1. Only qualified electrical personnel familiar with the equipment, its operation and the associated hazards should be permitted to work on the equipment. Additionally, only qualified personnel should be permitted to install or operate the equipment.

2. Always be certain that the primary and secondary circuits are de-energized or the circuit breaker is removed to a safe work location before attempting any maintenance.

3. For maximum safety, only insert a completely assembled breaker into an energized cell.

4. Always ensure that drawout circuit breakers are in one of their designed cell positions, such as Connect, Test, Disconnect or Remove. A circuit breaker permitted to remain in an intermediate position could result in control circuits being improperly connected resulting in electrical failures.

1-4 QUALIFIED PERSONNEL

For the purpose of operating and maintaining low voltage power circuit breakers, a person should not be considered qualified if the individual is not thoroughly trained in the operation of the circuit breaker and how it interfaces with the assembly in which it is used. In addition, the individual should have knowledge of the connected loads.

For the purpose of installing and inspecting circuit breakers and their associated assembly, a qualified person should also be trained with respect to the hazards inherent to working with electricity and the proper way to perform such work. The individual should be able to de-energize, clear and tag circuits in accordance with established safety practices.

1-5 OTHER PUBLICATIONS AND DOCUMENTATION

In addition to this instruction manual, other printed information and documentation is available and supplied as appropriate. This additional information can include, but not necessarily be limited to, an instruction manual for a specific electronic trip unit, instruction leaflets for accessory items, renewal parts information, necessary dimensional drawings and a Product (application) Guide. Specific reference documents associated with Magnum DS, DSX and DSL circuit breakers are listed in a separate document entitled *Engineering Data TD013018004E*

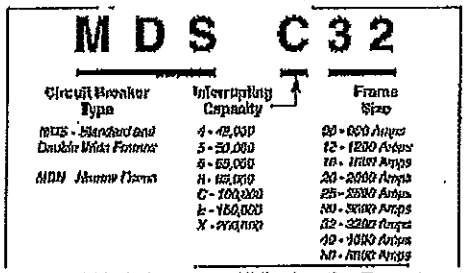


Figure 1-3 Typical Magnum DS Designation Example

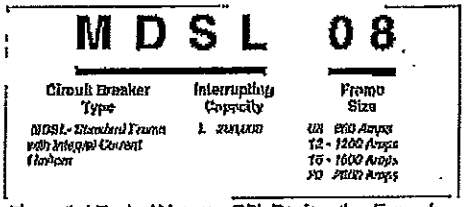


Figure 1-4 Typical Magnum DSL Designation Example

Table 1.2 Magnum DSL Ratings at 600 Volts and Below

Breaker Designation	Frame Size Amperes	Max. Interrupting Rating, RMS Sym. Amp., System Voltage 600 or Below
MDSL08	800	200,000
MDSL12	1200	200,000
MDSL16	1600	200,000
MDSL20	2000	200,000

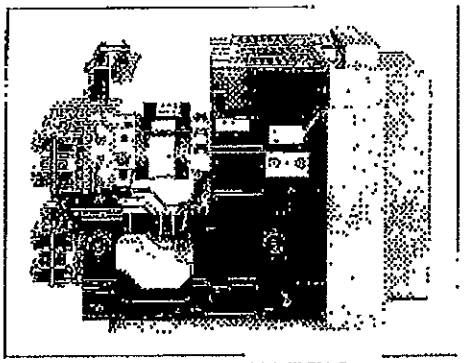


Figure 1-5 Typical Magnum DSL(MDSL) Drawout Circuit Breaker with Integral Current Limiters

SECTION 2: RECEIVING, HANDLING AND INSTALLATION

2-1 GENERAL INFORMATION

Magnum DS, DSX and DSL Power Circuit Breakers, when supplied as part of an assembly, may be shipped already installed in their respective breaker compartments. Receiving and handling of this equipment is addressed in an assembly instruction manual supplied with the assembled equipment. This instruction manual applies to only the circuit breakers.

2-2 SUGGESTED TOOLS

A large number of different tools are not required to properly install and maintain Magnum DS, DSX and DSL circuit breakers. The following tools are, however, suggested:

- Flat blade screwdriver
- Phillips head screwdriver
- 3/8" socket (rachet) wrench
- 10 mm socket
- 17 mm socket
- Secondary wiring removal tool

2-3 UNPACKING CIRCUIT BREAKER

Before beginning to unpack new Magnum circuit breakers, read and understand these directions. Following the directions will ensure that no damage is caused.

Shipping containers should be inspected for obvious signs of rough handling and/or external damage incurred during the transportation phase. Record any observed damage for reporting to the transportation carrier and Cutler-Hammer, once the inspection is completed. All reports and claims should be as specific as possible and include the order number and other applicable nameplate information.

Every effort is made to ensure that Magnum circuit breakers arrive at their destination undamaged and ready for installation. Care should be exercised, however, to protect the breakers from impact at all times. Do not remove protective packaging until the breakers are ready for inspection, testing and/or installation.

When ready to inspect and install a Magnum circuit breaker, carefully remove the banding straps and lift off the cardboard box. Remove any additional packing material and internally packed documentation. The circuit breaker and/or cassette are mounted to a wooden shipping pallet.

On drawout circuit breakers shipped without a cassette, two shipping clamps hook into the breaker side plates and are held to the pallet with 4 lag screws (Figure 2-1). Remove the lag screws and clamps. Save the screws and clamps for future shipment of the breaker. On empty cassettes, remove the 4 or 6 lag screws and/or machine screws which pass through the floorpan of the cassette holding it to the wooden pallet. On drawout breakers shipped in a cassette, first remove the breaker from the cassette using the levering mechanism and drawout rails. After the breaker is removed the machine screws passing through the floorpan can be removed.

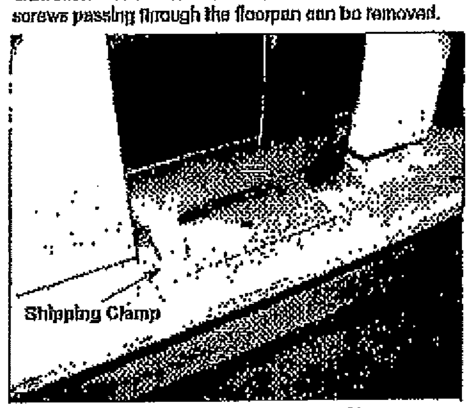


Figure 2-1 Shipping Clamps for Drawout Circuit Breaker

On fixed breakers, remove the lag screws passing through the mounting feet which hold the breaker to the pallet.

Circuit breakers are designed to be easily lifted from the wooden pallet using an appropriate lifting yoke and overhead or portable lifting device (Figure 2-2).

2-3.1 STORING CIRCUIT BREAKER

If it is necessary to store a circuit breaker before installation, do so in its original shipping container. Keep the circuit breaker in a clean dry place. Ensure there is ample air circulation and heat, if necessary, to prevent condensation. It is very important that the circuit breaker not be exposed to dirt or moisture.

NOTICE

A circuit breaker that has been stored for any length of time should be operated a minimum of five times before it is placed in service.

CUTLER HAMMER LV MAGNUM DS BREAKER MANUAL

Figure 2-2 Magnum DS Circuit Breaker with Lifting Yoke Attached

2-4 LIFTING CIRCUIT BREAKER

CAUTION

DO NOT ATTEMPT TO LIFT CIRCUIT BREAKERS WITH ORDINARY CRANE HOOKS, ROPES, CHAINS OR OTHER SUCH DEVICES. FAILURE TO FOLLOW THIS CAUTION COULD RESULT IN DAMAGE TO VITAL PARTS SUCH AS ARC CHUTES, BARRIERS AND WIRING OR THE ENTIRE CIRCUIT BREAKER.

To closely examine, install or just become more familiar with the circuit breaker, carefully lift and place the circuit breaker on a solid work surface capable of handling the circuit breaker's weight (Table 2.1) or on the captive drawout extension rails of the breaker compartment (Figure 2-2). This is accomplished by using the appropriate lifting yoke and lifter. The lifting yoke consists of two steel hooks specially shaped to hook under the integral molded lifting handles on both sides of the circuit breaker (Figure 5-1). Every effort should be made during lifting to minimize circuit breaker swing and tilt.

If the circuit breaker is to be lifted onto compartment extension rails, follow the instructions in paragraph 2-8 entitled "Installing Drawout Circuit Breaker."

Table 2.1 Basic Circuit Breaker Weights

Breaker Model	Weights (lbs)					
	Fixed 3P	Fixed 4P	Drawout 3P	Drawout 4P	Universal Cassette 3P	Universal Cassette 4P
MDN-408 MDN-508 MDN-608 MDN-412 MDN-512 MDN-612 MDN-416 MDN-516 MDN-616	95	120	107	130	61	78
MDS 408	114	141	120	161	117	123
MDS-508 MDS-608 MDS-412 MDS-512 MDS-612 MDS-416 MDS-516 MDS-616	118	146	138	172	117	123
MDS-620 MDS-820 MDS-808 MDS-812 MDS-816 MDS-820 MDS-C08 MDS C12 MDS C16 MDS C20	128	163	155	184	117	123
MDS-675 MDS-825 MDS-630 MDS-832 MDS-C25 MDS-C30 MDS-C32 MDS-C25 MDS-C30 MDS-C37	150	190	189	240	123	150
MDS-840, 84N MDS-C40, C4N MDS-E40, E4N	237	318	303	390	190	250
MDS 850, 85N MDN-860, 86N MDS-C50, C5N MDS-C60, C6N MDN-F50, F5N MDN-F60, F6N	276	360	343	441	212	302
MDSL08 MDSL12 MDSL16 MDSL20	NA	NA	190 203 203 215	NA	124 124 124 131	NA
MDS-X08 MDS-X12 MDS-X16 MDS-X20 MDS-X25 MDS-X32	184	NA	216	NA	149	NA
MDS-X40 MDS-X50	278	NA	345	NA	210	NA

2-5 CIRCUIT BREAKER INSPECTION

All circuit breakers, once removed from their shipping containers, should be visually inspected for any obvious damage.

