46.7	CC 33.3	105.8–113.7	CC 87.7
46.8–50.5	CC 36.4	113.8–122.5	CC 94.0
50.6–54.3	CC 39.6	122.6–132.3	CC 103
54.4–58.9	CC 42.7	132.4–142.5	CC 112
59.0–63.3	CC 46.6	142.6–153.5	CC 121
63.4–68.1	CC 50.1	153.6–165.9	CC 132
		166.0–180.0	CC 143

Size 4

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
105–112	CC 74.6	170–181	CC 132
113–122	CC 81.5	182–195	CC 143
123–131	CC 87.7	196–209	CC 156
132–142	CC 94.0	210–227	CC 167
143–153	CC 103	228–247	CC 180
154–157	CC 112	248–266	CC 196
158–169	CC 121		

Size 5

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
176–190	DD 112	342–361	DD 220
191–203	DD 121	362–395	DD 240
204–223	DD 128	396–409	DD 250
224–239	DD 140	410–427	DD 265
240–263	DD 150	428–475	DD 280
264–299	DD 160	476–487	DD 300
300–341	DD 185	488–532	DD 320

Size 5 (Form Y342)

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
40.8–45.5	B 1.03	115–128	B 3.00
45.6–49.9	B 1.16	129–140	B 3.30
51.0–57.5	B 1.30	141–160	B 3.70
57.6–65.9	B 1.45	161–193	B 4.15
66.0–73.1	B 1.67	194–209	B 4.85
73.2–81.5	B 1.88	210–232	B 5.50
81.6–92.3	B 2.10	233–248	B 6.25
92.4–104	B 2.40	249–266	B 6.90
105–114	B 2.65		

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Melting Alloy Overload Selection Tables For Fusible Switch Part Winding Combination Starter Units

Select proper thermal overload from applicable starter size table below (see starter nameplate). For the selection procedure, refer to the **Thermal Unit Selection** section of the Square D *Digest.*

⚠ DANGER

HAZARD OF BODILY INJURY OR EQUIPMENT DAMAGE.

Do not exceed maximum fuse rating shown opposite the thermal unit selection. Time delay fuses may be necessary to permit motor starting. UL Class RK5/CSA Class R fuses are recommended.

Failure to observe this precaution will result in severe personal injury, death, or equipment damage!

Size 1

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)	Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)
1.12–1.27	B 0.81	1.25	6.46–6.99	B 4.85	7.0
1.28–1.37	B 0.92	1.40	7.00–7.71	B 5.50	7.0
1.38–1.55	B 1.03	1.40	7.72–8.23	B 6.25	8.0
			8.24–9.41	B 6.90	9.0
1.56–1.71	B 1.16	1.60			
1.72–1.95	B 1.30	1.80	9.42–10.43	B 7.70	10.0
1.96–2.19	B 1.45	2.0	10.44–11.07	B 8.20	10.0
2.20–2.43	B 1.67	2.25	11.08–12.35	B 9.10	12.0
			12.36–14.05	B 10.2	12.0
2.44–2.67	B 1.88	2.5			
2.68–3.07	B 2.10	2.8	14.06–15.85	B 11.5	15.0
3.08–3.47	B 2.40	3.2	15.86–17.23	B 12.8	17.5
3.48–3.79	B 2.65	3.5	17.24–18.35	B 14	17.5
			18.36–20.1	B 15.5	20.0
3.80–4.35	B 3.00	4.0			
4.36–5.07	B 3.30	4.5	20.2–22.1	B 17.5	20.0
5.08–5.75	B 3.70	5.6	22.2–23.7	B 19.5	20.0
5.76–6.45	B 4.15	6.25	23.8–27.1	B 22	25.0
			27.2–30.7	B 25	30.0
					600V Max. / 250V Max.
			30.8–34.9	B 28	30. / 30.
			35.0–38.9	B 32	30. / 35.
			39.0–44.5	B 36	30. / 40.
			44.6–50.3	B 40	30. / 40.
			50.4–54.0	B 45	30. / 40.

Size 2

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Class Rating (Amperes)	Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Class Rating (Amperes)
7.88–8.91	B 6.90	8.0	23.0–24.7	B 19.5	25.0
8.92–9.95	B 7.70	10.0	24.8–27.9	B 22	25.0
			28.0–31.7	B 25	30.0
9.96–10.57	B 8.20	10.0	31.8–35.9	B 28	35.0
10.58–11.95	B 9.10	10.0			
11.96–13.79	B 10.2	12.0	36.0–39.9	B 32	40.0
13.80–15.85	B 11.5	15.0	40.0–45.7	B 36	45.0
			45.8–50.9	B 40	50.0
15.86–17.43	B 12.8	17.5	51.0–61.7	B 45	50.0
17.44–18.55	B 14.0	17.5			
18.56–20.5	B 15.5	20.0	61.8–65.1	B 50	60.0
20.6–22.9	B 17.5	20.0	65.2–69.9	B 56	60.0
			70.0–79.5	B 62	70.0
			79.6–89.4	B 70	70.0
				B 79	80.0

Size 3

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)	Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)
28.0–29.9	CC 20.9	30.0	68.2–73.7	CC 59.4	80.0
30.0–32.5	CC 22.8	30.0	73.8–79.7	CC 64.3	80.0
32.6–34.5	CC 24.6	35.0	79.8–84.7	CC 68.5	90.0
34.6–37.5	CC 26.3	35.0	84.8–91.5	CC 74.6	100.0
37.6–40.5	CC 28.8	40.0			
					600V Max. / 250V Max.
40.6–43.5	CC 31.0	45.0			
43.6–46.7	CC 33.3	45.0	91.6–98.5		
46.8–50.5	CC 36.4	50.0	98.6–105.7	CC 81.5	100 / 110
50.6–54.3	CC 39.6	50.0	105.8–113.7	CC 87.7	100 / 110
54.4–58.9	CC 42.7	60.0	113.8–122.5	CC 94.0	100 / 125
			122.6–132.3	CC 103	100 / 125
59.0–63.3	CC 46.6	60.0	132.4–142.5	CC 112	100 / 125
63.4–68.1	CC 50.1	70.0	142.6–153.5	CC 121	100 / 125
	CC 54.5	75.0	153.6–165.9	CC 132	100 / 125
			166.0–180.0	CC 143	100 / 125

Size 4

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)
105–112	CC 74.6	110
113–122	CC 81.5	125
123–131	CC 87.7	125
132–142	CC 94.0	125
143–153	CC 103	150
154–157	CC 112	150
158–169	CC 121	175
170–181	CC 132	175
182–195	CC 143	200
196–209	CC 156	200
210–227	CC 167	200
228–247	CC 180	200
248–266	CC 196	200

Size 5

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)
176–190	DD 112	175
191–203	DD 121	200
203–223	DD 128	225
224–239	DD 140	250
240–253	DD 150	250
264–299	DD 160	250
300–341	DD 185	300
342–361	DD 220	350
362–395	DD 240	400
396–409	DD 250	400
410–427	DD 265	400
428–475	DD 280	400
476–487	DD 300	400
488–532	DD 320	400

Size 5 (Form Y342)

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)
81.6–91.1	B 1.03	90
91.2–101	B 1.16	100
102–115	B 1.30	110
116–131	B 1.45	125
132–146	B 1.67	125
147–163	B 1.88	150
164–184	B 2.10	175
185–209	B 2.40	200
210–229	B 2.65	225
230–257	B 3.00	250
258–281	B 3.30	250
282–321	B 3.70	300
322–387	B 4.15	350
388–419	B 4.85	400
420–465	B 5.50	400
466–497	B 6.25	400
498–532	B 6.90	400

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SECTION 12—AMBIENT COMPENSATED BIMETALLIC OVERLOAD SELECTION TABLES

Circuit Breaker Combination Starter Units

Select the proper thermal overload for starter forms B and Y59 (MCC forms Y331, Y334–Y337:TJE) from the applicable starter size table below (see starter nameplate). For the selection procedure, refer to the **Thermal Unit Selection** section of the Square D *Digest*.

Size 1

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
0.57–0.60	AR 1.05	3.46–3.81	AR 5.8
0.61–0.66	AR 1.15	3.82–4.20	AR 6.4
0.67–0.73	AR 1.26	4.21–4.65	AR 7.0
0.74–0.81	AR 1.39	4.66–5.29	AR 7.7
0.82–0.90	AR 1.53	5.30–5.84	AR 8.5
0.91–1.05	AR 1.68	5.85–6.27	AR 9.3
1.06–1.15	AR 1.85	6.28–6.97	AR 10.2
1.16–1.25	AR 2.04	6.98–7.59	AR 11.2
1.26–1.35	AR 2.24	7.60–7.89	AR 12.4
1.36–1.47	AR 2.46	7.90–8.95	AR 13.6
1.48–1.58	AR 2.71	8.96–10.3	AR 15.4
1.59–1.74	AR 2.98	10.4–11.7	AR 17.6
1.75–1.94	AR 3.28	11.8–13.3	AR 20.5
1.95–2.20	AR 3.62	13.4–15.2	AR 23
2.21–2.47	AR 3.98	15.3–17.2	AR 27
2.48–2.76	AR 4.37	17.3–19.7	AR 30
2.77–3.07	AR 4.80	19.8–22.4	AR 35
3.08–3.45	AR 5.3	22.5–26.0	AR 40

Size 2

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
4.24–4.62	AR 8.5	16.5–18.9	AR 35
4.63–5.05	AR 9.3	19.0–21.6	AR 40
5.06–5.54	AR 10.2	21.7–23.3	AR 44
5.55–6.13	AR 11.2	23.4–24.9	AR 47
6.14–6.44	AR 12.4	25.0–26.9	AR 51
6.45–7.48	AR 13.6	27.0–29.1	AR 55
7.49–8.55	AR 15.4	29.2–31.3	AR 60
8.56–9.74	AR 17.6	31.4–33.5	AR 66
9.75–11.1	AR 20.5	33.6–36.9	AR 72
11.2–12.7	AR 23	37.0–39.1	AR 79
12.8–14.4	AR 27	39.2–40.9	AR 86
14.5–16.4	AR 30	41.0–45.0	AR 94

Size 3

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
27.1–30.0	E 67		
30.1–33.2	E 69		
33.3–35.7	E 70		
35.8–39.4	E 71	51.6–57.0	E 76
39.5–43.4	E 72	57.1–62.8	E 77
43.5–46.9	E 73	62.9–69.1	E 78
47.0–51.5	E 74	69.2–75.0	E 79
		75.1–83.3	E 80

Size 4

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
50–55.9	E 88	82–86.9	E 96
56–60.9	E 89	87–92.9	E 97
61–65.9	E 91	93–97.9	E 98
66–69.9	E 92	98–107.9	E 99
70–75.9	E 93	108–113.9	E 101
76–81.9	E 94	114–125.9	E 102

Sizes 3 And 4 (Type TJE)

Motor Full-Load Current (Ampferes)	Form Number	Thermal Overload Relay Part Number
40–60	Y334	9065TJE 40
55–80	Y335	9065TJE 55
80–120	Y336	9065TJE 80
100–150	Y337	9065TJE 100

Size 5

Motor Full-Load Current (Amp)	Thermal Unit Number	Motor Full-Load Current (Amp)	Thermal Unit Number
105–116	AR 3.28	166–184	AR 4.80
117–132	AR 3.62	185–207	AR 5.3
133–148	AR 3.98	208–229	AR 5.8
149–165	AR 4.37	230–266	AR 6.4

Size 6

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
146–169	AR 1.68	280–311	AR 3.28
170–185	AR 1.85	312–353	AR 3.62
186–201	AR 2.04	354–396	AR 3.98
202–217	AR 2.24		
218–236	AR 2.46	397–442	AR 4.37
237–253	AR 2.71	443–492	AR 4.80
254–279	AR 2.98	493–520	AR 5.3

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Ambient Compensated Bimetallic Overload Selection Tables For Fusible Switch Combination Starter Units

Select the proper thermal overload for starter forms B and Y59 (MCC forms Y331, Y334–Y337:TJE) from the applicable starter size table below (see starter nameplate). For the selection procedure, refer to the **Thermal Unit Selection** section of the Square D *Digest.*

⚠ DANGER

HAZARD OF BODILY INJURY OR EQUIPMENT DAMAGE.

Do not exceed maximum fuse rating shown opposite the thermal unit selection. Time delay fuses may be necessary to permit motor starting. UL Class RK5/CSA Class R fuses are recommended.

Failure to observe this precaution will result in severe personal injury, death, or equipment damage!

Size 1

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)	Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)	
0.57–0.60	AR 1.05	1.25	3.46–3.81	AR 5.8	7.	
0.61–0.66	AR 1.15	1.25	3.82–4.20	AR 6.4	8.	
0.67–0.73	AR 1.26	1.4	4.21–4.65	AR 7.0	9.	
0.74–0.81	AR 1.39	1.6	4.66–5.29	AR 7.7	10.	
0.82–0.90	AR 1.53	1.8	5.30–5.84	AR 8.5	10.	
0.91–1.05	AR 1.68	2.	5.85–6.27	AR 9.3	12.	
1.06–1.15	AR 1.85	2.25	6.28–6.97	AR 10.2	12.	
1.16–1.25	AR 2.04	2.5	6.98–7.59	AR 11.2	15.	
1.26–1.35	AR 2.24	2.8	7.60–7.89	AR 12.4	15.	
1.36–1.47	AR 2.46	2.8	7.90–8.95	AR 13.6	17.5	
1.48–1.58	AR 2.71	3.2	8.96–10.3	AR 15.4	20.	
1.59–1.74	AR 2.98	3.5	10.4–11.7	AR 17.6	20.	
					600V Max.	250V Max.
1.75–1.94	AR 3.28	3.5	11.8–13.3	AR 20.5	25.	25.
1.95–2.20	AR 3.62	4.	13.4–15.2	AR 23.	30.	30.
2.21–2.47	AR 3.98	4.5	15.3–17.2	AR 27.	30.	30.
2.48–2.76	AR 4.37	5.	17.3–19.7	AR 30.	30.	35.
2.77–3.07	AR 4.80	5.6	19.8–22.4	AR 35.	30.	40.
3.08–3.45	AR 5.3	6.25	22.5–26.0	AR 40.	30.	40.

Size 2

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)	Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)
4.24–4.62	AR 8.5	9	16.5–18.9	AR 35	35
4.63–5.05	AR 9.3	10	19.0–21.6	AR 40	40
5.06–5.54	AR 10.2	10	21.7–23.3	AR 44	45
5.55–6.13	AR 11.2	12	23.4–24.9	AR 47	50
6.14–6.44	AR 12.4	12	25.0–26.9	AR 51	50
6.45–7.48	AR 13.6	12	27.0–29.1	AR 55	60
7.49–8.55	AR 15.4	15	29.2–31.3	AR 60	60
8.56–9.74	AR 17.6	17.5	31.4–33.5	AR 66	60
9.75–11.1	AR 20.5	20	33.6–36.9	AR 72	60
11.2–12.7	AR 23	25	37.0–39.1	AR 79	60
12.8–14.4	AR 27	25	39.2–40.9	AR 86	60
14.5–16.4	AR 30	30	41.0–45.0	AR 94	60

Sizes 3 and 4 (Type TJE)

Motor Full-Load Current (Amperes)	Form Number	Thermal Overload Relay Part Number
40–60	Y334	9065TJE 40
55–80	Y335	9065TJE 55
80–120	Y336	9065TJE 80
100–150	Y337	9065TJE 100

Size 3

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)	Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)	
27.1–30.0	E 67	60				
30.1–33.2	E 69	60				
33.3–35.7	E 70	70			600V Max.	250V Max.
35.8–39.4	E 71	80	51.6–57.0	E 76	100	110
39.5–43.4	E 72	80	57.1–62.8	E 77	100	125
43.5–46.9	E 73	90	62.9–69.1	E 78	100	125
47.0–51.5	E 74	100	69.2–75.0	E 79	100	125
			75.1–83.3	E 80	100	125

Size 4

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)	Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)
50–55.9	E 88	110	82–86.9	E 96	175
56–60.9	E 89	125	87–92.9	E 97	175
61–65.9	E 91	125	93–97.9	E 98	200
66–69.9	E 92	125	98–107.9	E 99	200
70–75.9	E 93	150	108–113.9	E 101	200
76–81.9	E 94	150	114–125.9	E 102	200

Size 5

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Class Rating (Amperes)	Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Class Rating (Amperes)
105–116	AR 3.28	225	166–184	AR 4.80	350
117–132	AR 3.62	250	185–207	AR 5.3	400
133–148	AR 3.98	250	208–229	AR 5.8	400
149–165	AR 4.37	300	230–266	AR 6.4	400

Size 6

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)	Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)
146–169	AR 1.68	300	280–311	AR 3.28	600
170–185	AR 1.85	350	312–353	AR 3.62	600
186–201	AR 2.04	400	354–396	AR 3.98	600
202–217	AR 2.24	450			
218–236	AR 2.46	450	397–442	AR 4.37	600
237–253	AR 2.71	500	443–492	AR 4.80	600
254–279	AR 2.98	500	493–520	AR 5.3	600

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Ambient Compensated Bimetallic Overload Selection Tables For Circuit Breaker Part Winding Combination Starter Units

Select the proper thermal overload for starter forms B and Y59 (MCC forms Y331, Y334–Y337:TJE) from the applicable starter size table below (see starter nameplate). For the selection procedure, refer to the **Thermal Unit Selection** section of the Square D *Digest*.

Size 1

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
1.14–1.21	AR 1.05	6.92–7.63	AR 5.8
1.22–1.33	AR 1.15	7.64–8.41	AR 6.4
1.34–1.47	AR 1.26	8.42–9.31	AR 7.0
1.48–1.63	AR 1.39	9.32–10.59	AR 7.7
1.64–1.81	AR 1.53	10.60–11.69	AR 8.5
1.82–2.11	AR 1.68	11.70–12.55	AR 9.3
2.12–2.31	AR 1.85	12.56–13.95	AR 10.2
2.32–2.51	AR 2.04	13.96–15.19	AR 11.2
2.52–2.71	AR 2.24	15.20–15.79	AR 12.4
2.72–2.95	AR 2.46	15.80–17.91	AR 13.6
2.96–3.17	AR 2.71	17.92–20.7	AR 15.4
3.18–3.49	AR 2.98	20.8–23.5	AR 17.6
3.50–3.89	AR 3.28	23.6–26.7	AR 20.5
3.90–4.41	AR 3.62	26.8–30.5	AR 23
4.42–4.95	AR 3.98	30.6–34.5	AR 27
4.96–5.53	AR 4.37	34.6–39.5	AR 30
5.54–6.15	AR 4.80	39.6–44.9	AR 35
6.16–6.91	AR 5.3	45.0–52.0	AR 40

Size 2

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
8.48–9.25	AR 8.5	33.0–37.9	AR 35
9.26–10.11	AR 9.3	38.0–43.3	AR 40
10.12–11.09	AR 10.2	43.4–46.7	AR 44
11.10–12.27	AR 11.2	46.8–49.9	AR 47
12.28–12.89	AR 12.4	50.0–53.9	AR 51
12.90–14.97	AR 13.6	54.0–58.3	AR 55
14.98–17.11	AR 15.4	58.4–62.7	AR 60
17.12–19.49	AR 17.6	62.8–67.1	AR 66
19.50–22.3	AR 20.5	67.2–73.8	AR 72
22.4–25.5	AR 23	74.0–78.3	AR 79
25.6–28.9	AR 27	78.4–81.9	AR 86
29.0–32.9	AR 30	82.0–90.0	AR 94

Size 3

Motor Full-Load Current (Amperes)	Thermal Unit Number	Motor Full-Load Current (Amperes)	Thermal Unit Number
54.2–60.1	E 67		
60.2–66.5	E 69		
66.6–71.5	E 70		
71.6–78.9	E 71	103.2–114.1	E 76
79.0–86.9	E 72	114.2–125.7	E 77
87.0–93.9	E 73	125.8–138.3	E 78
94.0–103.1	E 74	138.4–150.1	E 79
		150.2–166.6	E 80

Size 4

Motor Full-Load Current (Amperes)	Thermal Unit Number
100–111.9	E 88
112–121.9	E 89
122–131.9	E 91
132–139.9	E 92
140–151.9	E 93
152–163.9	E 94
164–173.9	E 96
174–185.9	E 97
186–195.9	E 98
196–215.9	E 99
216–227.9	E 101
228–251.9	E 102

Sizes 3 and 4 (Type TJE)

Motor Full-Load Current (Amperes)	Form Number	Thermal Overload Relay Part Number
80–120	Y334	9065TJE 40
110–160	Y335	9065TJE 55
160–240	Y336	9065TJE 80
200–300	Y337	9065TJE 100

Size 5

Motor Full-Load Current (Amperes)	Thermal Unit Number
210–233	AR 3.28
234–265	AR 3.62
266–297	AR 3.98
298–331	AR 4.37
332–369	AR 4.80
370–415	AR 5.3
416–459	AR 5.8
460–532	AR 6.4

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Ambient Compensated Bimetallic Overload Selection Tables For Fusible Switch Part Winding Combination Starter Units

Select the proper thermal overload for starter forms B and Y59 (MCC forms Y331, Y334–Y337:TJE) from the applicable starter size table below (see starter nameplate). For the selection procedure, refer to the **Thermal Unit Selection** section of the Square D *Digest*.