The current rating of the rating plug installed in the trip unit should match the current rating of the sensors mounted on the lower primary studs of the circuit breaker. Check to make sure that this match exists. The rating plug rating can be viewed from the front of the circuit breaker (Figure 3-4). The sensor rating can be viewed through the viewing windows at the rear of the circuit breaker (Figure 2-3). Sensors and rating plugs can be easily changed as described in Section 6.

2-6 INSTALLING DRAWOUT CIRCUIT BREAKER

In structures equipped for drawout circuit breakers, a bolted-in cassette with movable extension rails supports the circuit breaker (Figures 2-2 and 2-4). The extension rails must first be pulled all the way out. Once the rails are fully extended, the circuit breaker can be carefully placed on the extension rails.

CAUTION

IT IS IMPORTANT TO TAKE GREAT CARE WHEN PLACING A DRAWOUT CIRCUIT BREAKER ON ITS EXTENSION RAILS. IF THE CIRCUIT BREAKER IS NOT PROPERLY SEATED ON THE EXTENSION RAILS, IT COULD FALL FROM THE RAILS CAUSING EQUIPMENT DAMAGE AND/OR BODILY INJURY.

Carefully lower the circuit breaker down onto the extension rails. Be certain that the circuit breaker's four molded drawout rail supports are fully seated in the extension rail cutouts on both sides (Figure 2-4). **Do not remove the lifting yoke from the circuit breaker until it is properly seated on the rails.**

Once the circuit breaker is on the extension rails and the lifting yoke is removed, proceed with the rest of the circuit breaker installation.

2-6.1 REJECTION INTERLOCKS

Within any one physical frame size Magnum type drawout circuit breakers come in a variety of continuous current and interruption ratings, some of which are incompatible with others. Double wide circuit breakers also come with several phase sequence options which are also incompatible. To prevent the insertion of circuit breakers with (1) inadequate interrupting capability, (2) with physically incompatible primary disconnects or (3) with an incompatible phase sequence, rejection interlock key plates are provided on both the circuit breaker and cassette. The key plate on the circuit breaker is pre-assembled at the factory; but the cassette-side rejection plate and key pattern must be assembled and installed by the switchboard builder.

Figure 2-3 Rear View Showing Current Sensor Rating Through Viewing Window

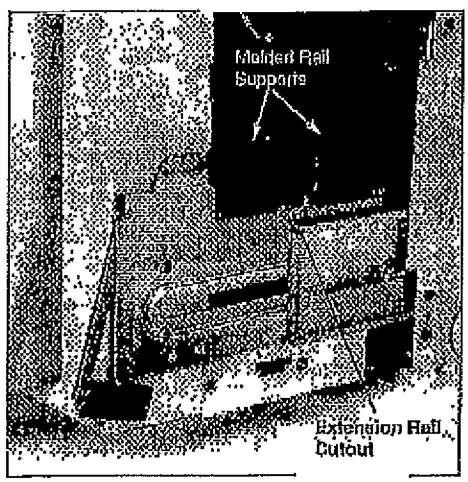


Figure 2-4 One Side of Drawout MDB/MDSX Circuit Breaker Properly Seated on Extension Rail

CAUTION

DO NOT DISABLE REJECTION INTERLOCKS. DOING SO AND USING A LOWER CAPACITY CIRCUIT BREAKER IN AN INCOMPATIBLE CASSETTE COULD RESULT IN AN ELECTRICAL FAULT WHICH COULD RESULT IN DEATH, BODILY INJURY AND/OR EQUIPMENT DAMAGE.

The rejection interlocks are steel pins in the floor of the circuit breaker cassette. As the circuit breaker is pushed into the structure, the mating pins on the bottom of the circuit breaker move past a set of corresponding pins in the cassette. If the circuit breaker and cassette are compatible, the rejection pins will block the insertion of the circuit breaker into the cassette before the levering-in mechanism is engaged.

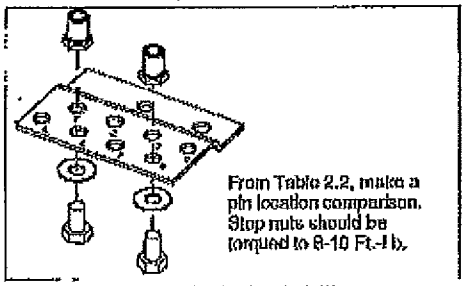
Before attempting to push the circuit breaker into the DISCONNECT position, compare the positioning of rejection interlock pins in the cassette in keeping with Table 2.2 and Figure 2-6 and the information supplied on the circuit breaker's nameplate. Proceed if the circuit breaker and cassette are compatible.

2-5.2 CIRCUIT BREAKER POSITIONING

Magnum DS, DSX and DSL drawout circuit breakers have four normal positions:

- REMOVE (Withdrawn) (Figure 2-6)
- DISCONNECT (Figure 2-7)
- TEST (Figure 2-8)
- CONNECT (Figure 2-9)

The REMOVE position is a position outside the compartment on the cassette's drawout rails where the circuit breaker is not engaged with the levering mecha-



From Table 2.2, make a pin location comparison. Stop nuts should be torqued to 8-10 Ft.-Lb.

Figure 2-6 Cassette Rejection Interlock Pin Positioning/Installation

Table 2.2 Rejection Interlock Pin Locations

Cell For:	Pin Locations 1	2	3	4	5	6	7	8
MDH-408, 412, 416	X	X						
MDH-608, 612, 616	X	X			X			
MDH-808, 812, 816	X	X			X	X		
MDS-408, 412, 416	X	X						
MDS-608, 612, 616, 620	X	X			X			
MDS-808, 812, 816, 820	X	X			X	X		
MDS-808, 812, 816, 820	X	X			X	X	X	
MDS-808, 812, 816, 820	X	X			X	X	X	X
MDS 625	X		X		X			
MDS-825, 832, 840	X		X		X	X		
MDS-825, 832, 852	X		X		X	X	X	
MDS 825, 832, 840	X		X		X	X	X	X
MDS-840	X	X				X		
MDS-840	X	X			X			
MDS-840	X	X				X	X	
MDS-840	X	X			X		X	
MDS 840	X	X				X	X	X
MDS-840	X	X			X		X	X
MDS-850, 860	X		X			X		
MDS-850, 860	X		X		X			
MDS-850, 860	X		X			X	X	
MDS 850, 860	X		X		X		X	
MDS-850, 860	X		X			X	X	X
MDS-850, 860	X		X		X		X	X
MDS108		X					X	
MDS112		X					X	
MDS116		X					X	
MDS120			X					X
MDS-X08	X		X-08		X			
MDS-X12	X		X-12		X			
MDS-X16	X		X-16		X			
MDS-X20	X		X-20		X			
MDS-X08	X		X-08			X		
MDS X12	X		X-12			X		
MDS X16	X		X-16			X		
MDS-X32	X		X-32		X			
MDS-X40	X		X-40		X			
MDS-X50	X		X-50		X			

NOTE: X-# IN TABLE 2.2 DENOTES LOWER HEIGHT STOP NUT 0.750 INCHES LONG

nism. The DISCONNECT, TEST, and CONNECT, positions are reached by means of the levering mechanism.

With the breaker solidly positioned on the cassette's extension rails and the levering-in mechanism in the DISCONNECT position, carefully and firmly push the circuit breaker into the compartment as far as it will go. The outer (recessed) portion of the circuit breaker face plate should align with the GREEN target line (labelled DISC) on the inside top left wall of the cassette (Figure 2-10).

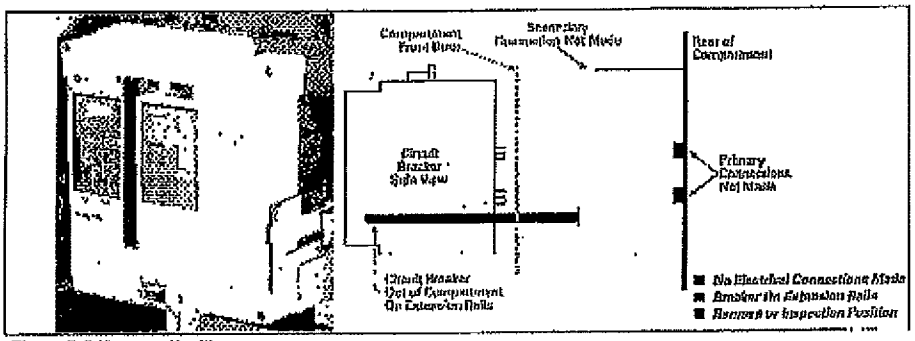


Figure 2-6 Remove Position

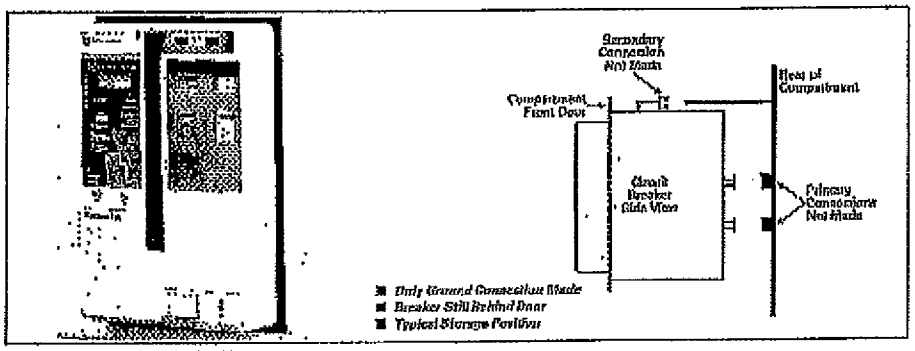


Figure 2-7 Disconnect Position

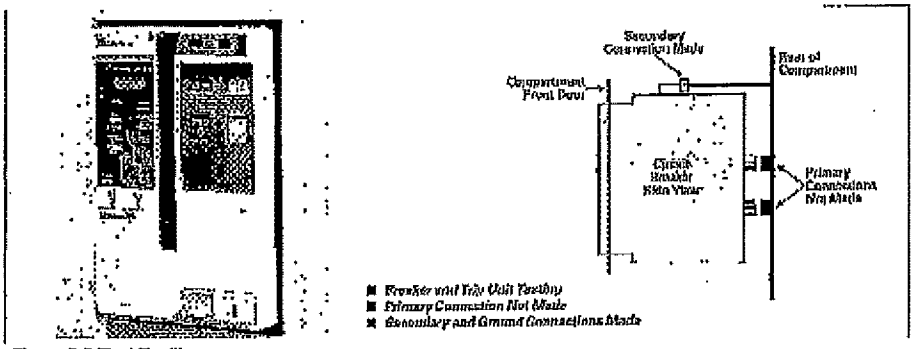


Figure 2-8 Test Position

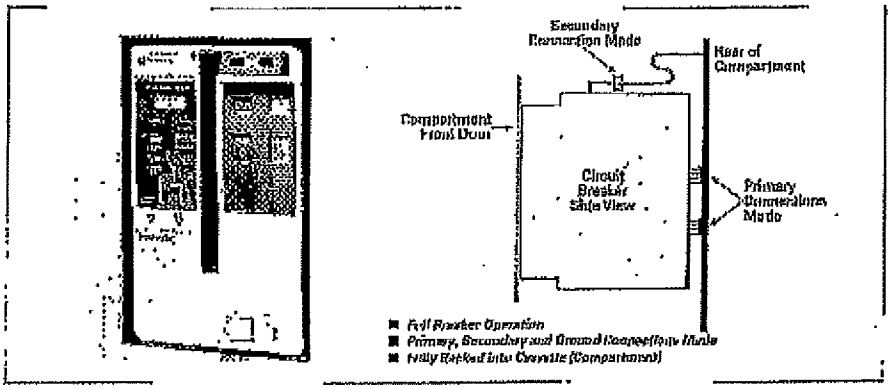


Figure 2-9 Connect Position

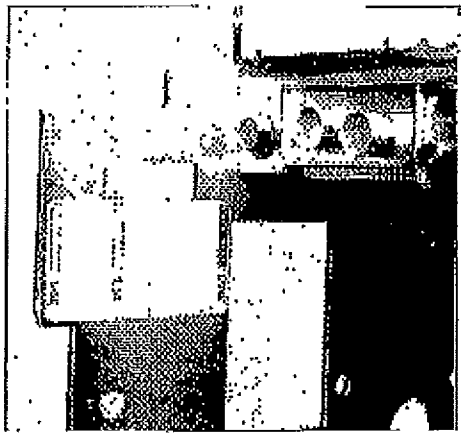


Figure 2-10 Cassette Label Showing Disconnected, Test and Connected Position of Recessed Cover

2-6.3 LEVERING CIRCUIT BREAKER

CAUTION

MAKE CERTAIN THAT THE CIRCUIT BREAKER IS FULLY INSERTED INTO ITS COMPARTMENT BEFORE ANY ATTEMPT IS MADE TO LEVER THE CIRCUIT BREAKER. ATTEMPTING TO LEVER THE CIRCUIT BREAKER IN BEFORE IT IS FULLY POSITIONED INSIDE ITS COMPARTMENT CAN RESULT IN DAMAGE TO BOTH THE CIRCUIT BREAKER AND THE COMPARTMENT.

The circuit breaker is now ready to be levered. With the circuit breaker OPEN, the levering device access door can be raised. The levering device is hand operated using a standard 3/8" square drive and ratchet, which is not provided (Figure 2-11). As long as the access door is raised, the circuit breaker is held trip free. Begin by rotating the levering-in screw to the full counterclockwise (DISCONNECT) position.

Close the compartment door and begin levering the breaker into its different positions using a clockwise ratcheting motion. When the circuit breaker is levered fully to the DISCONNECT or CONNECT position the levering shaft hits a hard stop; do not exceed 25 ft.lb. of torque or the levering mechanism may be damaged. The circuit breaker can be levered with the compartment door open or closed, but it is advisable to close the door prior to levering. The position of the circuit breaker within its compartment is indicated by color coded position indicators (Red = Connect, Yellow = Test, Green – Disconnect) (Figures 2-11 and 3-5). To remove the circuit breaker from its compartment, follow the procedure just described using a counterclockwise ratcheting motion.

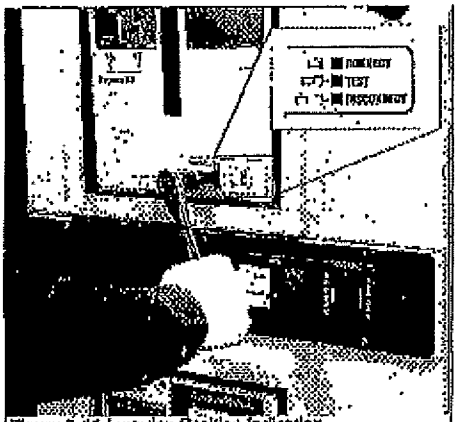


Figure 2-11 Levering Position Indication

NOTICE

The circuit breaker mechanism is interlocked such that charged closing springs are automatically discharged if the circuit breaker is levered into or out of the cell. Discharge takes place between the DISCONNECT and TEST position.

2-7 FIXED CIRCUIT BREAKER

Magnum DS fixed type circuit breakers differ from the drawout version in that it has no levering device, primary disconnects and secondary disconnects (Figure 2-12). In addition, a fixed circuit breaker does not have a standard feature to hold the breaker in a trip-free position. To ensure the proper sequence of operation between two or more circuit breakers, an optional key interlock is mounted through the front panel (Figure 3-44).

WARNING

FAILURE TO COMPLY WITH INSTALLATION OF THE FIXED MOUNTED MDSX ARC HOOD ASSEMBLY COULD RESULT IN EQUIPMENT DAMAGE, BODILY INJURY OR EVEN DEATH.

The MDSX fixed mounted breaker is shipped with an included arc hood assembly. This assembly is required to be installed on the top of the breaker prior to the unit being placed in service.

Circuit breaker terminals have holes for making bolted horizontal primary bus connections. Adapters are available for making vertical primary bus connections. Secondary connections can be made through standard terminal blocks or a special connector compatible with the drawout circuit breaker's type secondary connector. Both secondary connection devices are mounted at the top front of the circuit breaker.

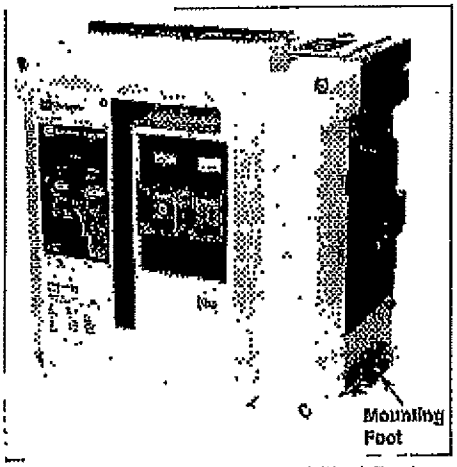


Figure 2-12 Typical Fixed Magnum DS Circuit Breaker

The fixed circuit breaker frame has two mounting feet, one on each side, to permit the fixed circuit breaker to be securely mounted. Each mounting foot has two slotted mounting holes which are used to bolt the circuit breaker securely in place. Use either M10 or 3/8" bolts for this purpose. Refer to the dimensional drawings referred to in Section 5 (Fixed Circuit Breakers) for circuit breaker and bus stab dimensions.

NOTICE

Refer to the circuit breaker weights in Table 2-1 to ensure that the panel on which a fixed circuit breaker is to be mounted is capable of supporting the weight.

2-8 CIRCUIT BREAKER OPERATION

Circuit breakers should be operated manually and/or electrically before they are put into service. This can be done during the installation process or some later date prior to start-up. To check circuit breaker operation, follow the operational procedures outlined in Section 3 for both manually operated and electrically operated circuit breakers.