⚠ DANGER

HAZARD OF BODILY INJURY OR EQUIPMENT DAMAGE.

Do not exceed maximum fuse rating shown opposite the thermal unit selection. Time delay fuses may be necessary to permit motor starting. UL Class RK5/CSA Class R fuses are recommended.

Failure to observe this precaution will result in severe personal injury, death, or equipment damage!

Size 1

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)	Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)	
1.14–1.21	AR 1.05	1.25	6.92–7.63	AR 5.8	7.	
1.22–1.33	AR 1.15	1.25	7.64–8.41	AR 6.4	8.	
1.34–1.47	AR 1.26	1.4	8.42–9.31	AR 7.0	9.	
1.48–1.63	AR 1.39	1.6	9.32–10.59	AR 7.7	10.	
1.64–1.81	AR 1.53	1.8	10.60–11.69	AR 8.5	10.	
1.82–2.11	AR 1.68	2.	11.70–12.55	AR 9.3	12.	
2.12–2.31	AR 1.85	2.25	12.56–13.95	AR 10.2	12.	
2.32–2.51	AR 2.04	2.5	13.96–15.19	AR 11.2	15.	
2.52–2.71	AR 2.24	2.8	15.20–15.79	AR 12.4	15.	
2.72–2.95	AR 2.46	2.8	15.80–17.91	AR 13.6	17.5	
2.96–3.17	AR 2.71	3.2	17.92–20.7	AR 15.4	20.	
3.18–3.49	AR 2.98	3.5	20.8–23.5	AR 17.6	20.	
					600V Max.	250V Max.
3.50–3.89	AR 3.28	3.5	23.6–26.7	AR 20.5	25.	25.
3.90–4.41	AR 3.62	4.	26.8–30.5	AR 23	30.	30.
4.42–4.95	AR 3.98	4.5	30.6–34.5	AR 27	30.	30.
4.96–5.53	AR 4.37	5.	34.6–39.5	AR 30	30.	35.
5.54–6.15	AR 4.80	5.6	39.6–44.9	AR 35	30.	40.
6.16–6.91	AR 5.3	6.25	45.0–52.0	AR 40	30.	40.

Size 2

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)	Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)
8.48–9.25	AR 8.5	9.	33.0–37.9	AR 35	35.
9.26–10.11	AR 9.3	10.	38.0-43.3	AR 40	40.
10.12–11.09	AR 10.2	10.	43.4–46.7	AR 44	45.
11.10–12.27	AR 11.2	12.	46.8–49.9	AR 47	50.
12.28–12.89	AR 12.4	12.	50.0–53.9	AR 51	50.
12.90–14.97	AR 13.6	12.	54.0–58.3	AR 55	60.
14.98–17.11	AR 15.4	15.	58.4–62.7	AR 60	60.
17.12–19.49	AR 17.6	17.5	62.8–67.1	AR 66	60.
19.50–22.3	AR 20.5	20.	67.2–73.8	AR 72	60.
22.4–25.5	AR 23	25.	74.0–78.3	AR 79	60.
25.6–28.9	AR 27	25.	78.4–81.9	AR 86	60.
29.0–32.9	AR 30	30.	82.0–90.0	AR 94	60.

Size 3

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)	Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)	
54.2–60.1	E 67	60				
60.2–66.5	E 69	60				
66.6–71.5	E 70	70			600V Max.	250V Max.
71.6–78.9	E 71	80	103.2–114.1	E 76	100	110
79.0–86.9	E 72	80	114.2–125.7	E 77	100	125
87.0–93.9	E 73	90	125.8–138.3	E 78	100	125
94.0–103.1	E 74	100	138.4–150.1	E 79	100	125
			150.2–166.6	E 80	100	125

Size 4

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)
100–111.9	E 88	200
112–121.9	E 89	250
122–131.9	E 91	250
132–139.9	E 92	250
140–151.9	E 93	300
152–163.9	E 94	300
164–173.9	E 96	350
174–185.9	E 97	350
186–195.9	E 98	400
196–215.9	E 99	400
216–227.9	E 101	400
228–251.9	E 102	400

Sizes 3 and 4 (Type TJE)

Motor Full-Load Current (Amperes)	Form Number	Thermal Overload Relay Part Number
80–120	Y334	9065TJE 40
110–160	Y335	9065TJE 55
160–240	Y336	9065TJE 80
200–300	Y337	9065TJE 100

Size 5

Motor Full-Load Current (Amperes)	Thermal Unit Number	Max. Fuse Rating (Amperes)
210–233	AR 3.28	225
234–265	AR 3.62	250
266–297	AR 3.98	250
298–331	AR 4.37	300
332–369	AR 4.80	350
370–415	AR 5.3	400
416–459	AR 5.8	400
460–532	AR 6.4	400

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SECTION 13—SQUARE D LITERATURE LIST

The following Square D publications may be useful in the maintenance and regular operation of your Model 6 Motor Control Center. They are available through your local Square D or Schneider Canada field office.

Class 8998 Model 6 Industrial Motor Control Center Pricing Guide
Lists most Model 6 structures, units, special options, and prices.

Square D Digest
Contains catalog listings on most Square D product lines.

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SECTION 14—INSULATION RESISTANCE CHART

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION.

- Turn *off* power supplying this equipment before working inside the motor control center.
- Before testing insulation resistance, disconnect solid state devices, capacitors, or any units not designed to withstand megger voltage.
- See DANGER and CAUTION notices on page 26.

Failure to observe these precautions will result in electric shock, severe personal injury, or death!

	Phase-To-Phase			Phase-To-Ground		
All Disconnects Open						
Date	A-B	B-C	C-A	A-ground	B-ground	C-ground
All Disconnects Closed						
Date	A-B	B-C	C-A	A-ground	B-ground	C-ground

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SECTION 15—INSTALLATION AND MAINTENANCE LOG

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INSTALLATION AND MAINTENANCE LOG (cont.)

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INSTALLATION AND MAINTENANCE LOG (cont.)

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INSTALLATION AND MAINTENANCE LOG (cont.)

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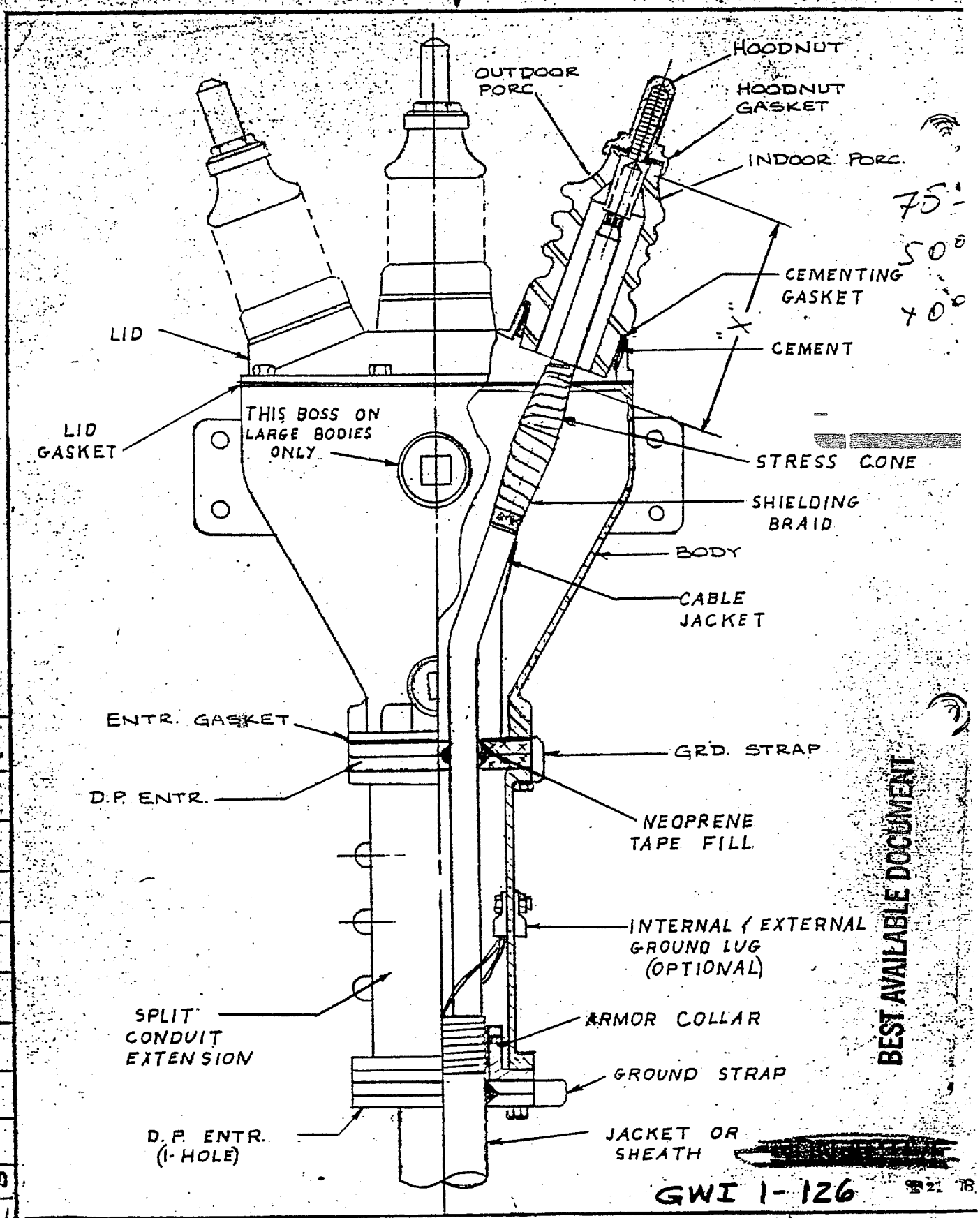


BEST AVAILABLE DOCUMENT

GWI 1-126

REVISIONS	POTHEAD, TYPE "T" 3/C, SHAPE "B" 124	
	DRAWN S.J.F. 9-21-76	DW'G No. A7773-35
	CH'K'D	CAT. No.
	APPROVED JWS 9-21-76	SCALE

G&W

FORM 40-17.4 2000 10-66

NEED FOR COMPOUND

Compound is used in cable terminations to fill the internal space around the prepared cable end with an insulating material superior to that of air. Considering air as the insulating medium, when sufficient potential exists between the live conductor and the cut back ground shielding, ionization of the air (corona) will begin at the shielding end. The effects of weather and atmospheric contamination materially decrease the effective surface insulation and may result in failure (flashover) of the cable under normal operating voltage.

PROPER COMPOUND FILLING PROCEDURES

Proper compound filling is essential to the performance of the cable termination. The following techniques and considerations should be noted:

1. Always fill the termination compartment from the bottom up. Compounding should never be done with terminations in a horizontal position.

2. A 3/16 inch minimum clearance must be provided between the porcelain wall and cable or stress cone to permit the compound to rise into the porcelain.

3. Preheat the termination compartment body to at least 70°F to prevent premature cooling of the compound. This can be done using hot oil, hot air or infra-red lights. DO NOT apply an open flame directly onto the porcelain.

4. Use a large diameter riser pipe (see figure 1). The pipe should extend approximately one foot above the high point of the porcelain to provide a static pressure head. The riser pipe should be the same size as the pipe boss or larger.

5. To vent the porcelain, loosen but do not remove the porcelain hoodnut and gasket.

6. For better and safer compounding, the compound should be heated and poured at the recommended temperature as shown on the compound container lable or corresponding chart printed in this catalog. Always use a thermometer to assure proper pouring temperature.

If the pouring temperature is too low, the compound may bridge across the smaller cavities and leave voids or clog up the filling and venting pipes. Also, all moisture laden air might not be driven out. When installing terminations in cold weather, it may be necessary to preheat the porcelain insulator and metal parts with a heating blanket, hot air oven or immersion in hot oil.

If the pouring temperature is too high, the compound may injure the cable insulation or even reach the flash point of the compound and ignite. Also, the hotter the compound, the more it will shrink while cooling. Compound shrinkage should always be kept to a minimum.

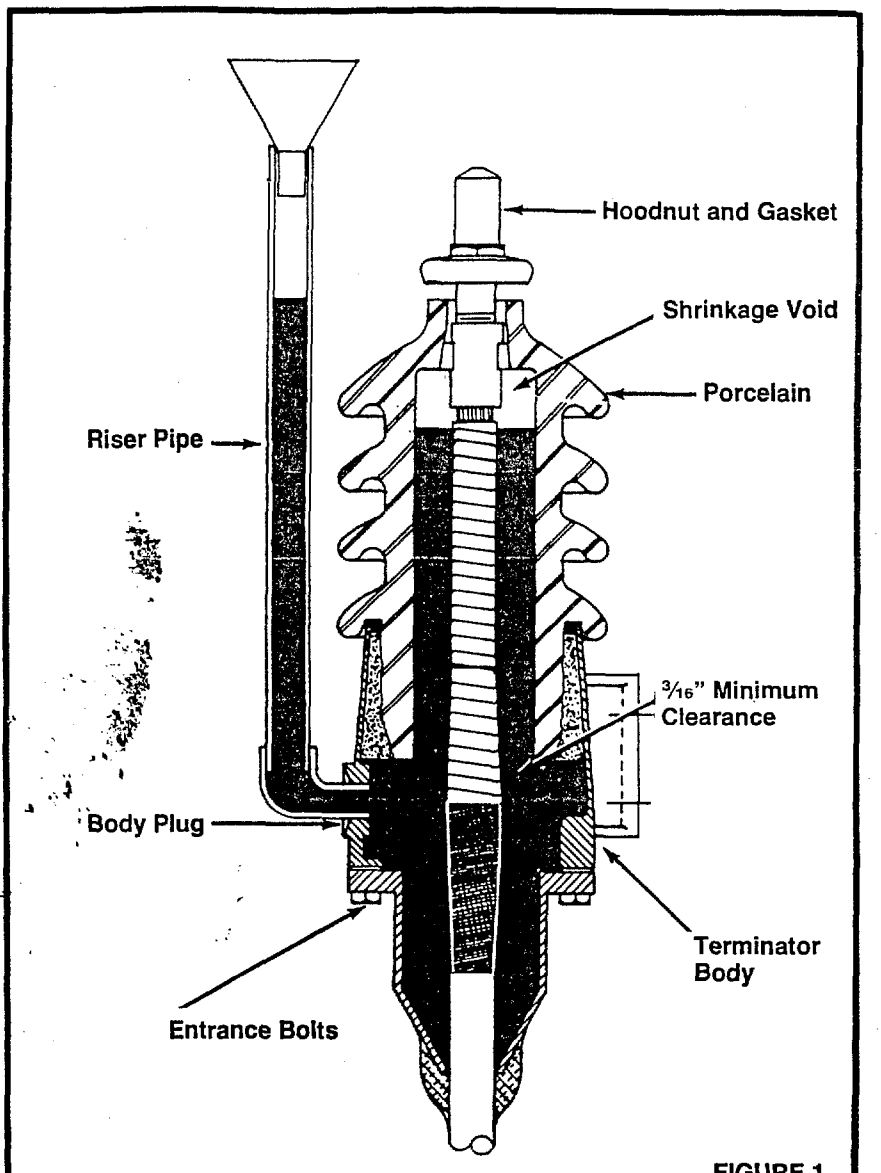


FIGURE 1.

7. For 3/C terminations only, pour the compound through the riser pipe until it shows at the plug in the compartment lid. Secure the plug.

For both 3/C and 1/C terminations, continue pouring until compound shows at the top of the porcelain. Temporarily tighten the hood nuts.

8. Keep the riser pipe full of hot compound during the complete filling operation, including porcelain cooling time.

9. Field compounded terminations will always have shrinkage voids at the top of the vertically mounted porcelains above the cable insulation. A small shrinkage void in this area is not objectionable. This shrinkage space is in a low stress area and provides room for compound expansion and contraction due to changes in ambient temperatures and load cycling. DO NOT "top off" terminations.

10. Let the compound cool down in the terminations and riser pipe.

11. Remove the riser pipe and secure the termination body plug.

12. Remove the hoodnut. Be certain to wipe the porcelain neck surface clean. Clean the porcelain of any spilled compound.

13. Install the hoodnut and gasket. The gasket must be clean, dry and oil free. Apply torque to the hoodnut to insure proper gasket seal. Torque and check the entrance bolts between the terminations body and entrance fittings.

14. Make the required hoodnut aerial connections.

COMPOUNDS

Compounds are a high dielectric strength filler material used in terminations, cableheads, cable boxes and cable joints. An ideal compound should be chemically inert, adhesive and tacky; have low melting point to permit flow into all unoccupied space before solidfying, low moisture absorption, low dielectric loss, high dielectric strength and high flash and fire point for personnel safety. The selection of the proper compound for a particular installation depends upon:

1. Cable type and kind of insulation
2. Operating voltage and temperatures
3. Cable system elevation differentials (PILC cable only).

TYPES OF COMPOUND

NOVOID "A" is a medium soft asphaltic base compound recommended for use in most termination and cablehead (switch or box) installations at 38kV or below.

NOVOID "C" is a medium hard asphaltic base compound recommended for use in terminations and cableheads for application in hot climates or hot exposure at voltages up to and including 38kV.

NOVOID "X" is a hard resin base, oil insoluble compound recommended for use in terminations, cableheads and joints where migration of the cable-tape impregnant may be a problem. There are temperature limitations.

NOVOID #224 is a heavy polybutene base compound recommended for use in terminations, cableheads and joints for polyethylene and EPR insulated cables.

NOVOID "9A" is a very soft asphaltic base compound recommended for use in spreaderhead installations up to 38kV where the compound must be very fluid to rise up in lead or copper tubes. The lower part of the spreaderhead may be filled with Novoid "X" to provide a barrier to help prevent migration of the Novoid "9A" down into the cable.

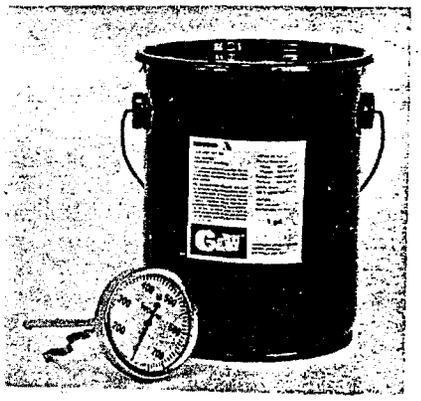
NOVOID #219 is a medium viscosity oil recommended for use as a "flushing compound" for building cable splices or terminating where such "flushing" is required. It may also be used as a filling compound in terminations and joints on solid type paper insulated cables where oil filled accessories are desired.

OZITE "B" is a medium soft asphaltic base compound recommended for use in terminations or cableheads.

THERMOMETERS

Thermometers have a stainless steel stem, adjustable clip handle and temperature scale in either Centigrade or Fahrenheit.

Catalog Number	Temperature Range	Stem Length (Inches)
CT3	150°F. to 750°F.	6
CT3-12	150°F. to 750°F.	12
CT3-18	150°F. to 750°F.	18
CT3-C	0°C. to 300°C.	6
CT3-C-12	0°C. to 300°C.	12
CT3-C-18	0°C. to 300°C.	18



Compounds are available in 1 gal., 2 gal., and 5 gal. containers.

COMPOUND SELECTOR CHART

TYPE OF CABLE INSULATION	COMPOUNDS			
	NOVOID A	NOVOID C	NOVOID X	NOVOID 224
Paper Insulated, Lead Covered P.I.L.C.	Yes	Yes Note 1	Yes Note 2	No
Varnish Cambric, Lead Covered V.C.L.C.	Yes	Yes	Yes	No
Butyl Rubber I.I.R. Type	Yes Note 3	Yes Note 3	No	No
Cross Linked Polyethylene X-L Poly.	Yes	No	No	Yes
Ethylene Propylene Rubber E.P.R.	Yes Note 3	No	No	Yes
Hi-Molecular Weight Poly	No	No	No	Yes
Kerite Insulation Permashield Type	Yes	Yes	No	No

Note 1: For abnormal temperatures -30° C (-22°F) to above 40°C (104°F).

Note 2: Not recommended for terminations and cableheads operating above 15 kV where temperature may fall below -12°C (+10°F), or 15 kV and below, where temperature may fall below -24°C (-10°F). No temperature limitation for compound used in joints.

Note 3: Maximum pouring temperature 150°C (302°F).

Temperature ranges are specified in IEEE 48-1975 standards.