SECTION 3: CIRCUIT BREAKER DESCRIPTION AND OPERATION

3-1 INTRODUCTION

Magnum DS (MDS), DSX (MDSX) circuit breakers are available in both drawout and fixed mounting configurations (Figures 3-1 and 3-2). Magnum DSL (MDSL) circuit breakers with integral current limiters are available only in a drawout configuration (Figure 3-3). A majority of features are common to all configurations, and will be discussed in this section. The mounting features unique to the drawout and fixed configurations will be covered individually in Sections 4 and 5 respectively.

Controls and indicators for both drawout and fixed circuit breakers are functionally grouped on the front of the circuit breaker. The front escutcheon (faceplate) is common for all Magnum frame sizes up through 5000 amperes.

Double Wide DS and DSX frame circuit breakers utilize six (or eight) sets of rear primary connections; these circuit breakers are available from the factory with several different phase sequences, distinguishable by the sixth character in the model number. The phase sequence is also labeled on the rear of the circuit breaker (Figure 3-4). For these DS and DSX drawout breakers, phase sequence labels are also supplied with the cassette and must be applied by the switchgear builder. Circuit breakers with different phase sequences are **not** interchangeable. DS and DSX drawout breakers with differing phase sequence are prevented from insertion into the cassette by properly assembled rejection key plates (see section 2-6.2).

The Magnum DSL (MDSL) drawout circuit breaker is available only in a 3-pole single wide standard configuration. The MDSL is a coordinated combination of a standard Magnum DS circuit breaker and series connected current limiters. The primary purpose of the current limiters is to extend the interrupting rating of the MDS circuit breaker up to 200,000 amperes.

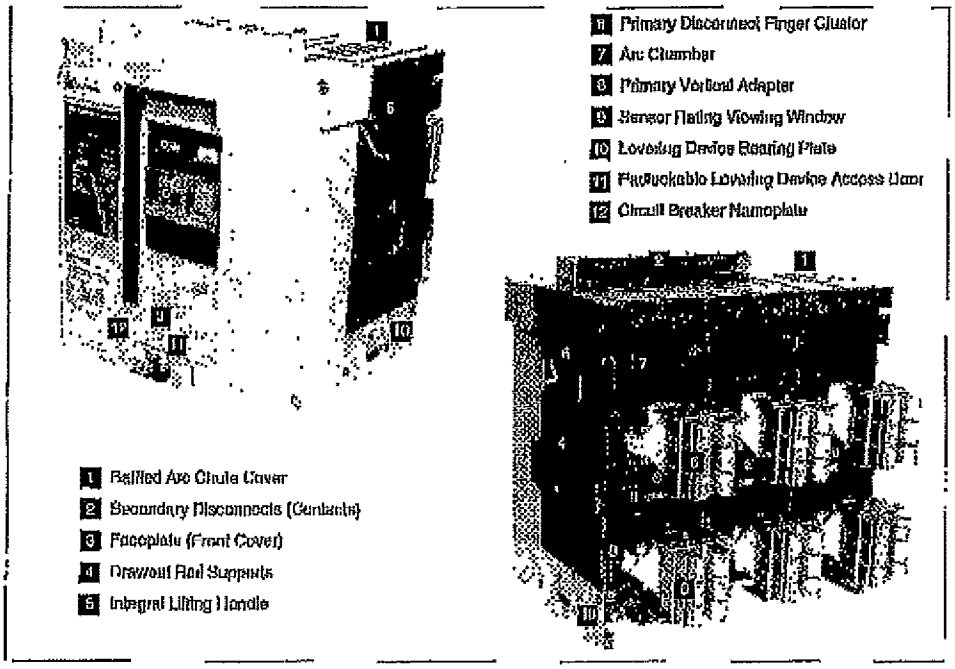


Figure 3-1 Typical MDS /MDSX Drawout Circuit Breaker Features (Front and Rear Views)

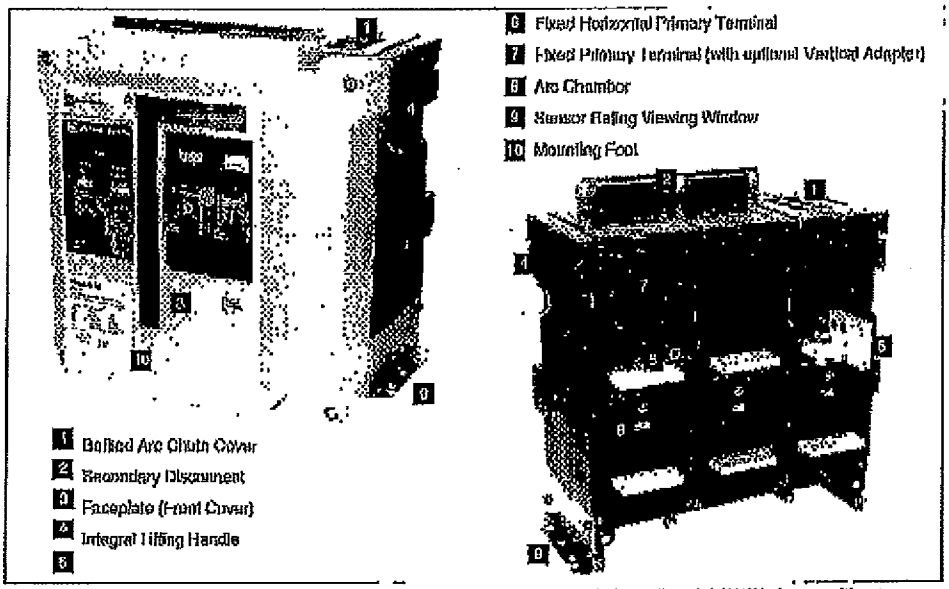


Figure 3-2 Typical MDS/MDSX Fixed Circuit Breaker Features (Front and Rear Views) (MDSX shown without required arc hood)

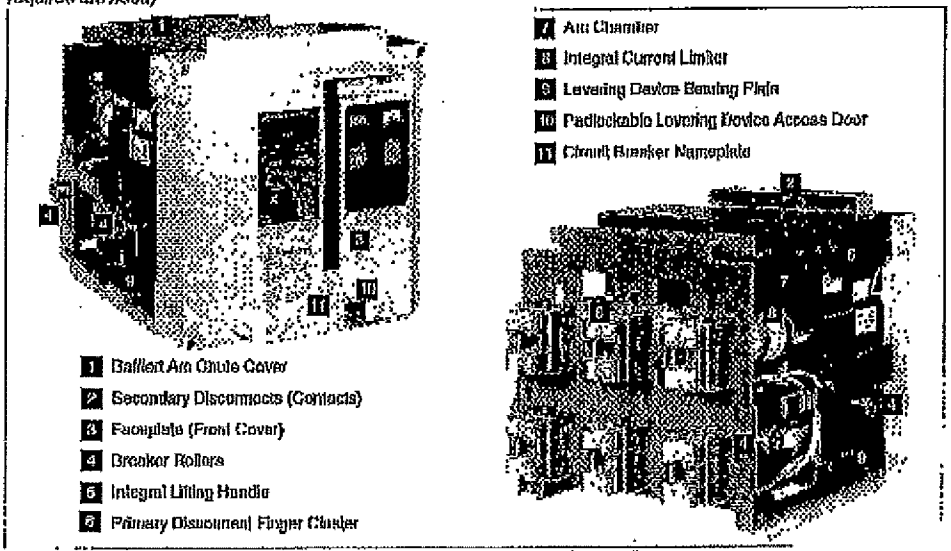
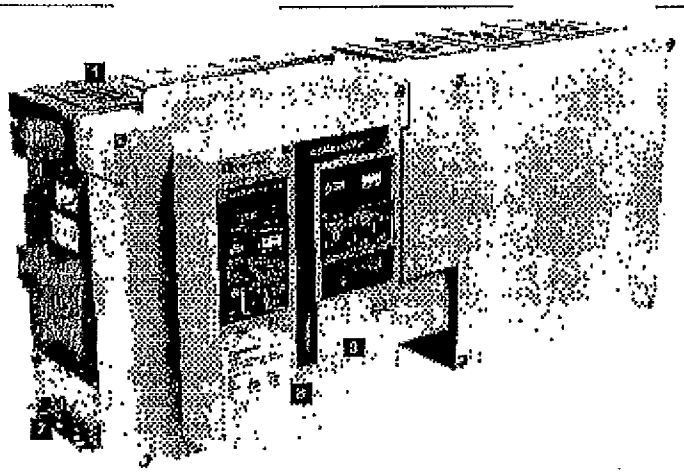


Figure 3-3 Typical MDSL Drawout Circuit Breaker Features (Front and Rear Views)



1. Bolted Arc Chute Cover
2. Secondary Contact Cumulator
3. Faceplate (Front Cover)
4. Integral Lifting Handle
5. Fixed Vertical Primary Terminals with Optional Vertical Adapter
6. Arc Chamber
7. Mounting Foot
8. Circuit Breaker Nameplate
9. Phase Identification Labels