TEST	A.S.T.M. Designation	NOVOID "A"	NOVOID "C"	NOVOID "9A"	NOVOID "X"	NOVOID 219	NOVOID 224	OZITE "B"
Flash Point (°C)	D92	320	293	204	232	160	221	320
Fire Point (°C)	D92	370	307	252	269	170	273	370
Softening Point (°C)	D36	35	90	32	54	—	—	35
Pouring Temp (°C) Max	—	227	232	149	171	121	121	227
Normal	—	149	149	121	149	110	88	149
Loss on Heating (%)	D6	.26	.27	.22	.12	.40	.30	.26
Vol. Coef. of Exp. (in³/°C)	D1168	.0006	.00056	.0007	.0006	.00065	.00065	.0006
Specific Gravity	D70	.98	.97	.99	1.14	.86	.90	.98
Dielectric Str (v/mil) 25°C	D149 & D176	1000	920	800	900	400	500	1000
Power Factor (%) 25°C	D150	1.0	1.5	1.8	9.0	.001	.015	1.9
50°C		2.5	2.9	5.2	7.8	.001	.025	2.5
75°C		14.4	12.0	20.0	19.3	.002	.028	14.4
S.I.C. 25°C	D150	2.6	2.6	2.8	4.7	2.4	2.1	2.6
50°C		2.7	2.7	2.9	6.6	2.3	2.2	2.7
75°C		2.8	2.7	3.0	7.5	2.2	2.2	2.8
Consistency at 25°C	—	semi-solid	med hard	soft	hard	fluid	fluid	semi-solid
Color	—	black	black	black	brown	clear	clear	black
Weight (lbs./gal.)	—	10	10	10	11.5	7.2	7.5	10

All test data are typical values.

BEST AVAILABLE DOCUMENT

G&W ELECTRIC CO.

INSTALLATION INSTRUCTIONS
INDOOR TERMINATION KIT
1/C Shielded Cable

GENERAL:

1. These instructions assume the workmen have a proper knowledge of acceptable splicing practice and proficiency in use of tools.
2. The letters "A," and "B," etc. used in the text are shown on the drawing. Refer to the drawing for the corresponding dimensions in inches.

PRECAUTIONS:

1. Apply the special cement under the first layer of Nozone tape only.
2. Avoid bending the cable to a radius less than the minimum recommended by the cable manufacturer.
3. Care must be taken when removing the cable jacket and shielding, as not to damage the cable insulation and conductor.

INSTALLATION PROCEDURE:

1. Measure the depth of the lug socket.
2. Temporarily mount the lug and train the cable into its final position allowing the end to overlap the lug. Support the riser section of the cable.
3. Make three circumferential reference marks on the cable jacket or sheath.
   1st: Even with the bottom of the lug.
   2nd: The depth of the lug socket above the 1st reference mark.
   3rd: "A" plus ½" below 1st reference mark.
4. Cut the cable at the 2nd mark.
5. Ring the cable jacket or sheath at the 3rd reference mark made in step 3. Slit the jacket or sheath from the ring to the end of the cable in such a way as to avoid damage to the underlying shielding. Remove the jacket or sheath by pulling it directly away from the cable axis.
6. Remove the cable shielding and insulation down to the conductor strands for the depth of the lug socket plus ½" from the end of the cable.

7.a. **For Solder Connector—**
Bend conductor down and tin the bared conductor strands. Tin the lug socket.
Insert the conductor into the lug socket making sure the strands enter the lug socket its full length. Solder the lug to the conductor filling the strands completely with hot solder. Allow solder to cool. Bend conductor upright and make final lug attachment.

b. **For Press Connector—**
Press lug onto conductor according to press manufacturer's instructions and make final lug attachment.

8. Remove the cable shielding from the end of the cable to within ½" of the cable jacket or sheath. Remove all traces of semi-conducting material from the surface of the exposed insulation.
9. Apply a thin coat of special cement for "B" plus "B" inches above the end of the cable shielding. Allow cement to dry until tacky before applying tape.
10. Starting at the top end of the stress cone, apply a layer of half-lapped Nozone tape down to within ¼" of the cable shielding. Continue taping over this surface to form a double cone to the dimensions shown on the drawing.
11. Apply stress cone shielding of 1" wide tinned, shielding braid starting the tinned slightly below the peak of the stress c wrapping up to the peak. Make sure th no strands of braid protruding from th at the peak of the stress cone shielding. Continue the shielding by wrapping half-lapped down the slope and over the cable shielding for ½" and lead sheath if the cable is sheathed.
12. Solder the adjacent turns of braid together in three axial strips. Solder tack a ground wire to the base of the stress cone of non-leaded cables. Solder tack the braid to the lead sheath if cable is lead covered.
13. Pencil the insulation adjacent to the lug to the dimension shown on the drawing. Apply a thin coat of special cement over the penciled insulation and conductor strands adjacent to the lug. Use special cement under the first layer of tape only. Allow cement to dry until tacky before applying tape.
14. Fill in the area adjacent to the lug with half-lapped layers of Nozone tape to form a smooth surface from the top of the pencil to the lug barrel. Extend final layer of tape over edge of lug barrel.
15. Apply two half-lapped layers of cover (G&W #211) tape over the stress cone and the lug seal as shown on the drawing.
16. Paint over the cover tape with P&B paint.

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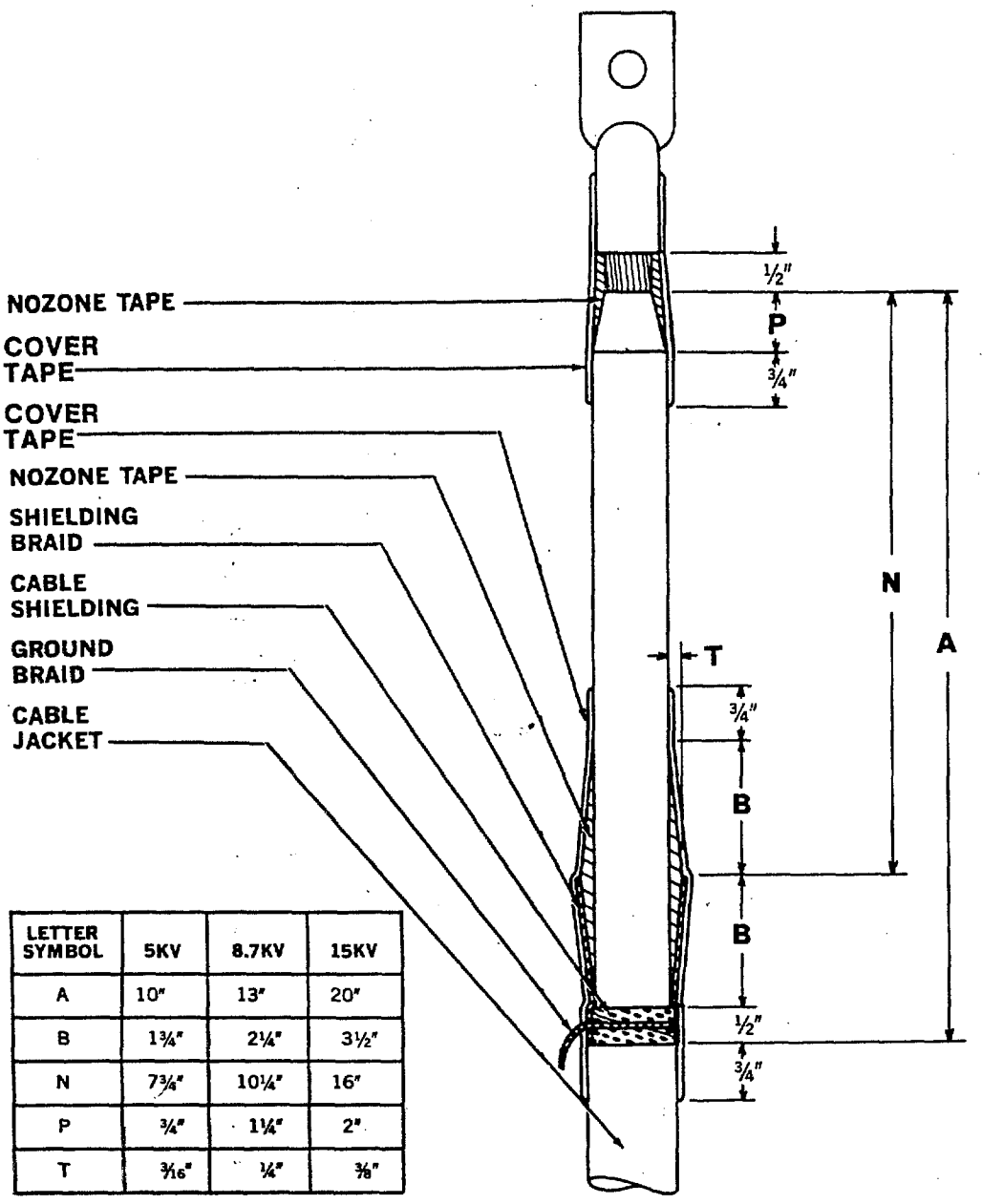

LETTER SYMBOL	5KV	8.7KV	15KV
A	10"	13"	20"
B	1¾"	2¼"	3½"
N	7¾"	10¼"	16"
P	¾"	1¼"	2"
T	3/16"	¼"	⅜"

G&W

G&W ELECTRIC CO.

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WARRANTY

The Seller warrants all devices to be free from defects in workmanship or material under normal use and service for a period of one year from date of shipment from the factory. Liability under this warranty is limited to replacement F.O.B. point of original destination of any parts which prove to be defective within that time. All technical advice, recommendations and services are based on technical data and information which the Seller believes to be reliable and are intended for use by persons having skill and knowledge of the business, at their own discretion. If it appears after written notice to Seller received by Seller during the period of the warranty provided for above that equipment shipped does not comply with the warranty, the Seller will at its option remedy the defect by replacement or repayment of the purchase price. In no case is Seller liable beyond replacement of equipment F.O.B. carrier at point of original destination or the full purchase price. This express warranty is in lieu of and excludes all other representations made by advertisements or by agents and all other warranties both express and implied. THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE FOR GOODS COVERED HEREUNDER.

BUYER'S REMEDIES

THE BUYER'S EXCLUSIVE AND SOLE REMEDY ON ACCOUNT OR IN RESPECT OF THE FURNISHING OF NON-CONFORMING MATERIAL SHALL BE TO SECURE REPLACEMENT THEREOF AS AFORESAID. THE SELLER SHALL NOT IN ANY EVENT BE LIABLE FOR THE COST OF ANY LABOR EXPENDED ON ANY NON-CONFORMING MATERIAL OR FOR ANY SPECIAL, DIRECT, INDIRECT OR CONSEQUENTIAL DAMAGES TO ANYONE BY REASON OF THE FACT THAT SUCH MATERIAL SHALL HAVE BEEN NON-CONFORMING.

BEST AVAILABLE DOCUMENT

SQUARE D COMPANY

Job Name:	KAZAKHSTAN REG WATER 5	Square D Quotation #:	
Job Location:		Quotation Revision #:	
		Sales Contact:	BOB HOFFMAN
		Sales Contact Location:	JACKSONVILLE
Purchaser:	HUGHES SUPPLY INC.	Customer:	HUGHES SUPPLY
Purchaser PO #:	01375471	Customer PO #:	
User:		Architect:	
User Location:		Cons. Engineer:	
Drawing Status:	RECORD		

TABLE OF CONTENTS

SQUARE D FACTORY ORDER NUMBER: 6514039

Equipment Designation	Equipment Type	Drawing Type	Drawing Number	Page	Revision Level
	PADMOUNT	GENERAL NOTES	6514039-F001	1	-
	TRANSFORMER	ELEVATION	6514039-F002		-
		RATING NAMEPLATE	6514039-F003		[redacted]

Submittal Type: ☒ Shop Drawing ☐ Sample

Review is only for limited purposes set forth in the Contract Documents.

APPROVED: (For Incorporation in the Work)
☒ Approved as Submitted
☐ Approved as Noted

DISAPPROVED: (Resubmittal Required)
☐ Make Corrections
☐ As Noted, Develop Replacement

INCOMPLETE: (Resubmittal Required)
☐ Complete and Resubmit
☐ Submit Missing Portions

By L. Henderson 5/1/96
CH2M HILL Date

These products are manufactured in a facility which is quality systems registered by Underwriters Laboratories to ISO 9000

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REV	DESCRIPTION	BY	DATE				

GENERAL NOTES

PRODUCT DESCRIPTION AND RATINGS

POWER SYSTEM DATA:

1000 KVA 10500 DELTA Primary 380Y/219 Secondary
3 Phase 50 Hz Class OA

ENCLOSURE DATA:

General Purpose - Outdoor
Finish MUN 7GY3.29/1.5 PMT GREEN

ESTIMATED SHIPPING WEIGHTS:

Core And Coils	3680 Lb
Enclosure	2420 Lb
Total	8900 Lb

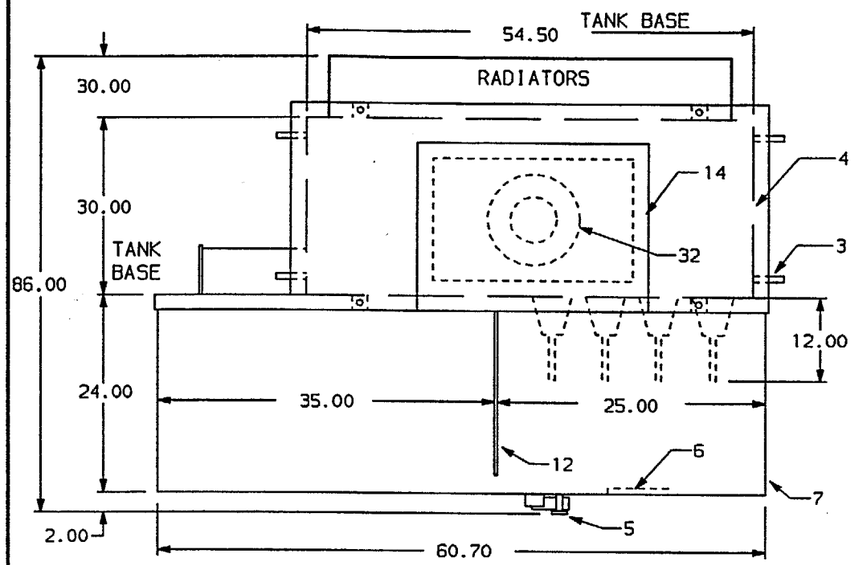
PRODUCT INFORMATION

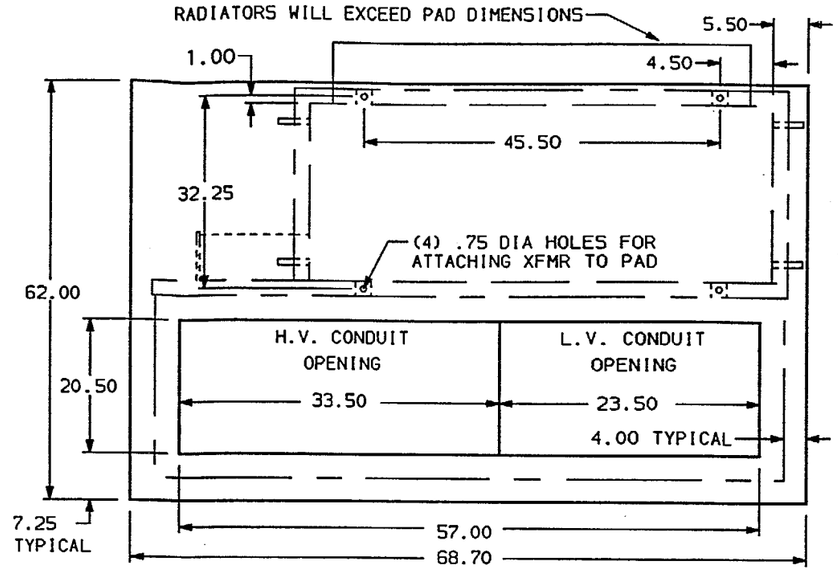
TRANSFORMER RATING

KVA:	1000/1120
Primary Voltage:	10500 DELTA Volts
Basic Impulse Level (KV):	95
Primary Voltage Connection:	DELTA
Secondary Voltage	380Y/219Volts
Basic Impulse Level (KV):	30
Secondary Voltage Connection:	WYE
Primary Conductor:	Copper
Secondary Conductor:	Copper
Taps:	+2 -2 At 2.5%
Impedance:	5.75 +-7.5%
Temperature rise:	55/65 Degrees C
Fluid Type:	SILICONE
Gallons:	350.0

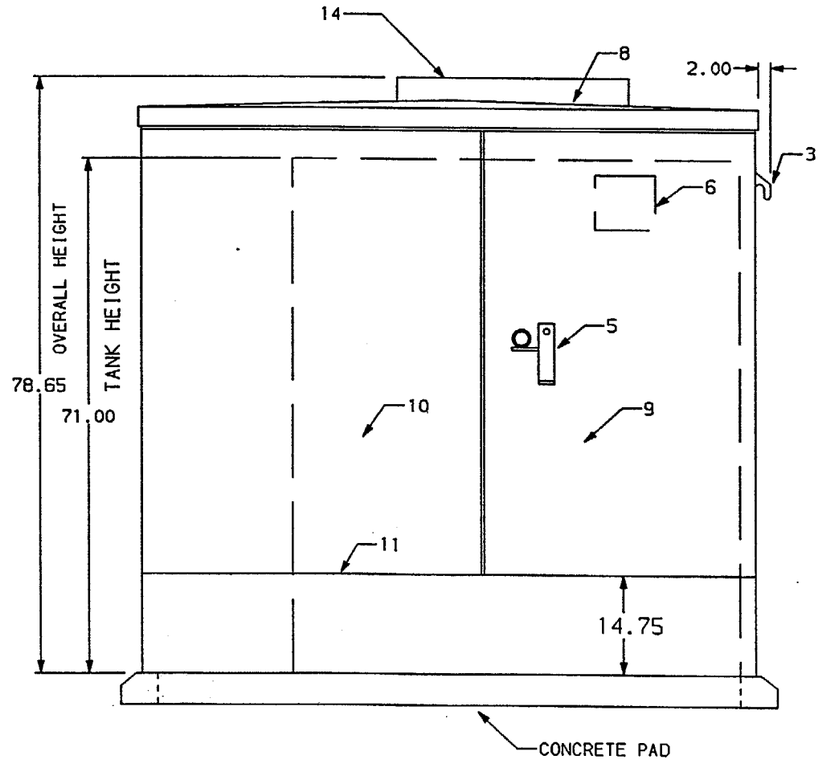
JOB NAME:	KAZAKHSTAN REG WATER S	EQUIPMENT DESIGNATION:	PS-2 PS-5
JOB LOCATION:		EQUIPMENT TYPE:	PADMOUNT TRANSFORMER
DRAWN BY:	G.MCWHORTER	DRAWING TYPE:	GENERAL NOTES
ENGR:		SQUARE D COMPANY	
DATE:	APRIL 18, 1996		
DRAWING STATUS:	RECORD	DWG# 6514039-F001	PG 1 OF 1 REV -

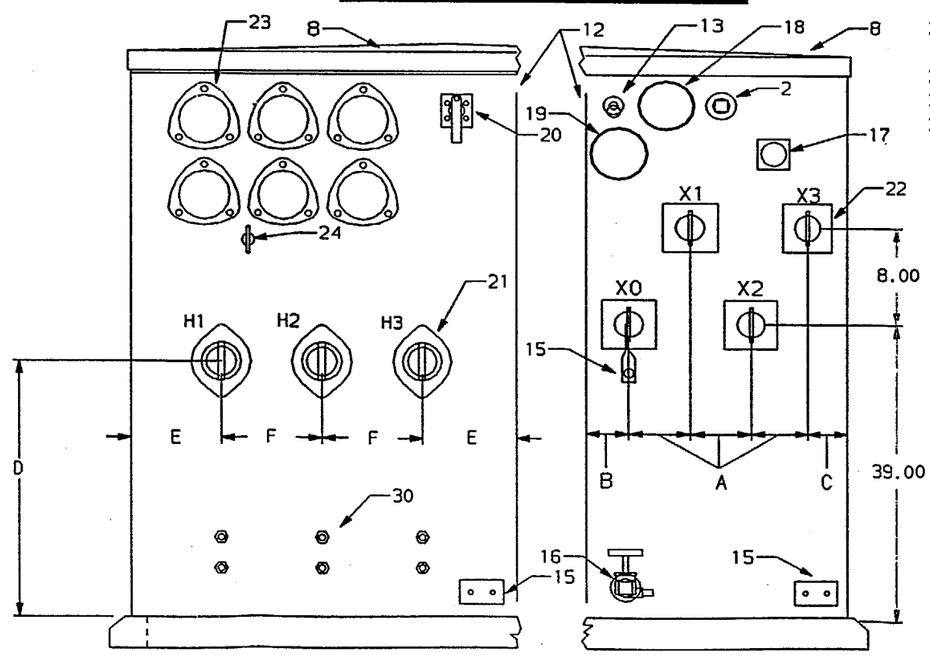
REV	DESCRIPTION	BY	DATE





RECOMMENDED PAD DIMENSIONS





H.V.DETAIL

L.V. DETAIL

NOTES:

1- TANK
2- 1.0 NPT FILLER PLUG
3- LIFTING LUGS (WITH TIE DOWN PROVISION)
4- BASE PROVISIONS FOR JACKING AND ROLLING
5- DOOR HANDLE WITH .50-13 HEXHEAD CAPTIVE BOLT AND PROVISIONS FOR PADLOCK
6- TRANSFORMER NAMEPLATE
7- REMOVABLE CABINET, HEIGHT = 73.50, DEPTH = 24.00, WIDTH = 60.70
8- CABINET HOOD, REMOVABLE
9- LV COMPARTMENT DOOR, LIFT-OFF
10- HV COMPARTMENT DOOR, LIFT-OFF
11- FRONT SILL, REMOVABLE
12- HV TO LV COMPARTMENT PARTITION
13- PRESSURE RELIEF VALVE
14- BOLTED HANDHOLE WITH REMOVABLE HOOD
15- HV & LV GROUND PAD (.50-13 x .44 DP. TAP)
16- 1.00 DRAIN VALVE WITH SAMPLER
17- MAGNETIC LIQUID LEVEL GAUGE
18- PRESSURE VACUUM GAUGE
19- THERMOMETER (WITH MAX TEMP INDICATOR)
20- TAP CHANGER (DE-ENERGIZED OPERATION ONLY)
21- LIVE FRONT HV BUSHING (126A 15KV) SQD#43523-004-03
22- LV BUSHING (8 HOLE SPADE) (4500 AMPS) COOPER#2637286C10
23- DRY WELL CL FUSE CANISTER (15.5 NLB) COOPER#ELX3564050M11
24- LOADBREAK SWITCH (2-POS 300A)
30- LIGHTNING ARRESTER QTY- 3 15KV
32- PRESSURE RELIEF DEVICE W/TAMPER PROOF COVER (W/OUT CONTACTS)

A	B	C	D	E	F
5.50	3.75	4.75	36.00	8.50	9.00

SERIAL NUMBER: 960143-A

JOB NAME:	KAZAKHSTAN REG WATER S	EQUIPMENT DESIGNATION:	PS-2 PS-5
JOB LOCATION:		EQUIPMENT TYPE:	PADMOUNT TRANSFORMER
DRAWN BY:	G.MCWHORTER	DRAWING TYPE:	ELEVATION
ENGR:	4-22-96	SQUARE D COMPANY	
DATE:	APRIL 18, 1996		
DRAWING STATUS:	RECORD	DWG# 6514039-F002	PG 1 OF 1 REV

DESCRIPTION	BY	DATE

SQUARE D COMPANY TRANSFORMER 78

SERIAL NO. 960143-B CLASS OA
THREE-PHASE 50 HERTZ

KVA RATING (CONTINUOUS) 1000/1120 55/65 C RISE
HV VOLTS 6000 DELTA
LV VOLTS 380Y/219
IMPEDANCE: 5.75 % AT 1000 KVA MFG. DATE

HV WINDING CONNECTIONS			
VOLTS H1-H2-H3	1120 KVA AMPS	TAP	CONNECTS
6300	102.6	A	1 TO 2
6150	105.1	B	2 TO 3
6000	107.8	C	3 TO 4
5850	110.5	D	4 TO 5
5700	113.4	E	5 TO 6
--	--	F	6 TO 7
--	--	G	7 TO 8

CAUTION:
DE-ENERGIZE TRANSFORMER
BEFORE CHANGING TAPS

WINDING MATERIAL	
HV	CU
LV	CU

LV WINDING CONNECTIONS	
VOLTS X1-X2-X3	AMPS 1120 KVA
380	1701.7

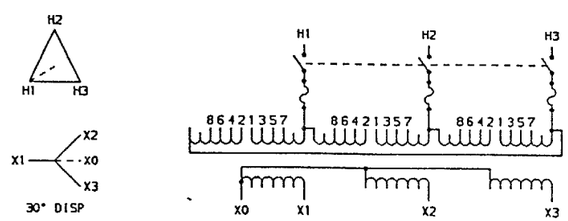
BIL LEVELS	
HV WINDING	95 KV
HV NEUTRAL	-- KV
HV NEUTRAL BUSHING	-- KV
LV WINDING	30 KV

READ INSTRUCTION MANUAL
43500-054-03
BEFORE INSTALLATION OR OPERATION

LIQUID TYPE SILICONE CONTAINS LESS THAN 1 PPM OF PCB LIQUID AT TIME OF MANUFACTURE. LIQUID LEVEL BELOW TOP OF MANHOLE FLANGE AT 25° C IS 9.5 INCHES. LIQUID LEVEL CHANGES 0.54 INCH PER 10° C CHANGE IN LIQUID TEMPERATURE. MAXIMUM OPERATING PRESSURES OF LIQUID PRESERVATION SYSTEM 7 PSI POSITIVE AND 7 PSI NEGATIVE. TANK SUITABLE FOR 7 PSI VACUUM FILLING.

APPROXIMATE WEIGHTS IN POUNDS

345 GALS. LIQ.	2760 LBS	TANK & FITTINGS	2400 LBS
CORE & COILS	3710 LBS	TOTAL	8870 LBS



MANUFACTURED BY SQUARE D COMPANY MADE IN U.S.A.

JOB NAME:	KAZAKHSTAN REG WATER S	EQUIPMENT DESIGNATION:	PS-1
JOB LOCATION:		EQUIPMENT TYPE:	PADMOUNT TRANSFORMER
DRAWN BY:	G.MCWHORTER	DRAWING TYPE:	NAMEPLATE
ENGR:	Stephen Cohen 4-23-96	SQUARE D COMPANY	
DATE:	APRIL 22, 1996		
DRAWING STATUS:	RECORD	DWG# 6514039-G003	PG 1 OF 1 REV -

CH2M HILL TRANSMITTAL

TO: Square D Company
4811 Beach Blvd., Suite 100, Scott Building
Jacksonville, FL 32207

FROM: Jill Carter/CH2M/GNV
3011 SW Williston Road
Gainesville, FL 32608

ATTN: Robert Hoffman

DATE: May 2, 1996

RE: Kazakstan P.S. Rehab

PROJECT NUMBER: 111600.A2.02 (RFP #100217.20)

WE ARE SENDING YOU:

- ATTACHED — UNDER SEPARATE COVER VIA
- SHOP DRAWINGS — DOCUMENTS — TRACINGS
- PRINTS — SPECIFICATIONS — CATALOGS
- COPY OF LETTER — OTHER:

QUANTITY	DESCRIPTION
1	Shop Drawings for Pad-mounted Transformers - P.S. #1,2,5 --- **APPROVED AS SUBMITTED**

IF MATERIAL RECEIVED IS NOT AS LISTED, PLEASE NOTIFY US AT ONCE

REMARKS:

COPY TO: 1 copy Mahmood/EPT, 1 copy Carter/GNV, ~~4~~ 3 copies on hold for field

Took 1 copy for Almaty

CH2M HILL,INC.
CH2M HILL, /GNV

Voice: (352)335-5877 x233

FAX: (352)335-2959

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UARE D COMPANY

Name: KAZAKHSTAN REG WATER S
Location:

Square D Quotation #:
Quotation Revision #:
Sales Contact: BOB HOFFMAN
Sales Contact Location: JACKSONVILLE

Purchaser: HUGHES SUPPLY INC.
Purchaser PO #: 01375471

Customer:
Customer PO #:

User:
User Location:

Architect:
Cons. Engineer:

Drawing Status: RECORD

TABLE OF CONTENTS

SQUARE D FACTORY ORDER NUMBER: 6514039

Equipment Designation	Equipment Type	Drawing Type	Drawing Number	Page	Revisio Level
	PADMOUNT	GENERAL NOTES	6514039-G001	1	-
	TRANSFORMER	ELEVATION	6514039-G002	2	-
		RATING NAMEPLATE	6514039-G003	3	-

Submittal Type: [illegible]
Review is only for limited purposes set forth in the Contract Documents.
APPROVED: (For Incorporation in the Work)
Approved as Submitted
Approved as Noted
DISAPPROVED: (Resubmittal Required)
Make Corrections
As Noted Vendor Replacement
INCOMPLETE: (Resubmittal Required)
Complete and Resubmit
Submit Missing Portions
By L. Henderson 5/6/96
CHIEF ENGR Date

These products are manufactured in a facility which is quality systems registered by Underwriters Laboratories to ISO 9000

APRIL 22, 1996
Pg 1 of 1
Rev: -

BEST AVAILABLE DOCUMENT

REV	DESCRIPTION	BY	DATE				

GENERAL NOTES

PRODUCT DESCRIPTION AND RATINGS

POWER SYSTEM DATA:

1000 KVA 6000 DELTA Primary 380Y/219 Secondary
3 Phase 50 Hz Class OA

ENCLOSURE DATA:

General Purpose - Outdoor
Finish MUN 7GY3.29/1.5 PMT GREEN

ESTIMATED SHIPPING WEIGHTS:

Core And Coils	3710 Lb
Enclosure	2400 Lb
Total	8870 Lb

PRODUCT INFORMATION

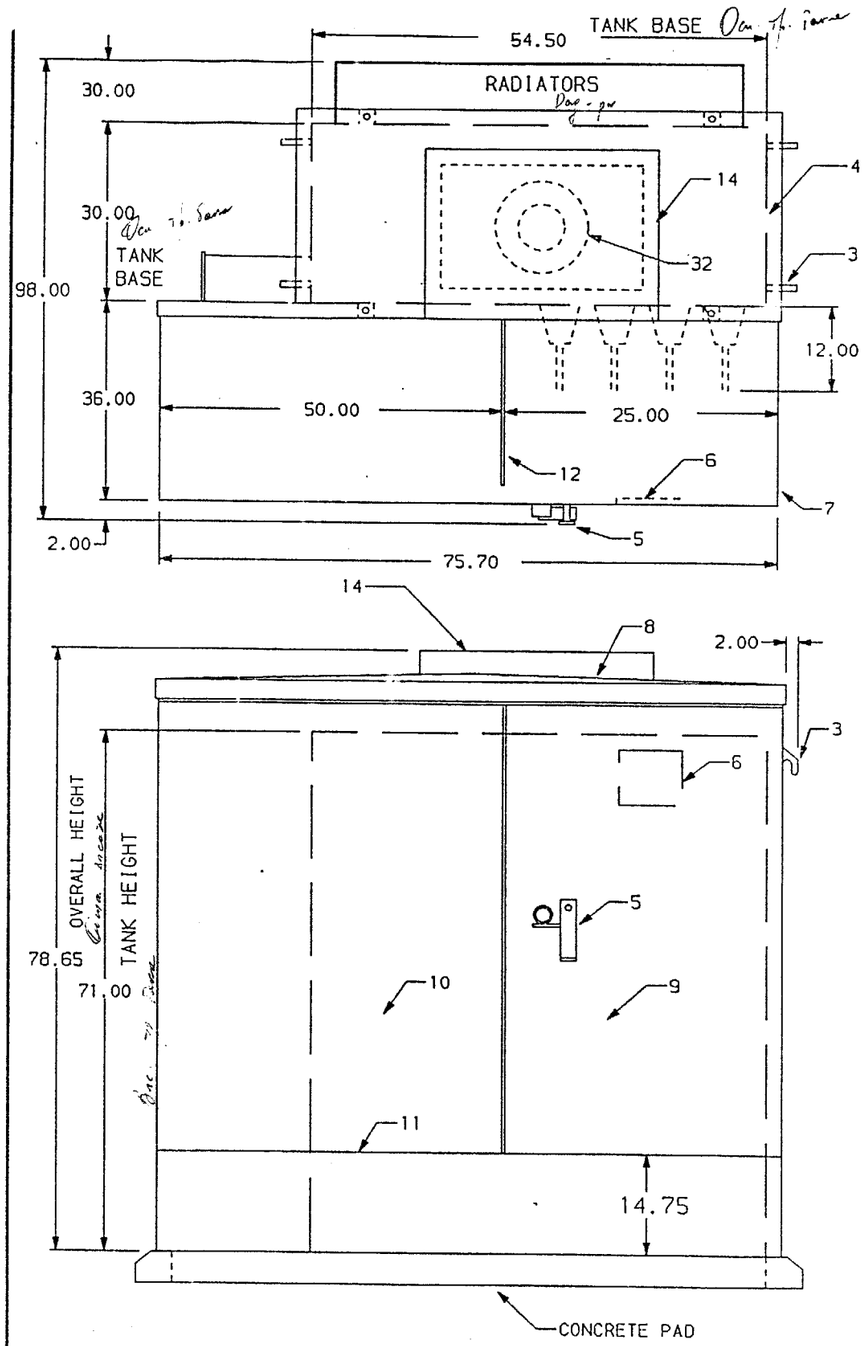
TRANSFORMER RATING

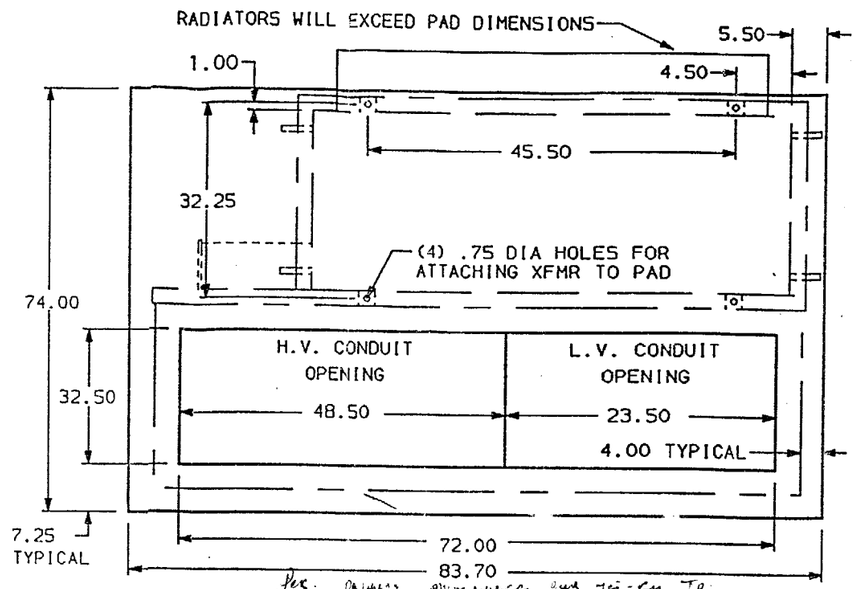
KVA:	1000/1120
Primary Voltage:	6000 DELTA Volts
Basic Impulse Level (KV):	95
Primary Voltage Connection:	DELTA
Secondary Voltage	380Y/219Volts
Basic Impulse Level (KV):	30
Secondary Voltage Connection:	WYE
Primary Conductor:	Copper
Secondary Conductor:	Copper
Taps:	+2 -2 At 2.5%
Impedance:	5.75 +-7.5%
Temperature rise:	55/65 Degrees C
Fluid Type:	SILICONE
Gallons:	345.0

JOB NAME:	KAZAKHSTAN REG WATER S	EQUIPMENT DESIGNATION:	[redacted]
JOB LOCATION:		EQUIPMENT TYPE:	PADMOUNT TRANSFORMER
DRAWN BY:	G.MCWHORTER	DRAWING TYPE:	GENERAL NOTES
ENGR:		SQUARE D COMPANY	
DATE:	APRIL 22, 1996		
DRAWING STATUS:	RECORD	DWG# 6514039-G001	PG 1 OF 1 REV -

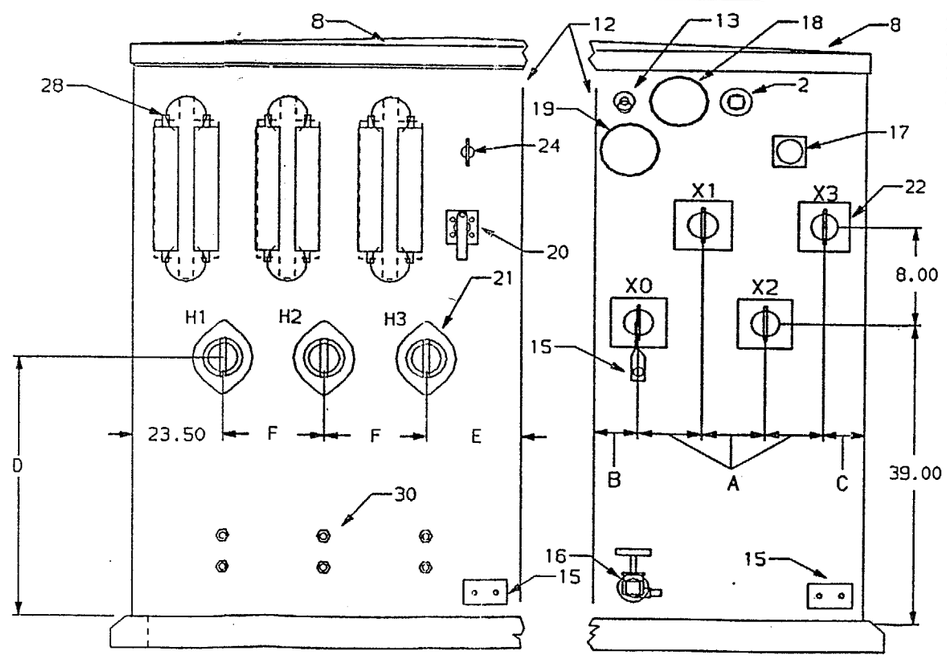
135

DESCRIPTION	BY	DATE





RECOMMENDED PAD DIMENSIONS



H.V. DETAIL

L.V. DETAIL

NOTES:

1- TANK
2- 1.0 NPT FILLER PLUG
3- LIFTING LUGS (WITH ~~TIE DOWN PROVISION~~)
4- BASE PROVISIONS FOR JACKING AND ROLLING
5- DOOR HANDLE WITH ~~.50-13 HEXHEAD CAPTIVE BOLT~~ AND PROVISIONS FOR PADLOCK
6- TRANSFORMER NAMEPLATE
7- REMOVABLE CABINET, HEIGHT = 73.50, DEPTH = 36.00, WIDTH = 75.70
8- CABINET HOOD, REMOVABLE
9- LV COMPARTMENT DOOR, LIFT-OFF
10- HV COMPARTMENT DOOR, LIFT-OFF
11- FRONT SILL, REMOVABLE
12- HV TO LV COMPARTMENT PARTITION
13- PRESSURE RELIEF VALVE
14- BOLTED HANDHOLE WITH REMOVABLE HOOD
15- HV & LV GROUND PAD (.50-13 x .44 DP. TAP)
16- 1.00 DRAIN VALVE WITH SAMPLER
17- MAGNETIC LIQUID LEVEL GAUGE
18- PRESSURE VACUUM GAUGE
19- THERMOMETER (WITH MAX TEMP INDICATOR)
20- TAP CHANGER (DE-ENERGIZED OPERATION ONLY)
21- LIVE FRONT HV BUSHING (126A 15KV) SQD#43523-004-03
22- LV BUSHING (8 HOLE SPADE) (4500 AMPS) COPPER#2637286C10
24- LOADBREAK SWITCH (2-POS 300A)
28- ME#FA3H80 (PARALLEL) MOUNTED ON HOLDER ME#FAB1K3
30- LIGHTNING ARRESTER QTY- 3 9KV
32- PRESSURE RELIEF DEVICE W/TAMPER PROOF COVER (W/OUT CONTACTS)

A	B	C	D	E	F
5.50	3.75	4.75	36.00	8.50	9.00

SERIAL NUMBER: 960143-8

JOB NAME:	KAZAKHSTAN REG WATER S	EQUIPMENT DESIGNATION:	[redacted]
JOB LOCATION:		EQUIPMENT TYPE:	PADMOUNT TRANSFORMER
DRAWN BY:	G.MCWHORTER	DRAWING TYPE:	ELEVATION
ENGR:	4-23-96	SQUARE D COMPANY	
DATE:	APRIL 22, 1996		
DRAWING STATUS:	RECORD	DWG# 6514039-G002	PG 1 OF 1 RE

REV	DESCRIPTION	BY	DATE

SQUARE D COMPANY TRANSFORMER 78

SERIAL NO. 960143-A CLASS OA
THREE-PHASE 50 HERTZ

KVA RATING (CONTINUOUS) 1000/1120 55/65 C RISE
HV VOLTS 10500 DELTA
LV VOLTS 380Y/219
IMPEDANCE: 5.75% AT 1000 KVA MFG. DATE

HV WINDING CONNECTIONS			
VOLTS H1-H2-H3	1120 KVA AMPS	TAP	CONNECTS
11025	58.7	A	1 TO 2
10763	60.1	B	2 TO 3
10500	61.6	C	3 TO 4
10238	63.2	D	4 TO 5
9975	64.8	E	5 TO 6
--	--	F	6 TO 7
--	--	G	7 TO 8

CAUTION:
DE-ENERGIZE TRANSFORMER
BEFORE CHANGING TAPS

WINDING MATERIAL	
HV	CU
LV	CU

LV WINDING CONNECTIONS	
VOLTS X1-X2-X3	AMPS 1120 KVA
380	1701.7

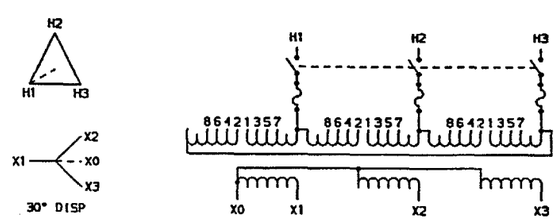
BIL LEVELS	
HV WINDING	95 KV
HV NEUTRAL	-- KV
HV NEUTRAL BUSHING	-- KV
LV WINDING	30 KV

READ INSTRUCTION MANUAL
43500-054-03
BEFORE INSTALLATION OR OPERATION

LIQUID TYPE SILICONE CONTAINS LESS THAN 1 PPM OF PCB LIQUID AT TIME OF MANUFACTURE. LIQUID LEVEL BELOW TOP OF MANHOLE FLANGE AT 25° C IS 9.5 INCHES. LIQUID LEVEL CHANGES 0.54 INCH PER 10° C CHANGE IN LIQUID TEMPERATURE. MAXIMUM OPERATING PRESSURES OF LIQUID PRESERVATION SYSTEM 7 PSI POSITIVE AND 7 PSI NEGATIVE. TANK SUITABLE FOR 7 PSI VACUUM FILLING.