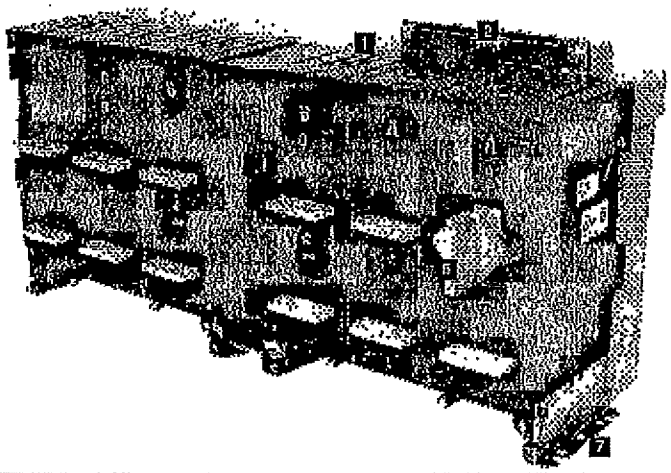


Figure 3-4 Typical Double-wide MDS/MDSX Standard Frame Fixed Circuit Breaker Features (Front and Rear Views) (MDSX shown without required arc hood)

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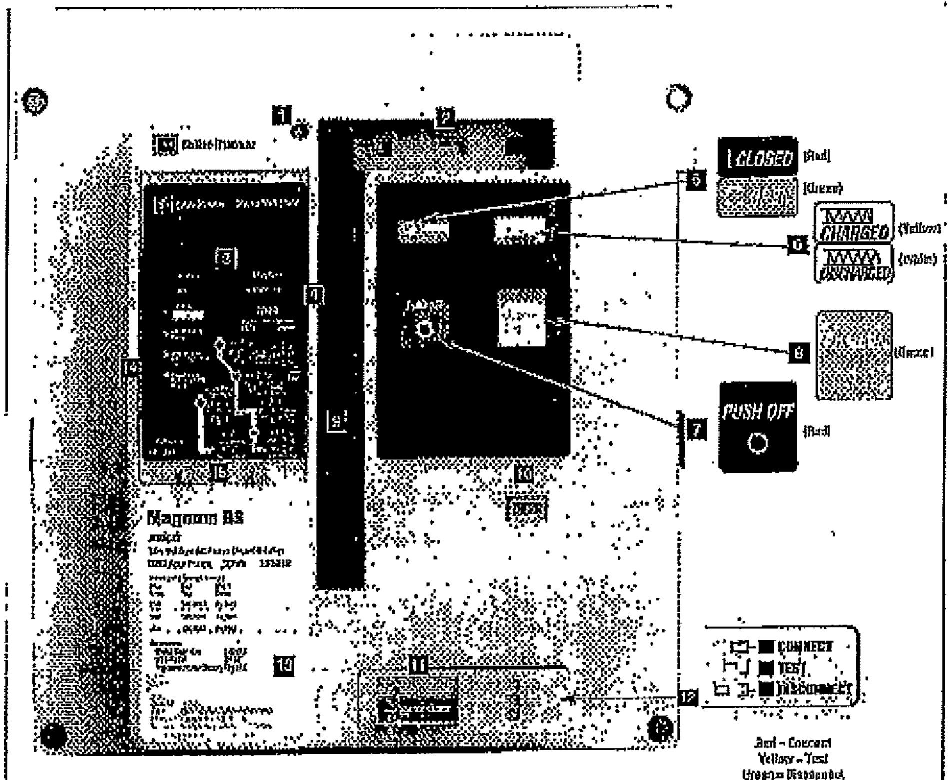

1 Trip Flag (Pop Out Indicator)
2 Three Accessory Windows
3 Trip Unit
4 Rating Plug
5 Contact Status (Open-Close)
6 Spring Status (Charged-Discharged)
7 Manual "OFF" Button (Push)
8 Manual "ON" Button (Push)
9 Manual Charge Handle
10 Optional Operation Counter
11 Padlockable Levering Device Access Door for Drawout Breaker
12 Color Coded-Breaker Position Indicator
13 Nameplate
14 Trip Unit Test Port
15 Trip Unit Cover with Two Mounting Screws (Mounting Screws will Accept Customer Supplied Lead Security Meter Seals

Figure 3-6 Typical Magnum DS/DSX Drawout Circuit Breaker Front Cover

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3-1.1 MDSL APPLICATION/OPERATION

MDSL circuit breakers are intended for applications requiring the overload protection and switching functions of air circuit breakers on systems whose available fault currents (1) exceed the interrupting ratings of the circuit breakers alone and/or (2) exceed the withstand and interrupting ratings of downstream circuit components.

The 800 through 2000 amp frame MDSL circuit breakers have integrally mounted limiters on the drawout breaker element. On overloads and faults within the circuit breaker interrupting rating, the circuit breaker protects the limiters. On higher fault currents exceeding the circuit breaker rating, the limiters protect the circuit breaker.

Interlock arrangements trip the circuit breaker whenever any limiter blows. The circuit breaker cannot be reclosed on a live source unless there are three unblown limiters on the circuit. The blown fuse indicator, located on the front of the circuit breaker, provides a visual indication when a current limiter in any phase has interrupted a short circuit. In addition, a blown limiter sensing circuit insures that a circuit breaker will be tripped when any current limiter has blown, preventing single phasing.

The MDSL circuit breaker must be completely withdrawn from its compartment onto the compartment's extension rails, thus assuring complete isolation, before the integral current limiters are accessible.

Additional information concerning current limiter ratings, limiter replacement and blown fuse operation is provided later in this chapter.

3-2 BASIC CIRCUIT BREAKER ASSEMBLY

All Magnum circuit breakers use a rigid frame housing construction of engineered thermoset composite resins. This construction provides high strength structural properties, excellent dielectric characteristics and resistance to arc tracking.

The 3-piece construction approach provides support while isolating and insulating power conductors (Figure 3-6):

❶ A 2-piece engineered thermoset composite resin case encloses current paths and arc chambers. The chambers act to channel arc gases up and out of the circuit breaker during interruption.

❷ The operating mechanism sits on the front of the case and is electrically isolated and insulated from current contact structures. It is covered by an insulating front cover.

3-3 POLE UNITS

A current carrying pole unit is individually enclosed and rigidly supported by the case. The individual chambers provide for pole unit isolation and insulation from one another. Each pole unit has one primary contact assembly, which consists of a moving portion and a fixed portion. The exact design configuration depends upon the breaker's frame size. Circuit breakers with frame sizes of 4000 amperes and higher use two pole units and arc chute assemblies connected mechanically and electrically in parallel to form one phase.

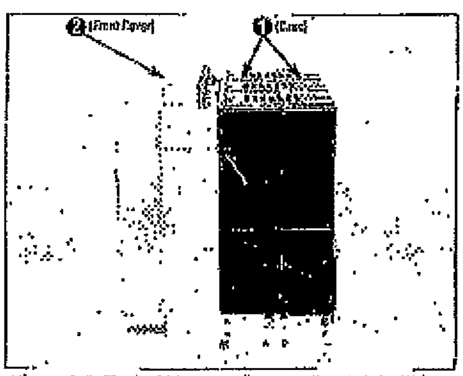

Figure 3-6 Typical Magnum Construction (Right Side View)

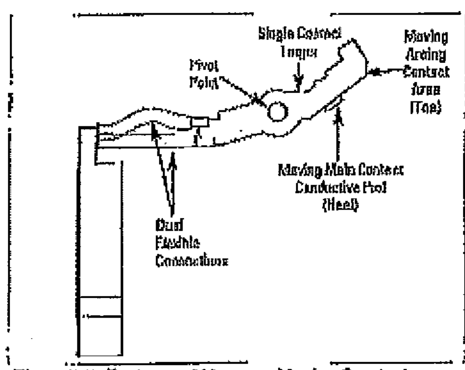

Figure 3-7 Features of Magnum Moving Conductor Assembly

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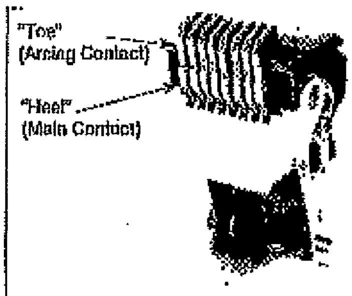

Figure 3-8 Narrow Frame (8-finger) Moving Conductor Assembly

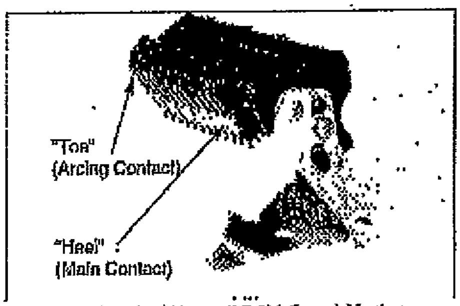

Figure 3-9 Standard Frame DS (12-finger) Moving Conductor Assembly

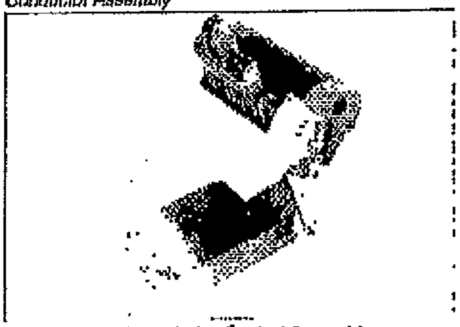

Figure 3-9a MDSX Moving Contact Assembly

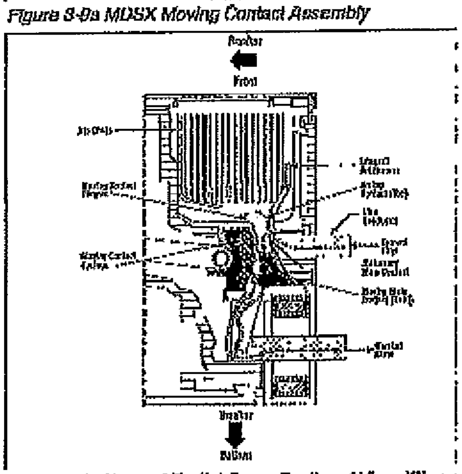

Figure 3-10 General Partial Cross-Sectional View (Shown In Closed Position) (not specific to any family/frame)

3-3.1 PRIMARY MOVING CONTACTS

Depending upon the frame size, each primary moving contact assembly is comprised of multiple individual copper contact fingers connected to the load conductor through flexible braided connectors (Figure 3-8). Two flexible connectors are used to connect each finger to the load conductor. The number of fingers used depends upon the circuit breaker's continuous and short-circuit current ratings (Figures 3-8 and 3-9). On some ratings fingers are removed and replaced with spacers.