APPROXIMATE WEIGHTS IN POUNDS

350 GALS. LIQ.	2800 LBS	TANK & FITTINGS	2420 LBS
CORE & COILS	3680 LBS	TOTAL	8900 LBS



MANUFACTURED BY SQUARE D COMPANY MADE IN U.S.A.

JOB NAME:	KAZAKHSTAN REG WATER S	EQUIPMENT DESIGNATION:	PS-2 , PS-5
JOB LOCATION:		EQUIPMENT TYPE:	PADMOUNT TRANSFORMER
DRAWN BY:	G.MCWHORTER	DRAWING TYPE:	NAMEPLATE
ENGR:	4-22-96	SQUARE D COMPANY	
DATE:	APRIL 18, 1996		
DRAWING STATUS:	RECORD	DWG# 6514039-F003	PG 1 OF 1 REV -

SQUARE D FACTORY ORDER NUMBER: 46-06514039-H

PAGE 1

CUSTOMER: HUGHES SUPPLY INC

ACCOUNT NUMBER: 2451

CUSTOMER ORDER NUMBER: 01375471

ARCHITECT:

ENGINEER:

CONTRACTOR: CH2M HILL INT'L SERVICES

SQUARE D COMPANY
MODEL 6 INDUSTRIAL MOTOR CONTROL CENTER

KAZAKHSTAN REG WATER SYS

MCC-1

SQUARE D FIELD ENGINEER: BOB HOFFMAN

SQUARE D FIELD OFFICE: JACKSONVILLE

PROCESSED BY: E FOSTER/RKB

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1 COPIES FOR RECORD 03/26/96

REVISION: 001

DATE: 03/26/96

Submittal Type: ☒ Shop Drawing ☐ Sample

Review is only for limited purposes set forth in the Contract Documents.

APPROVED: (For Incorporation in the Work)
☐ Approved as Submitted
☒ Approved as Noted

DISAPPROVED: (Resubmittal Required)
☐ Make Corrections
☐ As Noted, Develop Replacement

INCOMPLETE: (Resubmittal Required)
☐ Complete and Resubmit
☐ Submit Missing Portions

By L. Pendusa 4/1/96
CH2M HILL Date

BEST AVAILABLE DOCUMENT

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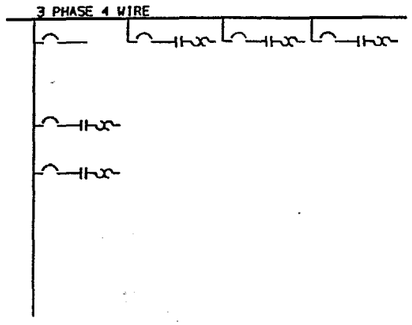

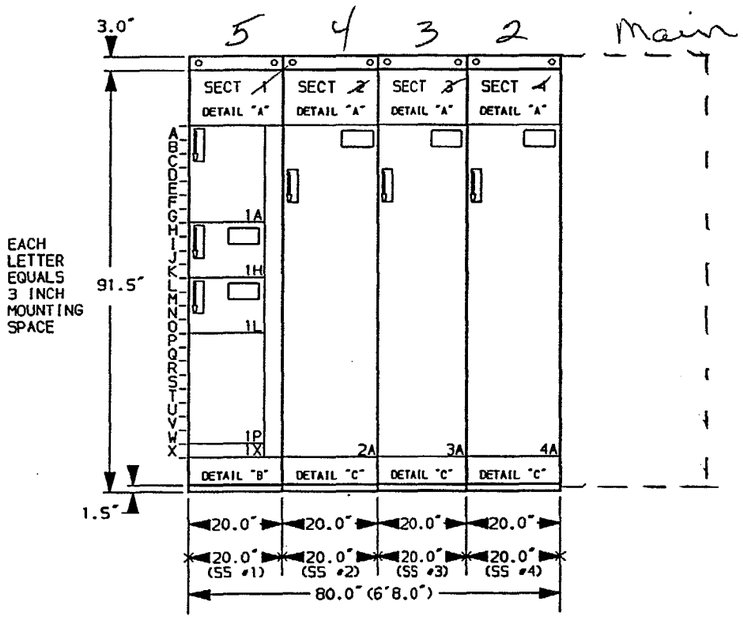

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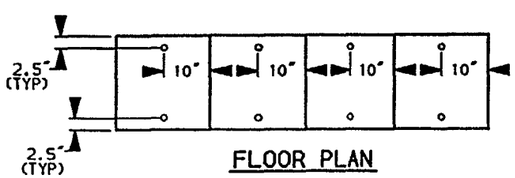
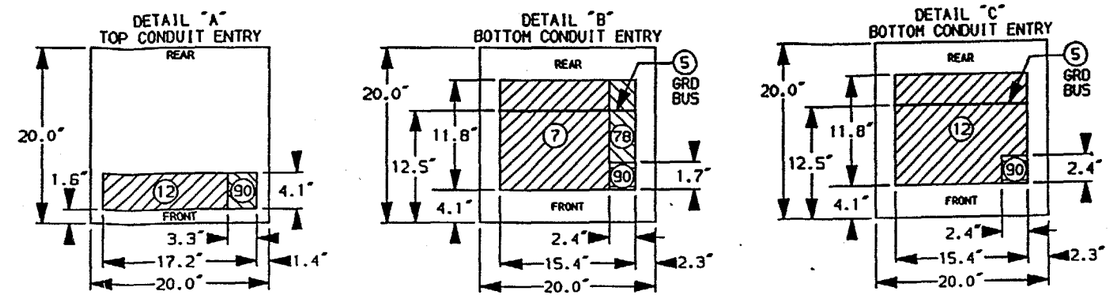


FLOOR PLAN

CROSSHATCHED AREA REPRESENTS CONDUIT ENTRY AREA.
NUMBERS IN CIRCLES INDICATE VERTICAL CLEARANCE IN INCHES TO NEAREST OBSTRUCTION. ALL DETAILS ARE TOP VIEW.

MODEL 6 INDUSTRIAL MOTOR CONTROL CENTER



GENERAL NOTES

NEMA CLASS 1 TYPE B WIRING

POWER SYSTEM DATA:
480 VOLTS 3 PHASE 3 WIRE 60 HZ
42,000 AMPS SHORT CIRCUIT RATING

FED BY

INCOMING CABLE DATA:
POWER CABLE: QUANTITY ( )
GROUND CABLE: QUANTITY (1) 250 MCM

BUS SYSTEM DATA:
MAIN HORIZONTAL BUS: 2000 AMP TIN PLATED COPPER
NEUTRAL HORIZONTAL BUS: 1200 AMP TIN PLATED COPPER
VERTICAL BUS: 0300 AMP TIN PLATED COPPER
HORIZONTAL GROUND BUS: .25x1.0 COPPER
UNITS SECURELY GROUNDED TO STRUCTURE THROUGH GROUND STAB

ENCLOSURE DATA:
ELECTRODEPOSITION FINISH #49 MEDIUM LIGHT GREY
20" DEEP NEMA TYPE 12 INDUSTRIAL DUTY ENCLOSURE
PER ANSI -Z55.1-1967

APPROX. SHIPPING WEIGHTS:
SHIPPING SPLIT # 1: 750lbs.
SHIPPING SPLIT # 2: 750lbs.
SHIPPING SPLIT # 3: 750lbs.
SHIPPING SPLIT # 4: 750lbs. TOTAL: 3000lbs.

STRUCTURE FEATURES:
NEUTRAL DROP 1
CU VERT GRD BUS 1
FISHTAPE BARR. 1
BUS CLOS. PLUGS 1
MASTER NP GREY 2
SPLICE TO MS(R) 4
NEUTRAL HOR. BUS 1,2,3,4

JOB NAME:	KAZAKHSTAN REG WATER SYS	EQUIPMENT DESIGNATION:	----
JOB LOCATION:	MCC-1	EQUIPMENT TYPE:	MODEL 6 MOTOR CONTROL CENTER
DRAWN BY:	MRJ	DRAWING TYPE:	ELEVATION
ENGR:	MEF		SQUARE D COMPANY
DATE:	MARCH 26, 1996		
DRAWING STATUS:	RECORD	DWG# F06514039-H-01	PG 1 OF 1 REV -

REV	DESCRIPTION	BY	DATE

COMPONENT INFORMATION

MCC DESIGNATION

UNIT LOC	NAMEPLATE DESIGNATION	UNIT TYPE	NEMA SIZE	HP	DISC AMPS	CONTROL TRANSFORMER VA	FUSE SIZE PRI	FUSE SIZE SEC	UNIT FEATURES	DRAWING NUMBER
1A	PANEL	BR.BKR			225				U221,U678,U341	E06514039-H-03-1
1H	PS1-S	FVNR	2	25	50				S5,U221,A,Y532,P1, U678,U273	E06514039-H-01-1
1L	PS1-S	FVNR	2	25	50				S5,U221,A,Y532,P1, U678,U273	E06514039-H-01-1
1P	24IN SPACE	SPACE							U678	
1X	3IN SPACE	SPACE							U678	
2A	PS1-T-1	FVNR	6	350	600				S5,U221,A,P1,U678, U273	E06514039-H-02-1
3A	PS1-T-2	FVNR	6	350	600				S5,U221,A,P1,U678, U273	E06514039-H-02-1
4A	PS1-T-3	FVNR	6	350	600				S5,U221,A,P1,U678, U273	E06514039-H-02-1

S5 DPDT INTLK
P1 RED ON P.L.
U221 240V CONTROL
U678 UNIT NP GREY
A START-STOP P.B.
U273 22MM PILOT DEV.
Y532 HIGH IC BREAKER
U341 EXTRA HI IC C/B

JOB NAME:	KAZAKHSTAN REG WATER SYS	EQUIPMENT DESIGNATION:	
JOB LOCATION:	MCC-1	EQUIPMENT TYPE:	MODEL 6 MOTOR CONTROL CENTER
DRAWN BY:	CAD	DRAWING TYPE:	COMPONENT INFORMATION
ENGR:	MEF	SQUARE D COMPANY	
DATE:	MARCH 26, 1996		
DRAWING STATUS:	RECORD	DWG# I06514039-H-01	PG 1 OF 1 REV

SQUARE D FACTORY ORDER NUMBER: 46-06514039-I

PAGE 1

CUSTOMER: HUGHES SUPPLY INC

ACCOUNT NUMBER: 2451

CUSTOMER ORDER NUMBER: 01375471

ARCHITECT:

ENGINEER:

CONTRACTOR: CH2M HILL INT'L SERVICES

SQUARE D COMPANY
MODEL 6 INDUSTRIAL MOTOR CONTROL CENTER

KAZAKHSTAN REG WATER SYS

MCC-2

SQUARE D FIELD ENGINEER: BOB HOFFMAN

SQUARE D FIELD OFFICE: JACKSONVILLE

PROCESSED BY: E FOSTER/RKB

---

1 COPIES FOR RECORD 03/26/96

REVISION: 001

DATE: 03/26/96

Submittal Type: ☐ Shop Drawing ☐ Sample

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☐ Approved as Submitted
☒ Approved as Noted

DISAPPROVED: (Resubmittal Required)
☐ Make Corrections
☒ As Noted, Develop Replacement

INCOMPLETE: (Resubmittal Required)
☐ Complete and Resubmit
☐ Submit Missing Portions

By L. Henderson 5/21/96
CH2M HILL Date

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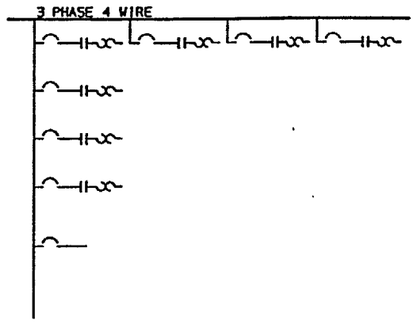
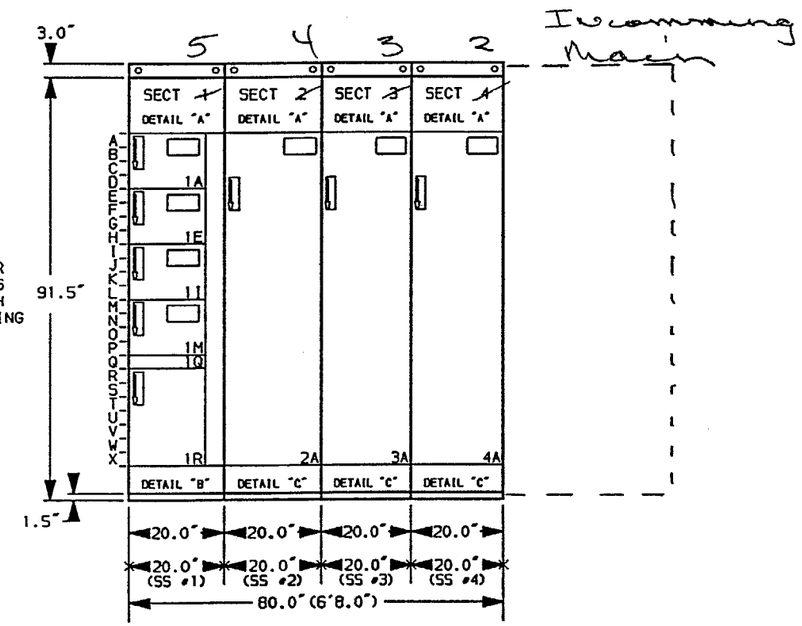
MODEL 6 INDUSTRIAL MOTOR CONTROL CENTER

CROSSHATCHED AREA REPRESENTS CONDUIT ENTRY AREA.
NUMBERS IN CIRCLES INDICATE VERTICAL CLEARANCE IN INCHES TO NEAREST OBSTRUCTION. ALL DETAILS ARE TOP VIEW.





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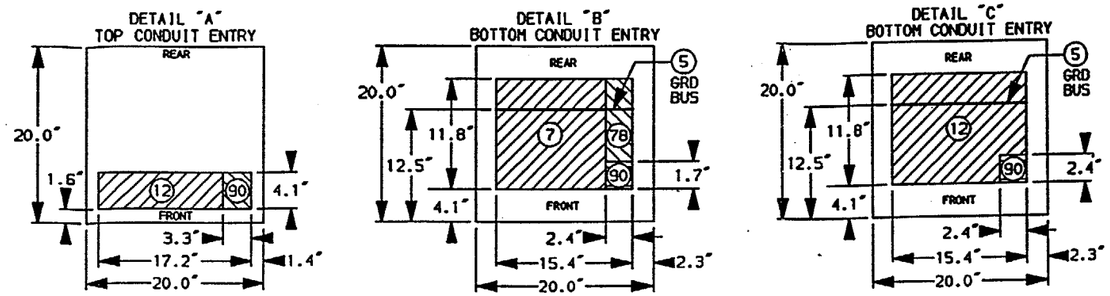

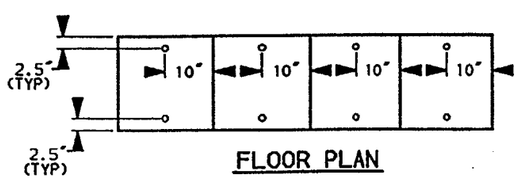

FLOOR PLAN

GENERAL NOTES

NEMA CLASS 1 TYPE B WIRING

POWER SYSTEM DATA:
480 VOLTS 3 PHASE 3 WIRE 60 HZ
42,000 AMPS SHORT CIRCUIT RATING

FED BY

INCOMING CABLE DATA:
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GROUND CABLE: QUANTITY (1) 250 MCM

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MAIN HORIZONTAL BUS: 2000 AMP TIN PLATED COPPER
NEUTRAL HORIZONTAL BUS: 1200 AMP TIN PLATED COPPER
VERTICAL BUS: 0300 AMP TIN PLATED COPPER
HORIZONTAL GROUND BUS: .25x1.0 COPPER
UNITS SECURELY GROUNDED TO STRUCTURE THROUGH GROUND STAB

ENCLOSURE DATA:
ELECTRODEPOSITION FINISH #49 MEDIUM LIGHT GREY
20" DEEP NEMA TYPE 12 INDUSTRIAL DUTY ENCLOSURE
PER ANSI -Z55.1-1967

APPROX. SHIPPING WEIGHTS:
SHIPPING SPLIT # 1: 750lbs.
SHIPPING SPLIT # 2: 750lbs.
SHIPPING SPLIT # 3: 750lbs.
SHIPPING SPLIT # 4: 750lbs. TOTAL: 3000lbs.

STRUCTURE FEATURES:
NEUTRAL DROP 1
CU VERT GRD BUS 1
FISHTAPE BARR. 1
600 A VERT. BUS 1
BUS CLOS. PLUGS 1
NEUTRAL HOR. BUS 1,2,3,4

JOB NAME:	KAZAKHSTAN REG WATER SYS	EQUIPMENT DESIGNATION:	----
JOB LOCATION:	MCC-2	EQUIPMENT TYPE:	MODEL 6 MOTOR CONTROL CENTER
DRAWN BY:	MRJ MRJ	DRAWING TYPE:	ELEVATION
ENGR:	MEF		SQUARE D COMPANY
DATE:	MARCH 26, 1996		
DRAWING STATUS:	RECORD	DWG# F06514039-I-01	PG 1 OF 1 REV -

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REV	DESCRIPTION	BY	DATE

COMPONENT INFORMATION

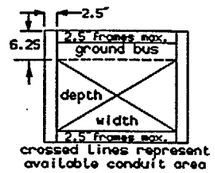
MCC DESIGNATION

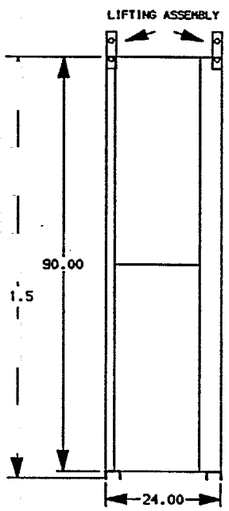
UNIT LOC	NAMEPLATE DESIGNATION	UNIT TYPE	NEMA SIZE	HP	DISC AMPS	CONTROL TRANSFORMER VA	FUSE SIZE PRI	FUSE SIZE SEC	UNIT FEATURES	DRAWING NUMBER
1A	PS2-S-1	FVNR	2	25	50				S5,U221,A,Y532,P1, U678,U273	E06514039-I-01-1
1E	PS2-S-2	FVNR	2	25	50				S5,U221,A,Y532,P1, U678,U273	E06514039-I-01-1
1I	PS2-S-3	FVNR	2	25	50				S5,U221,A,Y532,P1, U678,U273	E06514039-I-01-1
1M	PS2-S-4	FVNR	2	25	50				S5,U221,A,Y532,P1, U678,U273	E06514039-I-01-1
1Q	3IN SPACE	SPACE							U678	
1R	PANEL	BR.BKR			225				U221,U678,U341	E06514039-I-03-1
2A	PS2-T-1	FVNR	6	350	600				S5,U221,A,P1,U678, U273	E06514039-I-02-1
3A	PS2-T-2	FVNR	6	350	600				S5,U221,A,P1,U678, U273	E06514039-I-02-1
4A	PS2-T	FVNR	6	350	600				S5,U221,A,P1,U678, U273	E06514039-I-02-1

S5 DPDT INTLK
P1 RED ON P.L.
U221 240V CONTROL
U678 UNIT NP GREY
A START-STOP P.B.
U273 22MM PILOT DEV.
Y532 HIGH IC BREAKER
U341 EXTRA HI IC C/B

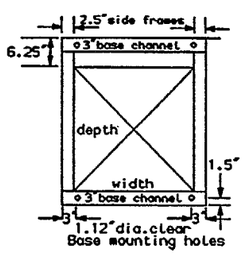
JOB NAME:	KAZAKHSTAN REG WATER SYS	EQUIPMENT DESIGNATION:	
JOB LOCATION:	MCC-2	EQUIPMENT TYPE:	MODEL 6 MOTOR CONTROL CENTER
DRAWN BY:	MRJ	DRAWING TYPE:	COMPONENT INFORMATION
ENGR:	MEF	SQUARE D COMPANY	
DATE:	MARCH 26, 1996		
DRAWING STATUS:	RECORD	DWG# I06514039-I-01	PG 1 OF 1 REV