The single contact finger performs both the main and arcing contact functions on different parts of the same finger (Figure 3-7). A highly conductive alloy pad is part of the contact finger and functions as the moving main contact, and is called the "Heel." The tip of the same contact finger functions as the moving arcing contact, and is called the "Toe."

In addition to the contact finger information given above, DSX (MDSX) utilize an inner and outer carriage design to facilitate a fast opening blow open contact structure (Figure 3-9a). The contact fingers mounted in the inner contact carrier can move independently from both the outer carrier and the opening mechanism in the breaker. This independence is the core design feature of its fast opening blow open contact structure.

3-3.2 PRIMARY STATIONARY CONTACTS

The primary stationary contact is a combination of two items (Figure 3-10). One is a conductive pad mounted on the line conductor which functions as the stationary main contact. The other is an arc runner, also connected to the line conductor. The integral arc runner serves a dual purpose:

- Fixed arcing contact
- Part of the arc chute

3-4 OPERATING MECHANISM

The Magnum DS/DSX/DSL operating mechanism is based on the proven cam and spring design of the DSII power circuit breaker. It is easily accessed by removing four cover screws and the front cover (Figure 3-11). The mechanism is a two-step stored energy mechanism. Potential energy is stored to close the circuit breaker. Sufficient energy to open the circuit breaker remains available after a closing operation.

3-4.1 MANUAL OPERATION

On manually operated circuit breakers, the closing spring can only be charged manually. To manually charge the spring, insert one finger in the recess behind the charging handle and pull out. This permits a gloved hand to grasp the handle and begin charging (Figure 3-12). It takes from 5 to 7 downward strokes on the charging handle to complete the manual charging process. It is possible to manually recharge the spring immediately after closing the circuit breaker and before it has been tripped open.

Standard manually operated circuit breakers are closed and opened by hand using the Manual "ON" and Manual "OFF" buttons respectively located on the front of the circuit breaker (Figure 3-6). Performing either operation is accomplished by pressing and releasing the appropriate button. Access to these pushbuttons can be limited by the use of an optional, padlockable cover. In addition, complete access to the "ON" button can be prevented with an optional prevent close cover. The status of the springs and the primary contacts are always indicated in an indicator window just above the pushbuttons.

Electrically operated optional devices are available to automatically close or trip a manually operated circuit breaker. An electrical spring release is available to close a manually operated circuit breaker. Two optional devices, a shunt trip and an undervoltage release, are available to automatically trip (open) a manually operated circuit breaker. All of these UL listed optional devices can be installed easily in the field. For more details on these devices, refer to paragraph 3-8 in this manual.

An electrical operator which is used to charge the closing spring automatically can be added to a manually operated circuit breaker in the field (Figure 3-13). Manually operated circuit breakers are pre-wired to accept this addition.

1. Secondary Wiring Points
2. Field Installable Accessories (3 maximum)
3. Trip Unit
4. Electric Charging Motor
5. Manual Charge Handle
6. Operations Counter (optional)
7. Padlockable Levering Device Access Door
8. Breaker Position Indicator

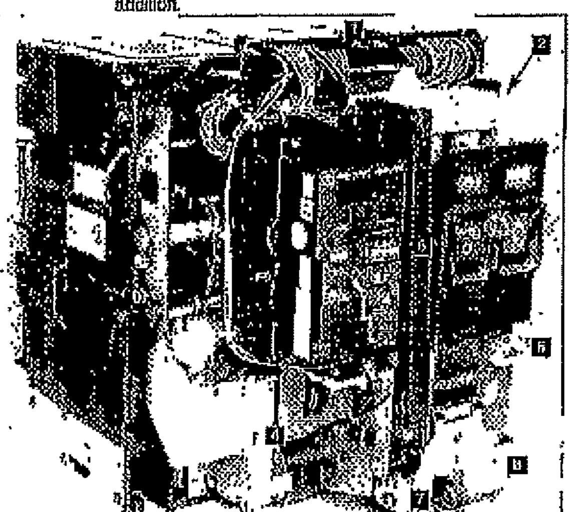

Figure 3-11 Typical Electrically Operated Drawout MDS/MDSX Circuit Breaker with Front Cover Removed

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Figure 3-12 Circuit Breaker Closing Springs Being Manually Charged

3-4.2 ELECTRICAL OPERATION

For electrically operated circuit breakers, the springs are normally charged through the use of an electrical operator (Figure 3-13). The springs can, however, be charged manually as just described in the previous paragraph (Figure 3-12).

Like the manually operated circuit breaker in the previous paragraph, electrically operated circuit breakers can also be manually closed and opened through the use of the front mounted Manual "ON" and Manual "OFF" buttons.

An electrically operated circuit breaker from the factory is also equipped as standard with a spring release to close the circuit breaker electrically. An optional shunt trip and undervoltage release are also available to trip (open) an electrically operated circuit breaker. Refer to paragraph 3-8 for more details on both standard and optional devices.

3-4.3 ANTI-PUMP FEATURE

The Magnum circuit breaker has both mechanical and electrical anti-pump features. If the circuit breaker is closed on a fault condition (and trips open while the CLOSE signal is maintained), using either the mechanical pushbutton or the spring release, it will not make subsequent attempt to close until the close command is removed and reapplied. Note that if the close signal is applied prematurely (before the breaker is completely charged and latched), the close command will be ignored until it is removed and reapplied. For electrical

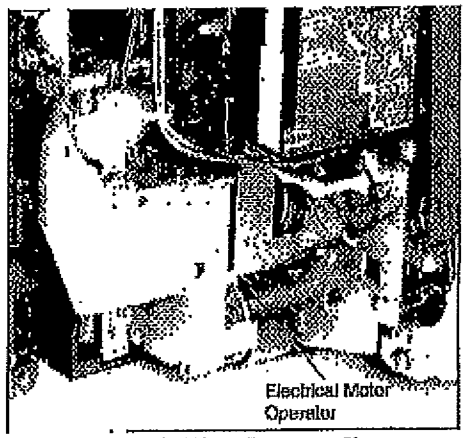

Figure 3-13 Electrical Motor Operator to Charge Closing Spring

closing, a Latch Check Switch (LCS) option is available (see paragraph 3-8.1) which will block the application of the electrical close command until the breaker is ready to close.

3-5 ARC CHAMBERS

The Magnum DS/DSX/DSL circuit breakers utilizes arc chambers to insulate and isolate individual poles from one another, from the rest of the circuit breaker, and from operating personnel (Figure 3-1). Arc chambers are molded and integral parts of the circuit breaker frame. Enclosed within each arc chamber is an arc chute which mounts over each set of primary contacts.

After the main contacts part, any remaining current is driven to the arcing contacts (Figure 3-14). Magnetic action draws the arc to the arc chute. As the arcing contacts separate, the moving arcing contacts discharge into the arc chute plates while the integral arc runner also helps to draw the arc into the arc chute (Figure 3-15).

3-5.1 ARC CHUTE

The Magnum DS/DSX/DSL arc chutes mount down over the arcing contact. V-shaped arc chute plates attract the arc and interrupt it. The top arc plate, which is a part of the arc chute itself, also helps to attract the arc away from the moving arcing contact and up into the arc chute's V-shaped plates (Figure 3-16 and 3-16a).

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Arc chute components are assembled in an insulating jacket which is removable from the top of the circuit breaker, as previously described in paragraph 2-4. Each arc chute has a baffled top cover.