REV	DESCRIPTION	BY	DATE
A	CORRECTED FRONT ELEVATION	SLC	4/22/96

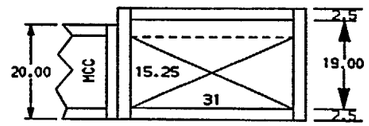




LEFT SIDE VIEW



TOP VIEW



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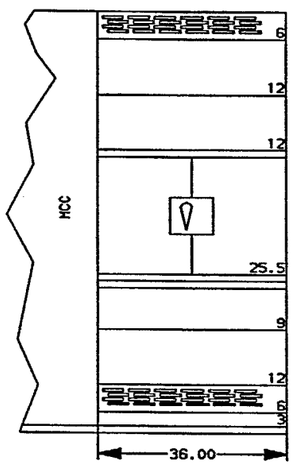
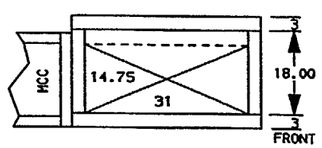
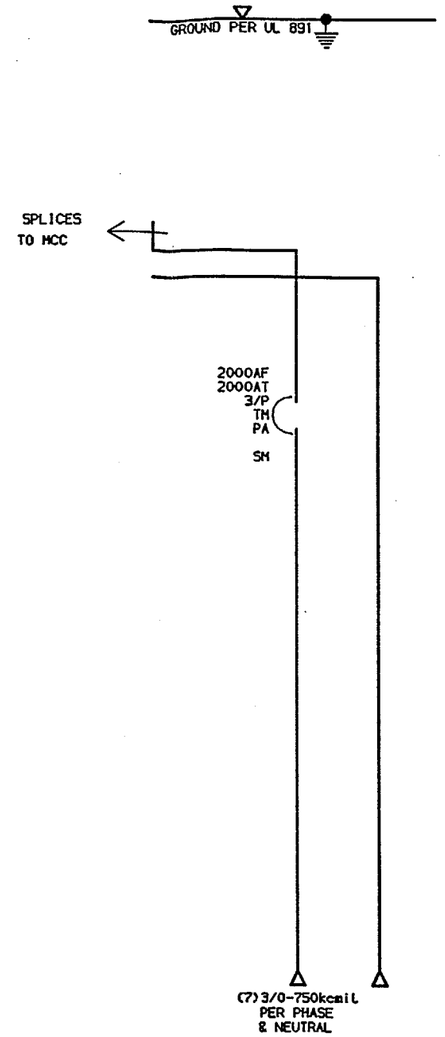


FLOOR PLAN





GENERAL NOTES

INCOMING FEED: CABLED, BOTTOM RIGHT
SYSTEM VOLTAGE: 220/380 3-PH 4-W
AVAILABLE FAULT CURRENT: 42,000 A RMS SYM
SYSTEM AMPERAGE: 2000 AMPS
BUS MATERIAL: COPPER
ACCESSIBILITY: FRONT ONLY
HANDLING: ROLLERS AND LIFTING
ENCLOSURE: TYPE 1
COLOR: ANSI 49
UL LABEL: DEADFRONT
SWBD MK: MCC-2

SINGLE SECTION WITHOUT THRU-BUS

JOB NAME:	KAZAKHSTAN WATER SYS	EQUIPMENT DESIGNATION:	MCC-2
JOB LOCATION:	N/A	EQUIPMENT TYPE:	POWER STYLE QED SWITCHBOARD
DRAWN BY:	DLS	DRAWING TYPE:	ELEVATION
ENGR:	SLC SLC	SQUARE D COMPANY	
DATE:	MAR 29 1996		
DRAWING STATUS:	RECORD	DWG# F06514039-K-01	PG 1 OF 1 REV A

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SQUARE D FACTORY ORDER NUMBER: 46-06514039-A

PAGE 1

CUSTOMER: HUGHES SUPPLY INC

ACCOUNT NUMBER: 2451

CUSTOMER ORDER NUMBER: 01375471

ARCHITECT:

ENGINEER:

CONTRACTOR: CH2M HILL INT'L SERVICES

SQUARE D COMPANY
MODEL 6 INDUSTRIAL MOTOR CONTROL CENTER

KAZAKHSTAN REG WATER SYS

MCC-3

SQUARE D FIELD ENGINEER: BOB HOFFMAN

SQUARE D FIELD OFFICE: JACKSONVILLE

PROCESSED BY: E FOSTER/RKB

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1 COPIES FOR RECORD 03/27/96

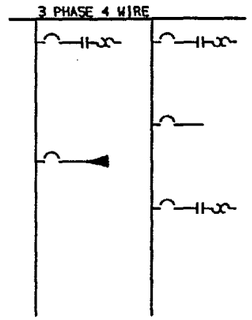
REVISION: 002

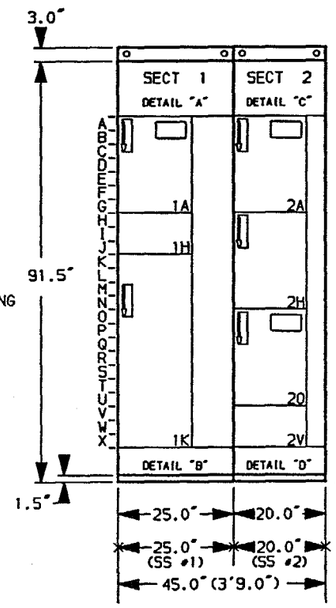
DATE: 03/27/96

DESCRIPTION	BY	DATE

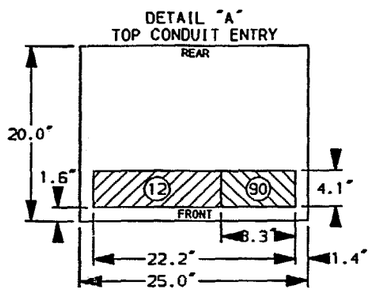
MODEL 6 INDUSTRIAL MOTOR CONTROL CENTER

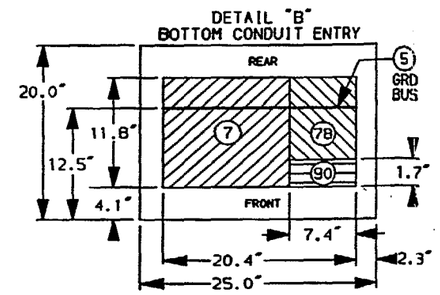
CROSSHATCHED AREA REPRESENTS CONDUIT ENTRY AREA.
NUMBERS IN CIRCLES INDICATE VERTICAL CLEARANCE IN INCHES
TO NEAREST OBSTRUCTION. ALL DETAILS ARE TOP VIEW.

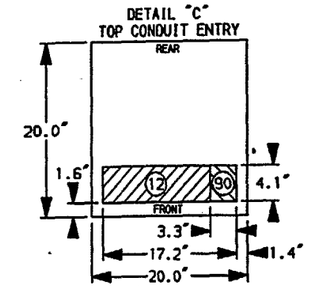


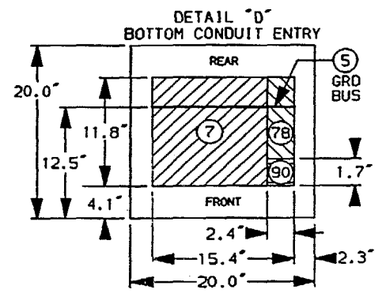


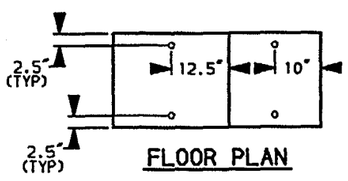
FRONT ELEVATION











FLOOR PLAN

GENERAL NOTES

NEMA CLASS 1 TYPE B WIRING

POWER SYSTEM DATA:
480 VOLTS 3 PHASE 4 WIRE 60 HZ
42,000 AMPS SHORT CIRCUIT RATING
POWER ENTERS MAIN BREAKER BOTTOM SECTION 1
FED BY

INCOMING CABLE DATA:
POWER CABLE: QUANTITY (3) 500 MCM PER PHASE
GROUND CABLE: QUANTITY (1) 250 MCM

BUS SYSTEM DATA:
MAIN HORIZONTAL BUS: 0600 AMP TIN PLATED COPPER
NEUTRAL HORIZONTAL BUS: 0600 AMP TIN PLATED COPPER
VERTICAL BUS: 0300 AMP TIN PLATED COPPER
HORIZONTAL GROUND BUS: .25x1.0 COPPER
UNITS SECURELY GROUNDED TO STRUCTURE THROUGH
GROUND STAB

ENCLOSURE DATA:
ELECTRODEPOSITION FINISH #49 MEDIUM LIGHT GREY
20" DEEP NEMA TYPE 12 INDUSTRIAL DUTY ENCLOSURE
PER ANSI -Z55.1-1967

APPROX. SHIPPING WEIGHTS:
SHIPPING SPLIT # 1: 750lbs.
SHIPPING SPLIT # 2: 750lbs. TOTAL: 1500lbs.

STRUCTURE FEATURES:
NEUTRAL DROP 1,2
CU VERT GRD BUS 1,2
FISHTAPE BARR. 1,2
BUS CLOS. PLUGS 1,2
600 A VERT. BUS 2
NEUTRAL HOR. BUS 1,2

JOB NAME:	KAZAKHSTAN REG WATER SYS	EQUIPMENT DESIGNATION:	----
JOB LOCATION:	MCC-3	EQUIPMENT TYPE:	MODEL 6 MOTOR CONTROL CENTER
DRAWN BY:	MRJ MRJ	DRAWING TYPE:	ELEVATION
ENGR:	MEF		SQUARE D COMPANY
DATE:	MARCH 27, 1996		
DRAWING STATUS:	RECORD	DWG# F06514039-A-01	PG 1 OF 1 REV -

DESCRIPTION	BY	DATE

COMPONENT INFORMATION

MCC DESIGNATION

UNIT LOC	NAMEPLATE DESIGNATION	UNIT TYPE	NEMA SIZE	HP	DISC AMPS	CONTROL TRANSFORMER VA	FUSE SIZE PRI	FUSE SIZE SEC	UNIT FEATURES	DRAWING NUMBER
1A	PS3-T-1	FVNR	4	75	250				S5,U221,A,P1,U678, U273	E06514039-A-01-1
1H	9IN SPACE	SPACE							U678	
1K		MN.BKR			600				U221,U231,Y532,U678	E06514039-A-02-1
2A	PS3-T-2	FVNR	4	75	250				S5,U221,A,P1,U678, U273	E06514039-A-01-1
2H	PANEL	BR.BKR			225				U221,U678,U341	E06514039-A-03-1
20	PS3-T-3	FVNR	4	75	250				S5,U221,A,P1,U678, U273	E06514039-A-01-1
2V	9IN SPACE	SPACE							U678	

S5 DPDT INTLK
U678 UNIT NP GREY
U341 EXTRA HI IC C/B
U221 240V CONTROL
U273 22MM PILOT DEV.
A START-STOP P.B.
U231 NEUTRAL LUG
P1 RED ON P.L.
Y532 HIGH IC BREAKER

JOB NAME:	KAZAKHSTAN REG WATER SYS	EQUIPMENT DESIGNATION:	
JOB LOCATION:	MCC-3	EQUIPMENT TYPE:	MODEL 6 MOTOR CONTROL CENTER
DRAWN BY:	CAD	DRAWING TYPE:	COMPONENT INFORMATION
ENGR:	MCF	SQUARE D COMPANY	
DATE:	MARCH 27, 1996		
DRAWING STATUS:	RECORD	DWG# I06514039-A-01	PG 1 OF 1 REV

SQUARE D FACTORY ORDER NUMBER: 46-06514039-B

PAGE 1

CUSTOMER: HUGHES SUPPLY INC

ACCOUNT NUMBER: 2451

CUSTOMER ORDER NUMBER: 01375471

ARCHITECT:

ENGINEER:

CONTRACTOR: CH2M HILL INT'L SERVICES

SQUARE D COMPANY
MODEL 6 INDUSTRIAL MOTOR CONTROL CENTER

KAZAKHSTAN REG WATER SYS

MCC-4

SQUARE D FIELD ENGINEER: BOB HOFFMAN

SQUARE D FIELD OFFICE: JACKSONVILLE

PROCESSED BY: E FOSTER/RKB/MRJ

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1 COPIES FOR RECORD 04/10/96

REVISION: 001

DATE: 03/26/96

Submittal Type: ☒ Shop Drawing ☐ Sample

Review is only for limited purposes set forth in the Contract Documents.

APPROVED: (For Incorporation in the Work)
- ☐ Approved as Submitted
- ☒ Approved as Noted

DISAPPROVED: (Resubmittal Required)
- ☐ Make Corrections
- ☒ As Noted, Develop Replacement

INCOMPLETE: (Resubmittal Required)
- ☐ Complete and Resubmit
- ☒ Submit Missing Portions

By [illegible] 5/1/96
CH2M HILL Date

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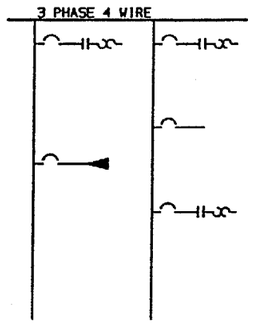
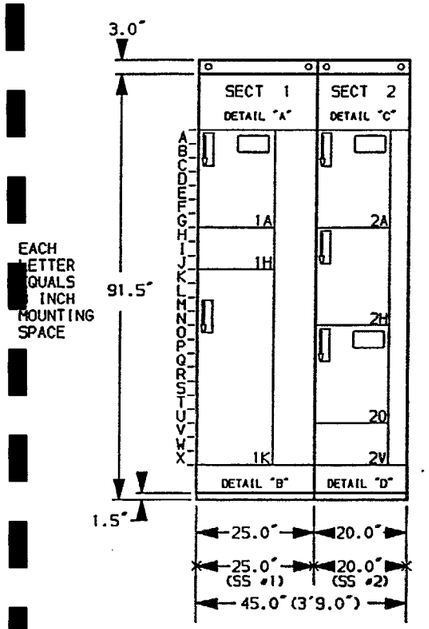
DESCRIPTION	BY	DATE

CROSSHATCHED AREA REPRESENTS CONDUIT ENTRY AREA.
NUMBERS IN CIRCLES INDICATE VERTICAL CLEARANCE IN INCHES
TO NEAREST OBSTRUCTION. ALL DETAILS ARE TOP VIEW.

MODEL 6 INDUSTRIAL MOTOR CONTROL CENTER





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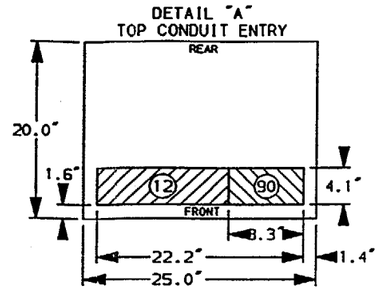

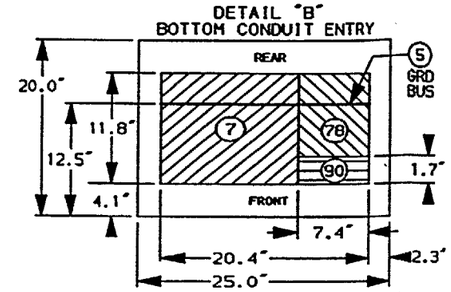

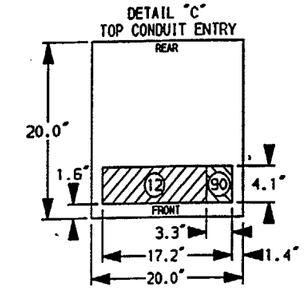

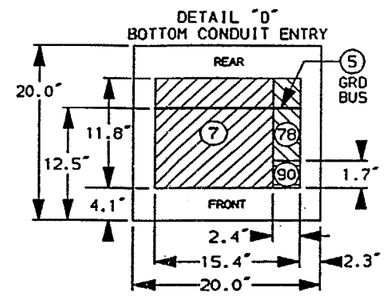

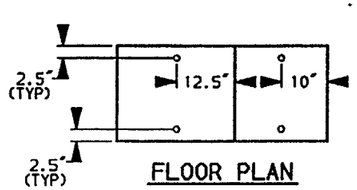

FLOOR PLAN

GENERAL NOTES

NEMA CLASS 1 TYPE B WIRING

POWER SYSTEM DATA:
480 VOLTS 3 PHASE 4 WIRE 60 HZ
42,000 AMPS SHORT CIRCUIT RATING
POWER ENTERS MAIN BREAKER BOTTOM SECTION 1
FED BY

INCOMING CABLE DATA:
POWER CABLE: QUANTITY (3) 500 MCM PER PHASE
GROUND CABLE: QUANTITY (1) 250 MCM

BUS SYSTEM DATA:
MAIN HORIZONTAL BUS: 0600 AMP TIN PLATED COPPER
NEUTRAL HORIZONTAL BUS: 0600 AMP TIN PLATED COPPER
VERTICAL BUS: 0300 AMP TIN PLATED COPPER
HORIZONTAL GROUND BUS: .25x1.0 COPPER
UNITS SECURELY GROUNDED TO STRUCTURE THROUGH
GROUND STAB

ENCLOSURE DATA:
ELECTRODEPOSITION FINISH #49 MEDIUM LIGHT GREY
20" DEEP NEMA TYPE 12 INDUSTRIAL DUTY ENCLOSURE
PER ANSI -Z55.1-1967

APPROX. SHIPPING WEIGHTS:
SHIPPING SPLIT # 1: 750lbs.
SHIPPING SPLIT # 2: 750lbs. TOTAL: 1500lbs.

STRUCTURE FEATURES:
NEUTRAL DROP 1,2
CU VERT GRD BUS 1,2
FISHTAPE BARR. 1,2
BUS CLOS. PLUGS 1,2
600 A VERT. BUS 2
NEUTRAL HORZ.BUS 1,2

JOB NAME:	KAZAKHSTAN REG WATER SYS	EQUIPMENT DESIGNATION:	----
JOB LOCATION:	MCC-4	EQUIPMENT TYPE:	MODEL 6 MOTOR CONTROL CENTER
DRAWN BY:	MRJ	DRAWING TYPE:	ELEVATION
ENGR:	MEF		SQUARE D COMPANY
DATE:	MARCH 26, 1996		
DRAWING STATUS:	RECORD	DWG# F06514039-B-01	PG 1 OF 1 REV -

REV	DESCRIPTION	BY	DATE

COMPONENT INFORMATION

MCC DESIGNATION

UNIT LOC	NAMEPLATE DESIGNATION	UNIT TYPE	NEMA SIZE	HP	DISC AMPS	CONTROL TRANSFORMER VA	FUSE SIZE PRI	FUSE SIZE SEC	UNIT FEATURES	DRAWING NUMBER
1A	PS4-T-1	FVNR	4	75	250				S5,U221,A,P1,U678, U273	E06514039-B-01-1
1H	9IN SPACE	SPACE							U678	
1K		MN.BKR			600				U221,U231,YS32,U678	E06514039-B-02-1
2A	PS4-T-2	FVNR	4	75	250				S5,U221,A,P1,U678, U273	E06514039-B-01-1
2H	PANEL	BR.BKR			225				U221,U678,U341	E06514039-B-03-1
20	PS4-T-3	FVNR	4	75	250				S5,U221,A,P1,U678, U273	E06514039-B-01-1
2V	9IN SPACE	SPACE							U678	

S5 DPDT INTLK
U678 UNIT NP GREY
U341 EXTRA HI IC C/B
U221 240V CONTROL
U273 22MM PILOT DEV.
A START-STOP P.B.
U231 NEUTRAL LUG
P1 RED ON P.L.
YS32 HIGH IC BREAKER

JOB NAME:	KAZAKHSTAN REG WATER SYS	EQUIPMENT DESIGNATION:	
JOB LOCATION:	MCC-3	EQUIPMENT TYPE:	MODEL 6 MOTOR CONTROL CENTER
DRAWN BY:	CAD	DRAWING TYPE:	COMPONENT INFORMATION
ENGR:	Mcf	SQUARE D COMPANY	
DATE:	MARCH 26, 1996		
DRAWING STATUS:	RECORD	DWG# I06514039-B-01	PG 1 OF 1 REV

SQUARE D FACTORY ORDER NUMBER: 46-06514039-C

PAGE 1

CUSTOMER: HUGHES SUPPLY INC

ACCOUNT NUMBER: 2451

CUSTOMER ORDER NUMBER: 01375471

ARCHITECT:

ENGINEER:

CONTRACTOR: CH2M HILL INT'L SERVICES

SQUARE D COMPANY
MODEL 6 INDUSTRIAL MOTOR CONTROL CENTER

KAZAKHSTAN REG WATER SYS

MCC-5

SQUARE D FIELD ENGINEER: BOB HOFFMAN

SQUARE D FIELD OFFICE: JACKSONVILLE

PROCESSED BY: E FOSTER/RKB

---

1 COPIES FOR RECORD 03/26/96

REVISION: 001

DATE: 03/26/96

Submittal Type: ☐ Shop Drawing ☒ Sample

Review is only for limited purposes set forth in the Contract Documents.

APPROVED: (For Incorporation in the Work)
☐ Approved as Submitted
☐ Approved as Noted

DISAPPROVED: (Resubmittal Required)
☐ Make Corrections
☐ As Noted, Develop Replacement

INCOMPLETE: (Resubmittal Required)
☐ Complete and Resubmit
☐ Submit Missing Portions

By L. Henderson 5/1/96
CH2M HILL Date
TW

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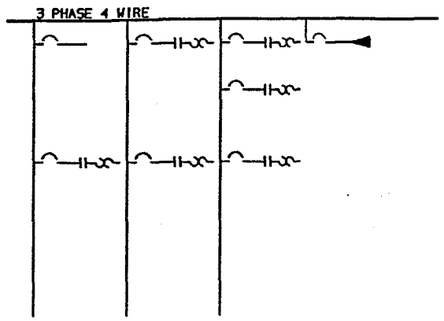
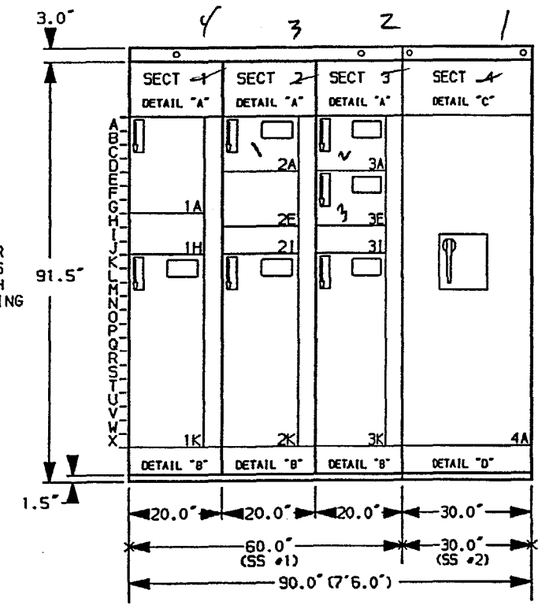
MODEL 6 INDUSTRIAL MOTOR CONTROL CENTER

CROSSHATCHED AREA REPRESENTS CONDUIT ENTRY AREA.
NUMBERS IN CIRCLES INDICATE VERTICAL CLEARANCE IN INCHES TO NEAREST OBSTRUCTION. ALL DETAILS ARE TOP VIEW.





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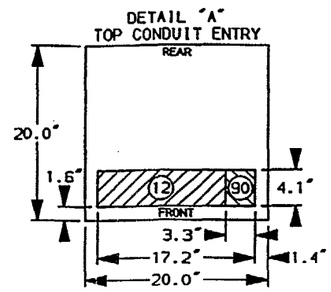

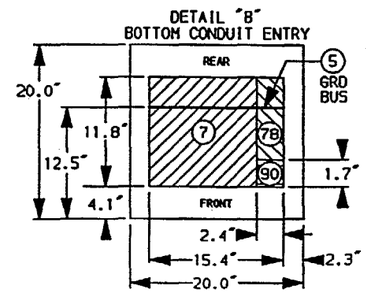

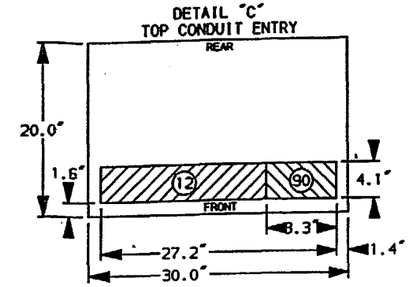

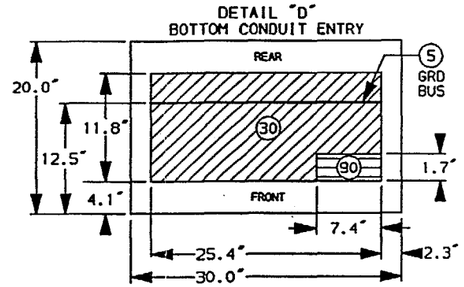

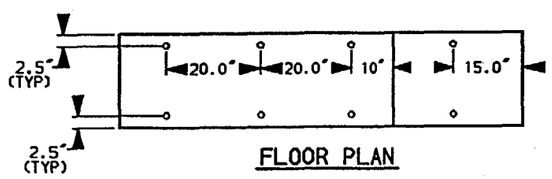

FLOOR PLAN

GENERAL NOTES

NEMA CLASS 1 TYPE B WIRING

POWER SYSTEM DATA:
480 VOLTS 3 PHASE 4 WIRE 60 HZ
42,000 AMPS SHORT CIRCUIT RATING
POWER ENTERS MAIN BREAKER BOTTOM SECTION 4
FED BY

INCOMING CABLE DATA:
POWER CABLE: QUANTITY (4) 750 MCM PER PHASE
GROUND CABLE: QUANTITY (1) 250 MCM

BUS SYSTEM DATA:
MAIN HORIZONTAL BUS: 1200 AMP TIN PLATED COPPER
NEUTRAL HORIZONTAL BUS: 1200 AMP TIN PLATED COPPER
VERTICAL BUS: 0300 AMP TIN PLATED COPPER
HORIZONTAL GROUND BUS: .25x1.0 COPPER
UNITS SECURELY GROUNDED TO STRUCTURE THROUGH GROUND STAB

ENCLOSURE DATA:
ELECTRODEPOSITION FINISH #49 MEDIUM LIGHT GREY
20" DEEP NEMA TYPE 12 INDUSTRIAL DUTY ENCLOSURE
PER ANSI -Z55.1-1967

APPROX. SHIPPING WEIGHTS:
SHIPPING SPLIT # 1: 2250lbs.
SHIPPING SPLIT # 2: 750lbs. TOTAL: 3000lbs.

STRUCTURE FEATURES:
NEUTRAL DROP 1,2,3,4
CU VERT GRD BUS 1,2,3
FISHTAPE BARR. 1,2,3
BUS CLOS. PLUGS 1,2,3
NEUTRAL HOR. BUS 1,2,3,4

JOB NAME:	KAZAKHSTAN REG WATER SYS	EQUIPMENT DESIGNATION:	——
JOB LOCATION:	MCC-5	EQUIPMENT TYPE:	MODEL 6 MOTOR CONTROL CENTER
DRAWN BY:	MRJ mrj	DRAWING TYPE:	ELEVATION
ENGR:	Mef	SQUARE D COMPANY	
DATE:	MARCH 26, 1996		
DRAWING STATUS:	RECORD	DWG# F06514039-C-01	PG 1 OF 1 REV -

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REV	DESCRIPTION	BY	DATE

COMPONENT INFORMATION

MCC DESIGNATION

UNIT LOC	NAMEPLATE DESIGNATION	UNIT TYPE	NEMA SIZE	HP	DISC AMPS	CONTROL TRANSFORMER VA	FUSE SIZE PRI	FUSE SIZE SEC	UNIT FEATURES	DRAWING NUMBER
1A	PANEL	BR.BKR			225				U221,U678,U341	E06514039-C-03-1
1H	9IN SPACE	SPACE							U678	
1K	PS5-T-1	FVNR	5	125	250				S5,U221,A,P1,U678, U273	E06514039-C-01-1
2A	PS5-S-1	FVNR	2	25	50				S5,U221,A,Y532,P1, U678,U273	E06514039-C-02-1
2E	12IN SPACE	SPACE							U678	
2I	6IN SPACE	SPACE							U678	
2K	PS5-T-2	FVNR	5	125	250				S5,U221,A,P1,U678, U273	E06514039-C-01-1
3A	PS5-S-2	FVNR	2	25	50				S5,U221,A,Y532,P1, U678,U273	E06514039-C-02-1
3E	PS5-S-3	FVNR	2	25	50				S5,U221,A,Y532,P1, U678,U273	E06514039-C-02-1
3I	6IN SPACE	SPACE							U678	
3K	PS5-T-3	FVNR	5	125	250				S5,U221,A,P1,U678, U273	E06514039-C-01-1
4A		MN.BKR			1200				U231,Y532,U678	E06514039-C-04-1

S5 DPDT INTLK
U678 UNIT NP GREY
U231 NEUTRAL LUG
U221 240V CONTROL
U273 22MM PILOT DEV.
A START-STOP P.B.
Y532 HIGH IC BREAKER
P1 RED ON P.L.
U341 EXTRA HI IC C/B

JOB NAME:	KAZAKHSTAN REG WATER SYS	EQUIPMENT DESIGNATION:	
JOB LOCATION:	MCC-5	EQUIPMENT TYPE:	MODEL 6 MOTOR CONTROL CENTER
DRAWN BY:	MRJ	DRAWING TYPE:	COMPONENT INFORMATION
ENGR:	MEF	SQUARE D COMPANY	
DATE:	MARCH 26, 1996		
DRAWING STATUS:	RECORD	DWG# I06514039-C-01	PG 1 OF 1 REV

SQUARE D FACTORY ORDER NUMBER: 46-06514039-D

PAGE 1

CUSTOMER: HUGHES SUPPLY INC

ACCOUNT NUMBER: 2451

CUSTOMER ORDER NUMBER: 01375471

ARCHITECT:

ENGINEER:

CONTRACTOR: CH2M HILL INT'L SERVICES

SQUARE D COMPANY
MODEL 6 INDUSTRIAL MOTOR CONTROL CENTER

KAZAKHSTAN REG WATER SYS

MCC-7

SQUARE D FIELD ENGINEER: BOB HOFFMAN

SQUARE D FIELD OFFICE: JACKSONVILLE

PROCESSED BY: E FOSTER/RKB

---

1 COPIES FOR RECORD 03/26/96

REVISION: 001

DATE: 03/26/96

Submittal Type: ☒ Shop Drawing
☒ Sample
Review is only for limited purposes set forth in the Contract Documents.
APPROVED: (For Incorporation in the Work)
☐ Approved as Submitted
☒ Approved as Noted
DISAPPROVED: (Resubmittal Required)
☐ Make Corrections
☒ As Noted, Develop Replacement
INCOMPLETE: (Resubmittal Required)
☐ Complete and Resubmit
☐ Submit Missing Portions
By L. Henderson 5/11/96
CH2M HILL Date

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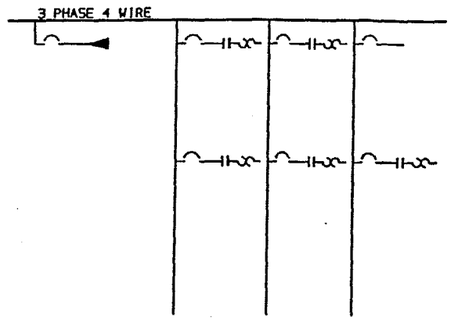
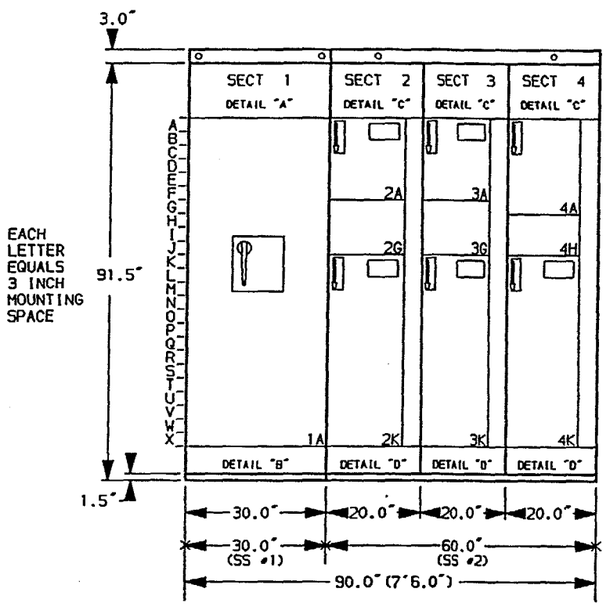
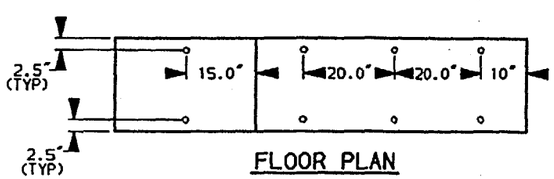
CROSSHATCHED AREA REPRESENTS CONDUIT ENTRY AREA.
NUMBERS IN CIRCLES INDICATE VERTICAL CLEARANCE IN INCHES
TO NEAREST OBSTRUCTION. ALL DETAILS ARE TOP VIEW.

MODEL 6 INDUSTRIAL MOTOR CONTROL CENTER

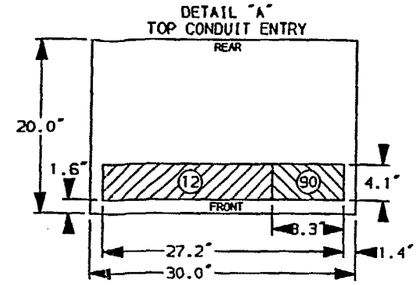


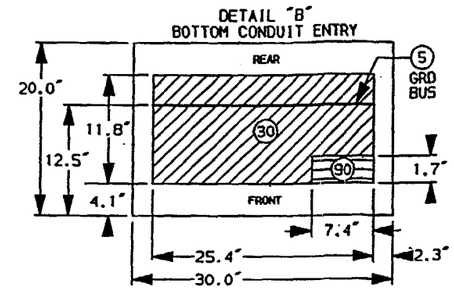


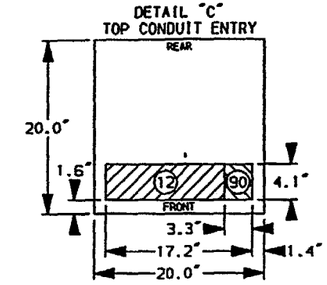
FRONT ELEVATION

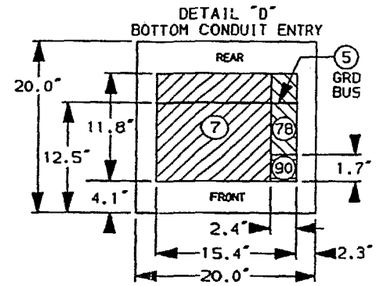


FLOOR PLAN









GENERAL NOTES

NEMA CLASS 1 TYPE B WIRING

POWER SYSTEM DATA:
480 VOLTS 3 PHASE 4 WIRE 60 HZ
42,000 AMPS SHORT CIRCUIT RATING
POWER ENTERS MAIN BREAKER BOTTOM SECTION 1
FED BY

INCOMING CABLE DATA:
POWER CABLE: QUANTITY (4) 750 MCM PER PHASE
GROUND CABLE: QUANTITY (1) 250 MCM

BUS SYSTEM DATA:
MAIN HORIZONTAL BUS: 1200 AMP TIN PLATED COPPER
NEUTRAL HORIZONTAL BUS: 1200 AMP TIN PLATED COPPER
VERTICAL BUS: 0300 AMP TIN PLATED COPPER
HORIZONTAL GROUND BUS: .25x1.0 COPPER
UNITS SECURELY GROUNDED TO STRUCTURE THROUGH GROUND STAB

ENCLOSURE DATA:
ELECTRODEPOSITION FINISH #49 MEDIUM LIGHT GREY
20" DEEP NEMA TYPE 12 INDUSTRIAL DUTY ENCLOSURE
PER ANSI -255.1-1967

APPROX. SHIPPING WEIGHTS:
SHIPPING SPLIT # 1: 750lbs.
SHIPPING SPLIT # 2: 2250lbs. TOTAL: 3000lbs.

STRUCTURE FEATURES:
NEUTRAL DROP 1,2,3,4
CU VERT GRD BUS 2,3,4
FISHTAPE BARR. 2,3,4
BUS CLOS. PLUGS 2,3,4
NEUTRAL HOR. BUS 1,2,3,4

JOB NAME:	KAZAKHSTAN REG WATER SYS	EQUIPMENT DESIGNATION:	----
JOB LOCATION:	MCC-7	EQUIPMENT TYPE:	MODEL 6 MOTOR CONTROL CENTER
DRAWN BY:	MRJ MRJ	DRAWING TYPE:	ELEVATION
ENGR:	MEF	SQUARE D COMPANY	
DATE:	MARCH 26, 1996		
DRAWING STATUS:	RECORD	DWG# F06514039-D-01	PG 1 OF 1 REV -

REV	DESCRIPTION	BY	DATE

COMPONENT INFORMATION

MCC DESIGNATION

UNIT LOC	NAMEPLATE DESIGNATION	UNIT TYPE	NEMA SIZE	HP	DISC AMPS	CONTROL TRANSFORMER VA	FUSE SIZE PRI	FUSE SIZE SEC	UNIT FEATURES	DRAWING NUMBER
1A		MN.BKR			1200				U221,U231,Y532,U678	E06514039-D-03-1
2A	PS7-S-1	FVNR	3	50	100				S5,U221,A,Y532,P1, U678,U273	E06514039-D-01-1
2G	12IN SPACE	SPACE							U678	
2K	PS7-T-1	FVNR	5	100	250				S5,U221,A,P1,U678, U273	E06514039-D-02-1
3A	PS7-S-2	FVNR	3	50	100				S5,U221,A,Y532,P1, U678,U273	E06514039-D-01-1
3G	12IN SPACE	SPACE							U678	
3K	PS7-T-2	FVNR	5	100	250				S5,U221,A,P1,U678, U273	E06514039-D-02-1
4A	PANEL	BR.BKR			225				U221,U678,U341	E06514039-D-04-1
4H	9IN SPACE	SPACE							U678	
4K	PS7-T-3	FVNR	5	100	250				S5,U221,A,P1,U678, U273	E06514039-D-02-1

S5 DPDT INTLK
P1 RED ON P.L.
U341 EXTRA HI IC C/B
U221 240V CONTROL
U678 UNIT NP GREY
A START-STOP P.B.
U273 22MM PILOT DEV.
Y532 HIGH IC BREAKER
U231 NEUTRAL LUG

JOB NAME:	KAZAKHSTAN REG WATER SYS	EQUIPMENT DESIGNATION:	
JOB LOCATION:	MCC-7	EQUIPMENT TYPE:	MODEL 6 MOTOR CONTROL CENTER
DRAWN BY:	MRJ	DRAWING TYPE:	COMPONENT INFORMATION
ENGR:	MEF	SQUARE D COMPANY	
DATE:	MARCH 26, 1996		
DRAWING STATUS:	RECORD	DWG# I06514039-D-01	PG 1 OF 1 REV

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SQUARE D FACTORY ORDER NUMBER: 46-06514039-E

PAGE 1

CUSTOMER: HUGHES SUPPLY INC

ACCOUNT NUMBER: 2451

CUSTOMER ORDER NUMBER: 01375471

ARCHITECT:

ENGINEER:

CONTRACTOR: CH2M HILL INT'L SERVICES

SQUARE D COMPANY
MODEL 6 INDUSTRIAL MOTOR CONTROL CENTER

KAZAKHSTAN REG WATER SYS

MCC ARALSK

SQUARE D FIELD ENGINEER: BOB HOFFMAN

SQUARE D FIELD OFFICE: JACKSONVILLE

PROCESSED BY: E FOSTER/RKB

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1 COPIES FOR RECORD 03/26/96

REVISION: 001

DATE: 03/26/96

Submittal Type: ☐ Shop Drawing ☒ Sample

Review is only for limited purposes set forth in the Contract Documents.

APPROVED: (For Incorporation in the Work)
☒ Approved as Submitted
☐ Approved as Noted

DISAPPROVED: (Resubmittal Required)
☐ Make Corrections
☐ As Noted, Develop Replacement

INCOMPLETE: (Resubmittal Required)
☒ Complete and Resubmit
☐ Submit Missing Portions

By L. Henderson 3/1/96
CH2M HILL Date

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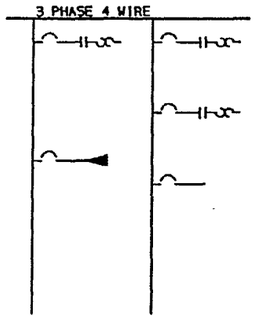
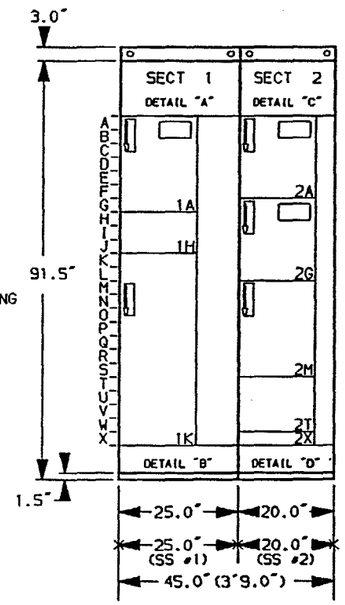
MODEL 6 INDUSTRIAL MOTOR CONTROL CENTER

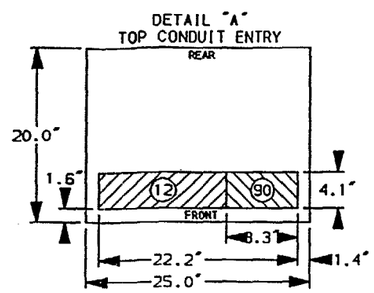
CROSSHATCHED AREA REPRESENTS CONDUIT ENTRY AREA.
NUMBERS IN CIRCLES INDICATE VERTICAL CLEARANCE IN INCHES TO NEAREST OBSTRUCTION. ALL DETAILS ARE TOP VIEW.