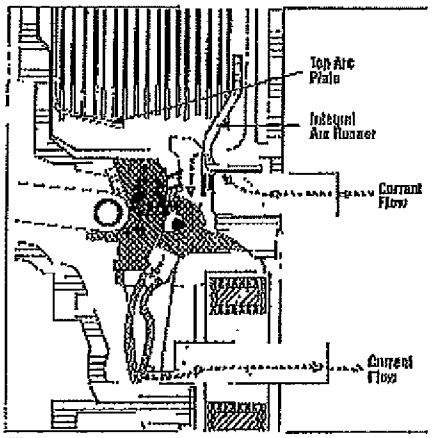


Figure 3-14 Cross Section of Conductor and Arc Control System

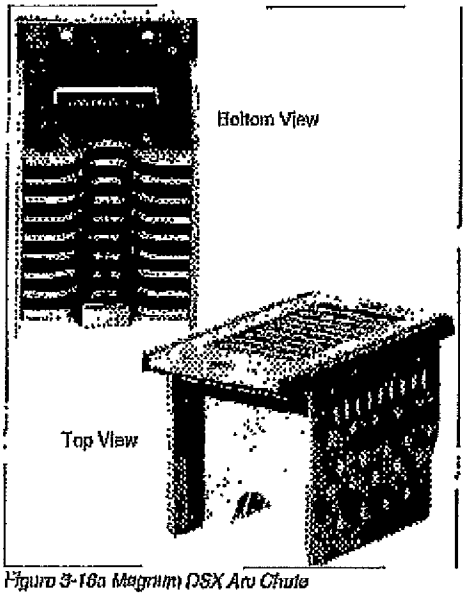


Figure 3-16a Magnum DSX Arc Chute

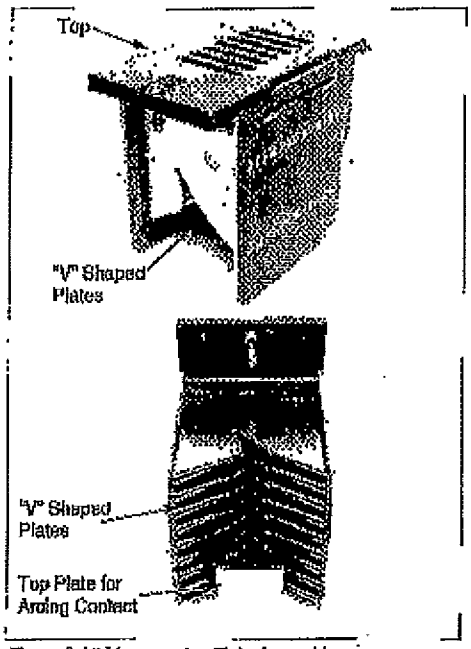


Figure 3-16 Magnum Arc Plate Assembly

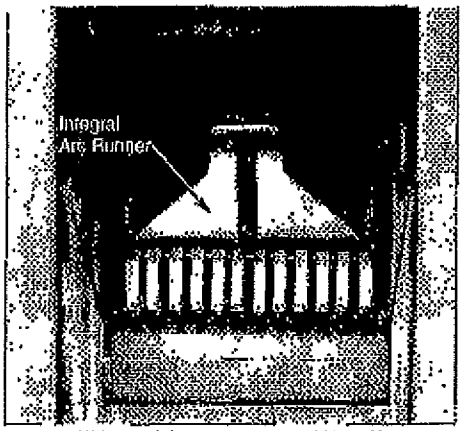


Figure 3-18 Integral Arc Runner Viewed From Top of Arc Chamber (Arc Chute Removed, Circuit Breaker Closed)

3-6 ELECTRONIC TRIPPING SYSTEM

The Magnum DS/DSX/DSL circuit breakers utilize a three part tripping system (Figure 3-17):

- Microprocessor-based trip unit
- Current Sensors
- Trip Actuator

All three parts of the tripping system are discussed here, except that the trip unit itself is not discussed in detail. For detailed information pertaining to the different trip unit models available with Magnum DS/DSX/DSL circuit breakers, refer to the specific instruction leaflet dedicated to the trip units (I.L. 70C1036 and I.L. 70C1037).

3-6.1 MICROPROCESSOR-BASED TRIP UNIT

Magnum circuit breakers use any one of a family of Digitrip RMS trip units whose main features are summarized in Table 3.1. Also, the MDSX family of breakers is intended to be used only with trip units manufactured after May 1, 2005.

Models 520 is plug compatible and interchangeable in the field. Circuit breakers with these trip units can be upgraded to Models 520M and/or 520MC in the field; however additional wiring (for power supply and communications) may be required to take full advantage of the additional features. Contact Cutler-Hammer for upgrading to Model 1150.

The electronic trip units are self-powered. When the circuit breaker is closed, no external power is required to operate their protective systems. Current signal levels and the control power are derived from the current sensors integrally mounted in the circuit breaker.

A functional local test of a major portion of the trip unit's electronic circuitry and the circuit breaker's mechanical tripping action can be verified through the trip unit's test receptacle (Figure 3-18). This is accomplished using a Digitrip (DS Type) Test Kit which provides a secondary injection test that simulates the current sensors. A small hand held Magnum functional Test Kit can also be used to check circuitry and mechanical tripping functions (Figure 3-19).

When the circuit breaker is shipped from the factory, the trip unit's protective functions are normally set at minimum values. For specific overload tripping characteristics and time/current curves to coordinate with a load or system, refer to the trip unit instruction book.

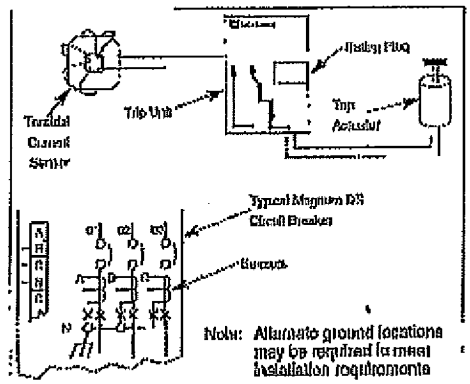


Figure 3-17 Pictorial Diagram of Typical Current Sensing, Processing and Tripping System

Table 3.1 Magnum Digitrip Trip Units

Functions	520	520M②	520MC②	1150②
LSIG Protection	Yes	Yes	Yes	Yes
Disable (I)	Yes	Yes	Yes	Yes
GF Protection	Yes	Yes	Yes	Yes
GF Alarm	No	Yes	Yes	Yes
Display	No	Yes ①	Yes ①	Yes ②
Programmable	No	No	No	Yes
Metering	No	Yes ③	Yes ③	Yes
Power and Energy Values	No	No	No	Yes
Power Quality	No	No	No	Yes
Communication	No	No	Yes	Yes

① One-line, (four characters per line) LCD display.
② Three line, (eight characters per line) LED display.
③ Phase, neutral, ground, and high load current only.
④ Available control voltages are 24/48Vdc, 125Vdc, 120Vac and 240Vac

3-6.2 RATING PLUG

All Magnum DS/DSX/DSL circuit breaker trip units use a fixed type rating plug. The current rating of the rating plug must match the current rating of the integrally mounted current sensors (Figure 2-3, 3-18 and Table 3.2). The rating plug performs several functions:

1) It tells the trip unit what the rating is of the current sensors. A label on the front of the rating plug clearly indicates that the rating plug and sensors must have the same rating.

2) It determines the maximum instantaneous setting which is a function of the current sensor rating.

3) The National Electrical Code (NEC) requires that the maximum ground fault pickup value not exceed 1200 amperes. A properly matched rating plug accomplishes this requirement for higher ampere sensors by incorporating circuitry to identify that level by sensor rating.

If the rating plug is removed from the trip unit, the circuit breaker will trip if it is carrying current. Make certain the rating plug is secured in position with its retaining screw. Do not torque the retaining screw beyond 15 in-Oz.

Refer to Table 3.2 for a tabulation of the available rating plugs.

3-6.3 CURRENT SENSORS

Three toroidally wound current sensors are installed at the rear of the circuit breaker on the lower terminals (Figure 3-20). The sensors produce an output current proportional to the load current. Under preselected conditions of current magnitude and time, the sensors furnish the trip unit with a signal and the energy required to trip the circuit breaker.

Neutral current sensors are available for customer installation. The additional sensor is not supplied with the circuit breaker and must be ordered separately. They are wired to the trip unit through the secondary contacts of the circuit breaker.

Refer to Table 3.2 for a tabulation of the available current sensor ratings.

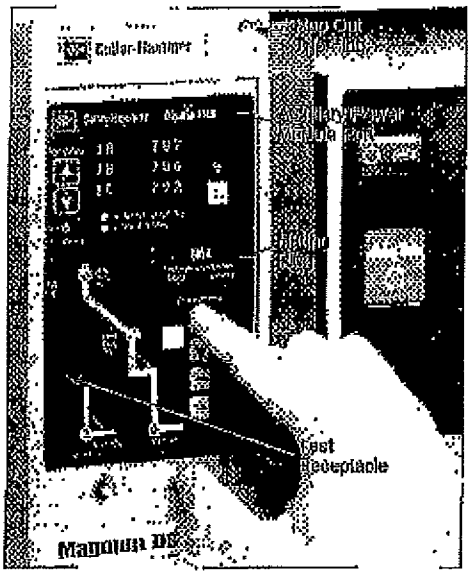


Figure 3-18 Digitrip RMS 1150 Programmable Trip Unit Installed in Magnum DS Circuit Breaker

Figure 3-19 Hand Held Tester

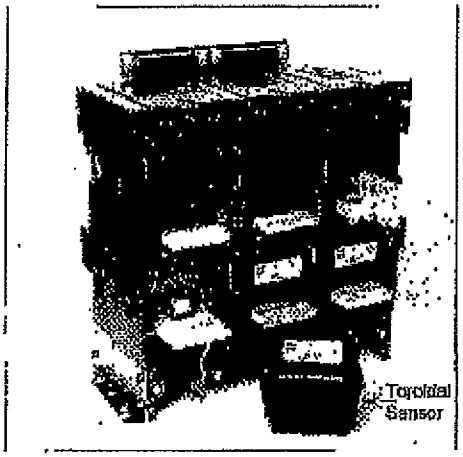


Figure 3-20 Replaceable Current Sensors Shown with Bottom Adaptors and Cover Plate Removed

Table 3.2 Magnum Current Sensors and Matching Rating Plugs

Current Rating In Amperes		
200	800	2500
250	1000	3000
300	1200	3200
400	1600	4000
600	2000	5000

3-6.4 TRIP ACTUATOR

The trip actuator is a small cylindrically shaped electromagnetic device which acts mechanically to trip the circuit breaker (Figure 3-17). In general, it is comprised of a permanent magnet, a spring loaded rod to produce the mechanical tripping, and a lever for resetting the actuator after tripping occurs. The electronic trip unit provides a pulse which counteracts the effect of the permanent magnet, allowing the spring loaded rod to act mechanically. The device is reset when the circuit breaker opens.