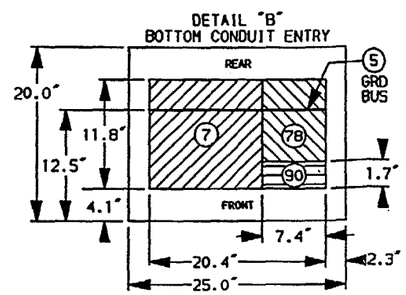


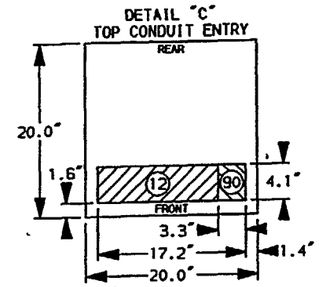


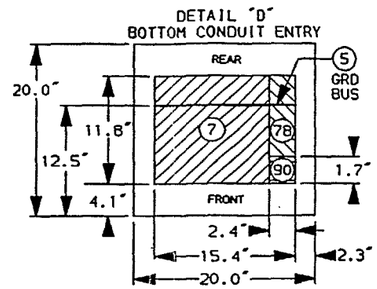
EACH LETTER EQUALS 3 INCH MOUNTING SPACE

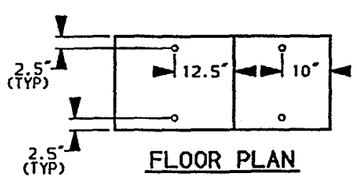
FRONT ELEVATION











FLOOR PLAN

GENERAL NOTES

NEMA CLASS 1 TYPE B WIRING

POWER SYSTEM DATA:
480 VOLTS 3 PHASE 4 WIRE 60 HZ
42,000 AMPS SHORT CIRCUIT RATING
POWER ENTERS MAIN BREAKER BOTTOM SECTION 1
FED BY

INCOMING CABLE DATA:
POWER CABLE: QUANTITY (3) 500 MCM PER PHASE
GROUND CABLE: QUANTITY (1) 250 MCM

BUS SYSTEM DATA:
MAIN HORIZONTAL BUS: 0600 AMP TIN PLATED COPPER
NEUTRAL HORIZONTAL BUS: 0600 AMP TIN PLATED COPPER
VERTICAL BUS: 0300 AMP TIN PLATED COPPER
HORIZONTAL GROUND BUS: .25x1.0 COPPER
UNITS SECURELY GROUNDED TO STRUCTURE THROUGH GROUND STAB

ENCLOSURE DATA:
ELECTRODEPOSITION FINISH #49 MEDIUM LIGHT GREY
20" DEEP NEMA TYPE 12 INDUSTRIAL DUTY ENCLOSURE
PER ANSI -Z55.1-1967

APPROX. SHIPPING WEIGHTS:
SHIPPING SPLIT # 1: 750lbs.
SHIPPING SPLIT # 2: 750lbs. TOTAL: 1500lbs.

STRUCTURE FEATURES:
NEUTRAL DROP 1,2
CU VERT GRD BUS 1,2
FISHTAPE BARR. 1,2
BUS CLOS. PLUGS 1,2
600 A VERT. BUS 2
NEUTRAL HOR. BUS 1,2

JOB NAME:	KAZAKHSTAN REG WATER SYS	EQUIPMENT DESIGNATION:	----
JOB LOCATION:	MCC ARALSK	EQUIPMENT TYPE:	MODEL 6 MOTOR CONTROL CENTER
DRAWN BY:	MRJ MRJ	DRAWING TYPE:	ELEVATION
ENGR:	MEF	SQUARE D COMPANY	
DATE:	MARCH 26, 1996		
DRAWING STATUS:	RECORD	DWG# F06514039-E-01	PG 1 OF 1 REV -

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REV	DESCRIPTION	BY	DATE

COMPONENT INFORMATION

MCC DESIGNATION

UNIT LOC	NAMEPLATE DESIGNATION	UNIT TYPE	NEMA SIZE	HP	DISC AMPS	CONTROL TRANSFORMER VA	FUSE SIZE PRI	FUSE SIZE SEC	UNIT FEATURES	DRAWING NUMBER
1A	ARALSK-S-1	FVNR	4	75	250				S5,U221,A,P1,U678, U273	E06514039-E-01-1
1H	9IN SPACE	SPACE							U678	
1K		MN.BKR			600				U221,U231,Y532,U678	E06514039-E-03-1
2A	ARALSK 2	FVNR	3	50	100				S5,U221,A,Y532,P1, U678,U273	E06514039-E-02-1
2G	ARALSK 3	FVNR	3	50	100				S5,U221,A,Y532,P1, U678,U273	E06514039-E-02-1
2M	PANEL	BR.BKR			225				U221,U678,U341	E06514039-E-04-1
2T	12IN SPACE	SPACE							U678	
2X	3IN SPACE	SPACE							U678	

S5 DPDT INTLK
U678 UNIT NP GREY
U341 EXTRA HI IC C/B
U221 240V CONTROL
U273 22MM PILOT DEV.
A START-STOP P.B.
Y532 HIGH IC BREAKER
P1 RED ON P.L.
U231 NEUTRAL LUG

JOB NAME:	KAZAKHSTAN REG WATER SYS	EQUIPMENT DESIGNATION:	
JOB LOCATION:	MCC ARALSK	EQUIPMENT TYPE:	MODEL 6 MOTOR CONTROL CENTER
DRAWN BY:	CAD	DRAWING TYPE:	COMPONENT INFORMATION
ENGR:	MEF	SQUARE D COMPANY	
DATE:	MARCH 26, 1996		
DRAWING STATUS:	RECORD	DWG# I06514039-E-01	PG 1 OF 1 REV

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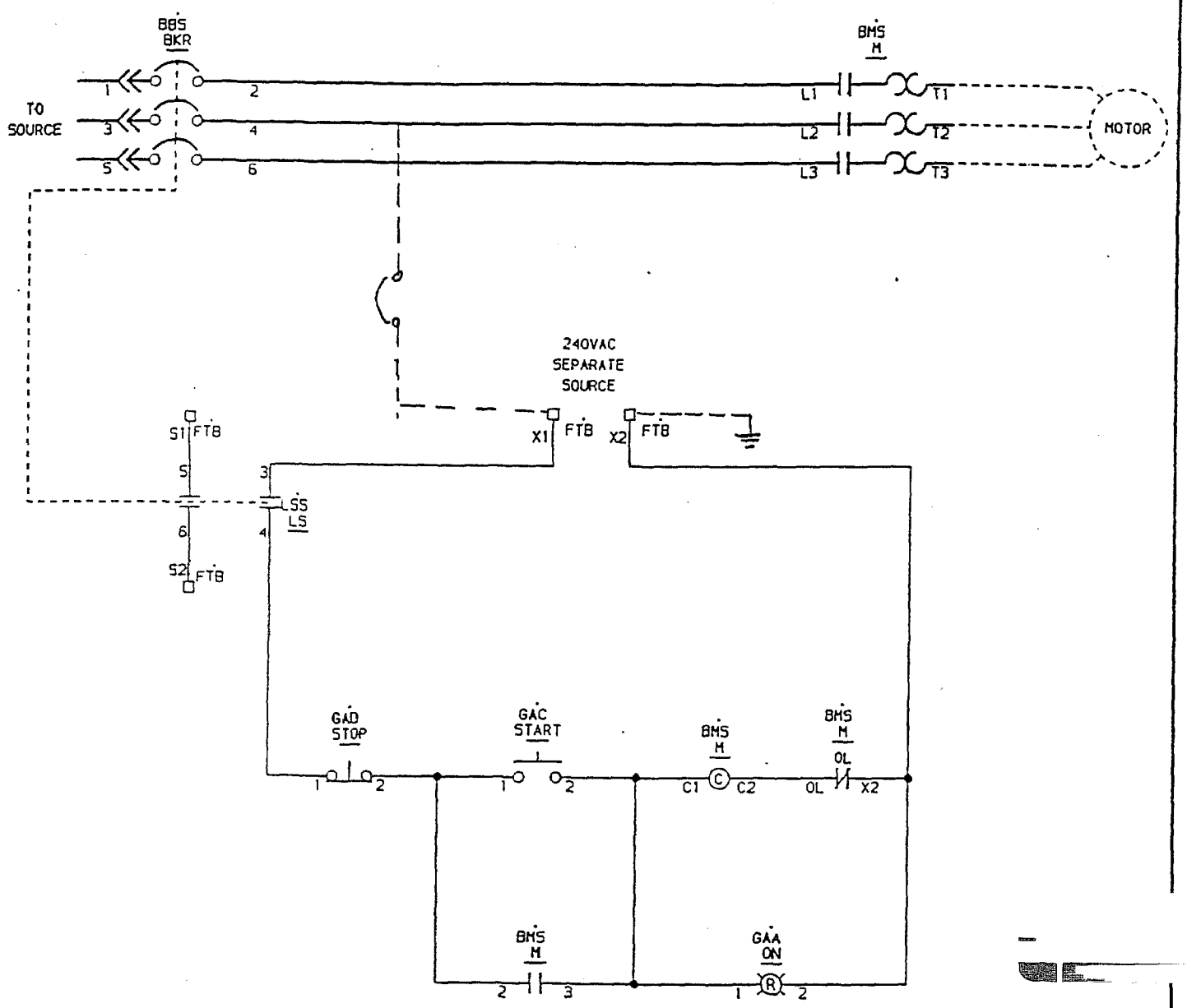
REV	DESCRIPTION	BY	DATE				

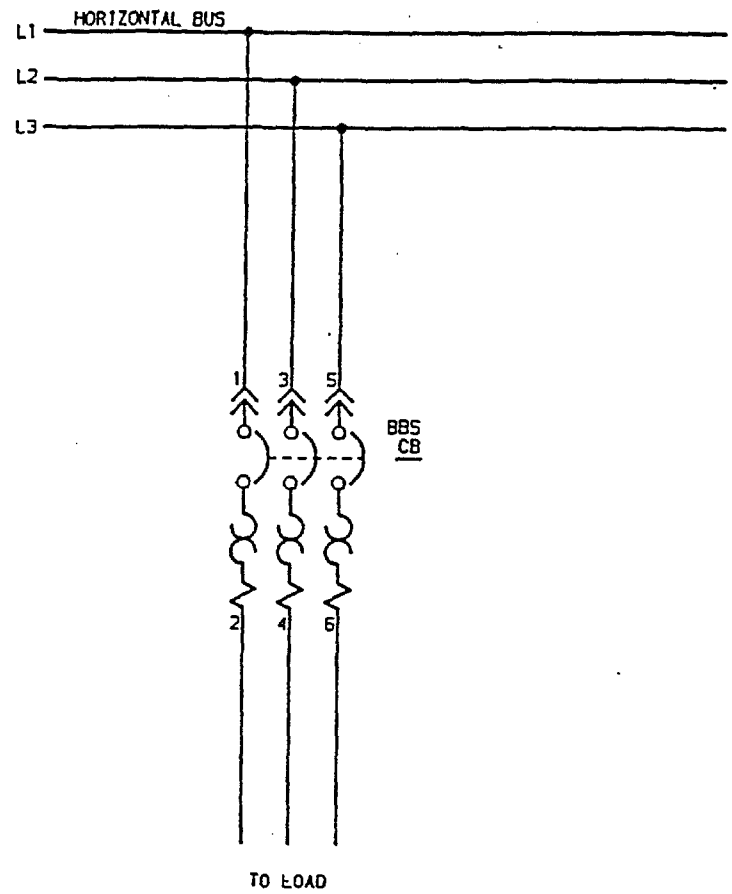


NOTES:

1) Typical for all motor size 125 HP and smaller at Pump Stations No's 3,4,5 and Aralsk Pump Station.

JOB NAME:	KAZAKHSTAN REG WATER SYS	EQUIPMENT DESIGNATION:	—
JOB LOCATION:	MCC-1	EQUIPMENT TYPE:	MODEL 6 MOTOR CONTROL CENTER
DRAWN BY:	MRJ	DRAWING TYPE:	ELEMENTARY DIAGRAM
ENGR:	MEF	SQUARE D COMPANY	
DATE:	MARCH 26, 1996		
DRAWING STATUS:	RECORD	DWG# E06514039-H-01	PG 1 OF 1 REV -

REV	DESCRIPTION	BY	DATE				



NOTES:

1) Typical for all power breakers at the motor control center.

JOB NAME:	KAZAKHSTAN REG WATER SYS	EQUIPMENT DESIGNATION:	——
JOB LOCATION:	MCC-1	EQUIPMENT TYPE:	MODEL 6 MOTOR CONTROL CENTER
DRAWN BY:	CAD	DRAWING TYPE:	ELEMENTARY DIAGRAM
ENGR:	MEF	SQUARE D COMPANY	
DATE:	MARCH 26, 1996		
DRAWING STATUS:	RECORD	DWG: E06514039-H-03	PG 1 OF 1 REV -

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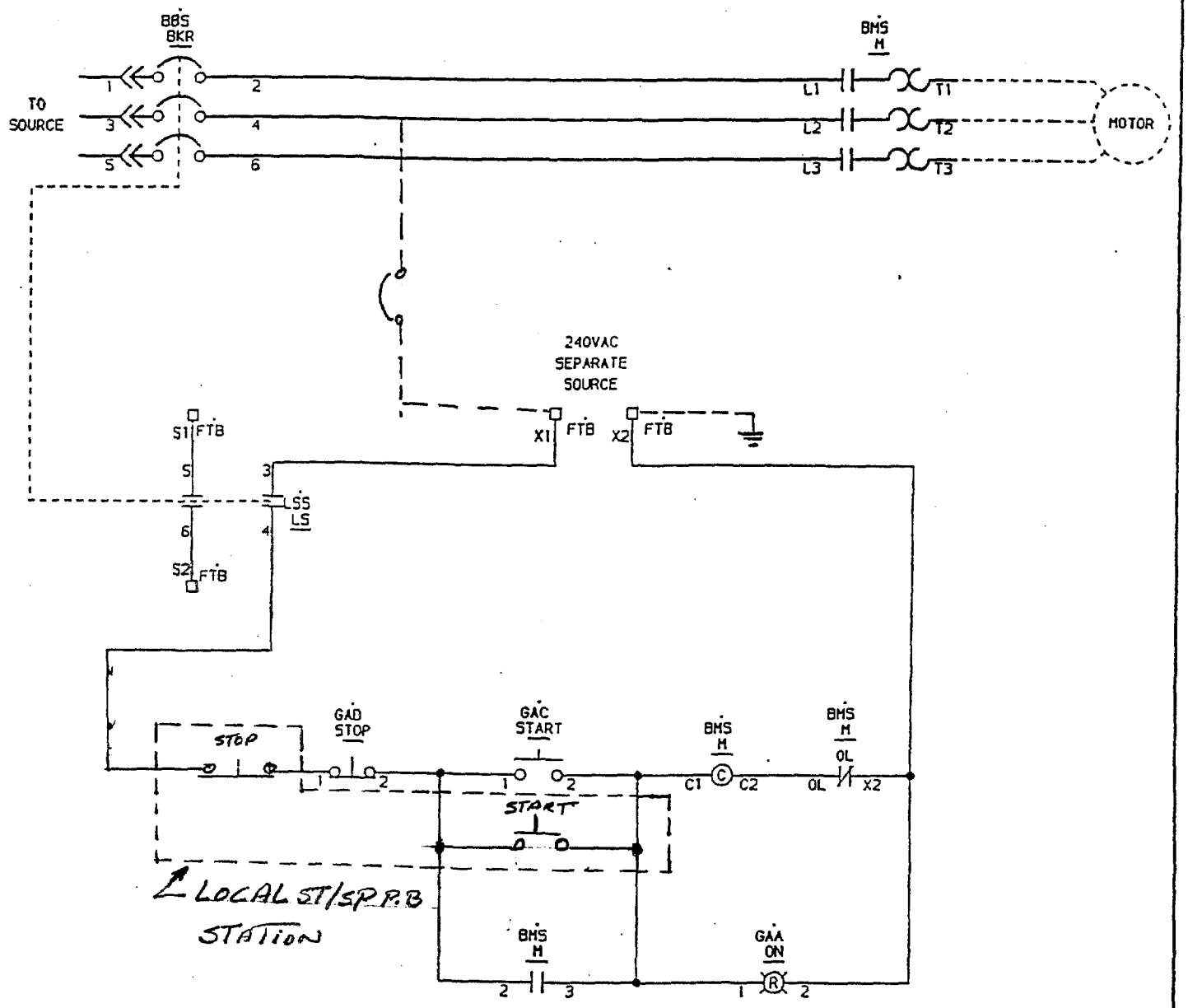
REV	DESCRIPTION	BY	DATE				

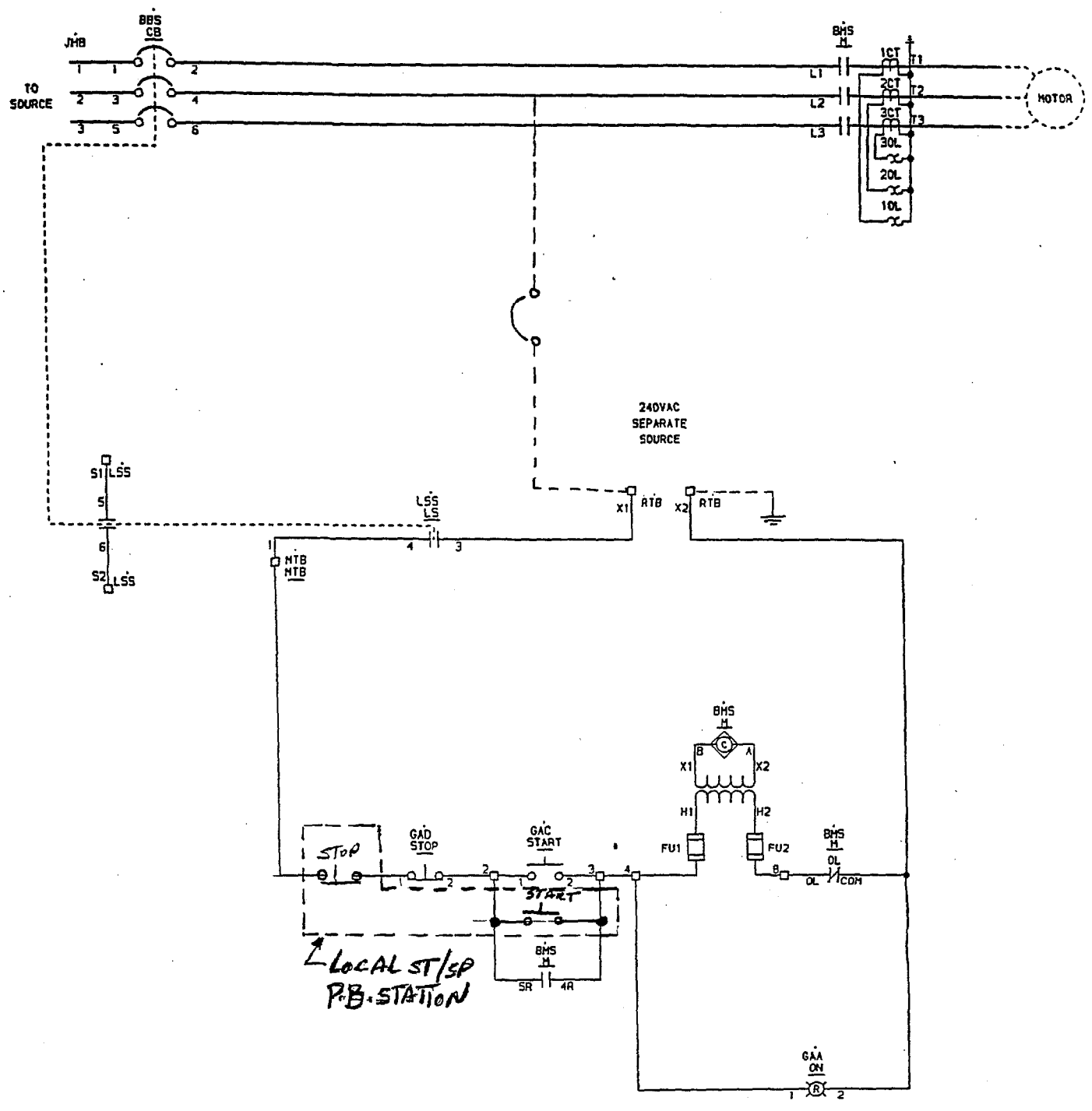


NOTES:

1) Typical for all motor size 125 HP and smaller at Pump Stations No's 1,2 and 7.

JOB NAME:	KAZAKHSTAN REG WATER SYS	EQUIPMENT DESIGNATION:	——
JOB LOCATION:	MCC-1	EQUIPMENT TYPE:	MODEL 6 MOTOR CONTROL CENTER
DRAWN BY:	MRJ MRJ	DRAWING TYPE:	ELEMENTARY DIAGRAM
ENGR:	MEF	SQUARE D COMPANY	
DATE:	MARCH 26, 1996		
DRAWING STATUS:	RECORD	DWG# E06514039-H-01	PG 1 OF 1 REV -

REV	DESCRIPTION	BY	DATE



NOTES:

1) Only: for 350 HP motor at Pump Stations No's 1 and 2.

JOB NAME:	KAZAKHSTAN REG WATER SYS	EQUIPMENT DESIGNATION:	——
JOB LOCATION:	MCC-1	EQUIPMENT TYPE:	MODEL 6 MOTOR CONTROL CENTER
DRAWN BY:	CAD	DRAWING TYPE:	ELEMENTARY DIAGRAM
ENGR:	MEF	SQUARE D COMPANY	
DATE:	MARCH 26, 1996		
DRAWING STATUS:	RECORD	DWG: E06514039-H-03	PG 1 OF 1 REV -