3-6.5 MECHANICAL TRIP FLAG

A red, pop out mechanical trip indicator is an optional Magnum DS/DSX/DSL feature. It is located above the trip unit on the breaker's front faceplate (Figure 3-18). It operates by releasing and popping out any time the circuit breaker trips due to an overcurrent condition. Note that the mechanical trip indicator will not prevent the breaker from being reclosed. The indicator is reset manually by pushing it back in. If the indicator is not reset the circuit breaker will operate normally, but future mechanical trip indication will be lost.

An optional overcurrent trip switch (bell alarm) that operates off the position of the mechanical trip indicator is also available. The switch is reset when the trip indicator is reset.

On optional Digitrip models with LED cause-of-trip indicators, these indicators should also be reset (by pushing momentarily) after the cause of the fault has been diagnosed; this will preserve the internal battery. On trip units equipped for communication the LED reset function can be performed remotely using INCOM commands.

3-6.6 MAKING CURRENT RELEASE

All Magnum DS/DSX/DSL circuit breaker trip units have a making current release function. This safety feature prevents the circuit breaker from being closed and latched on a faulted circuit. The non-adjustable release is preset at a peak instantaneous current of 25 x I_n; this corresponds to an rms current of 11 x I_n with maximum asymmetry.

The making current release is enabled only for the first 7 cycles following a circuit breaker closing operation. The making current release will trip the circuit breaker instantaneously, release the mechanical (pop-out) indicator and flash the instantaneous LED trip indicator, if so equipped.

3-6.7 HIGH INSTANTANEOUS TRIP OPTION (MAGNUM DS ONLY)

The high instantaneous trip option is installed in 800 to 3200 ampere Magnum DS/DSX circuit breakers with a 100 kA interrupting capacity. In general, the high instantaneous trip is comprised of three small air core sensors, one in each phase, which produce a signal and transmit it back to the trip unit when the 65 kA withstand rating of the circuit breaker is exceeded. The result is an instantaneous trip by the circuit breaker. This high instantaneous trip option permits the 800-3200 ampere Magnum DS circuit breakers to be applied where a 100 kA fault is possible, while selectivity up to 65 kA is maintained.

3-6.8 VOLTAGE TAPS

On circuit breakers with Digitrip 1150 trip units potential taps are required to monitor the three phase voltages. Voltage taps may be placed on either the line (top) or load (bottom) terminals of the breaker at the factory. Figure 3-21 illustrates line-side voltage taps.

3-7 SECONDARY CONTACTS AND CONNECTION DIAGRAMS

A maximum of sixty secondary wiring connection points are available on the standard frame circuit breaker (48 on narrow frame), each dedicated to a specific function (Figure 3-22). The wiring points are finger safe with no more than two wires per terminal.

Up to two secondary contact plug-in connectors (AMP), each with 30 secondary points, are mounted on the top rear portion of the circuit breaker . The plug-in connectors are protected by a molded hood (Figure 3-23). How many connectors are mounted depends upon a number of considerations, such as whether the circuit breaker is electrically or manually operated and how many features are required. When the front cover of the circuit breaker is removed, the top of each plug-in connector is exposed. A label on each connector identifies the wiring points.

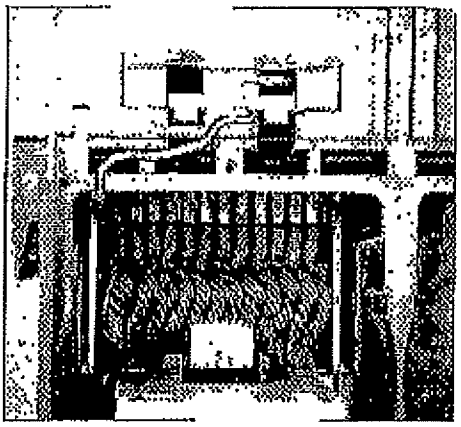


Figure 3-21 Line-Side Voltage Tap for 1150 Trip Unit

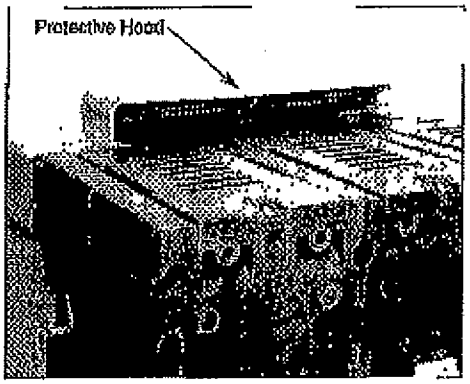
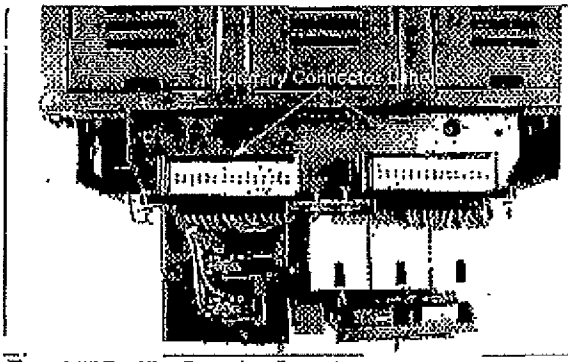


Figure 3-23 Secondary Connector Protective Hood



Labels Legend	
OVR	Overcurrent Trip Switch
UVR	Undervoltage Release
ATR	Automatic Trip Relay (1150 and 1150 Trip Units Only)
INCOM	PowerNet Communications Network
A HUB	(Future Use)
AUX	Auxiliary Contacts
NEUTRAL	Neutral Sensor Input
GF SGND	Source Ground Input
ZONE	Zone Interlocking
ST	Shunt Trip
SR	Spring Release
MOTOR	Charging Motor
LCS	Latch Check Switch

Figure 3-22 Top View Secondary Connectors

Drawout type circuit breakers: Compatible secondary plug-in connectors are mounted on the top front portion of the drawout cassette (Figure 3-24). These connectors match and plug into the circuit breaker mounted connectors. Contact points are wired from the cassette's plug-in connectors to cassette mounted terminal blocks. The terminal blocks are also mounted on the top front portion of the cassette. The secondary terminals have finger-proof hinged covers with small holes for probe testing.

Fixed type circuit breakers: There are two secondary connection options:

(1) Without Terminal Block

(2) With Terminal Block

1. Without Terminal Block - If a terminal block for customer use is not required, the circuit breaker is supplied with both plug-in connectors (male and female) just described in the two previous paragraphs. The plug-in connectors are joined and attached to the top portion of the circuit breaker. The customer can plug secondary wiring with crimp-on connectors into back of the plug-in connectors; subsequently the connections to the circuit breaker can be quickly joined or separated as required.

2. With Terminal Block - For those customers preferring to wire to a terminal block, terminal blocks with finger-proof hinged covers are added to the secondary configuration just described for a fixed circuit breaker "without a terminal block." The terminal blocks are wired to the plug-in connectors and also permanently attached to the upper rear portion of the circuit breaker (Figures 3-2 and 3-4).

A standard tool is available from the plug-in connector manufacturer (AMP) to facilitate the removal of secondary wiring from a plug-in connector, or contact Cutler-Hammer for assistance (Figure 3-25). The connector halves must be separated to use this tool.

3-7.1 CONNECTION DIAGRAMS

The connection diagrams for all Magnum circuit breakers using Digitrip RMS trip units are shown in Figures 3-26 through 3-46.

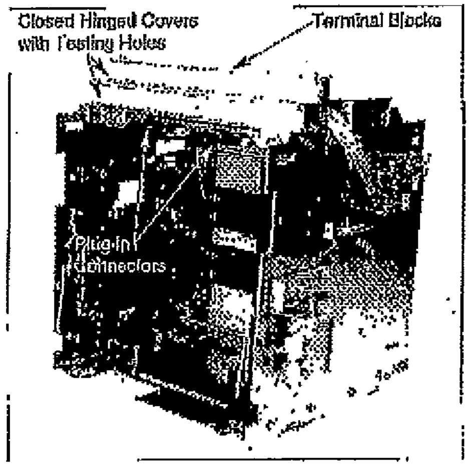


Figure 3-24 Typical Cassette Mounted Secondary Wiring

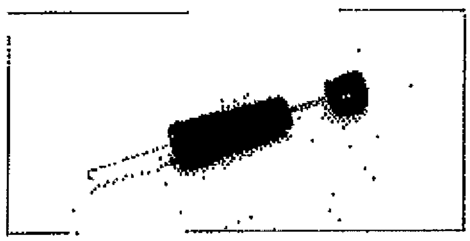


Figure 3-25 AMP Secondary Wiring Removal Tool

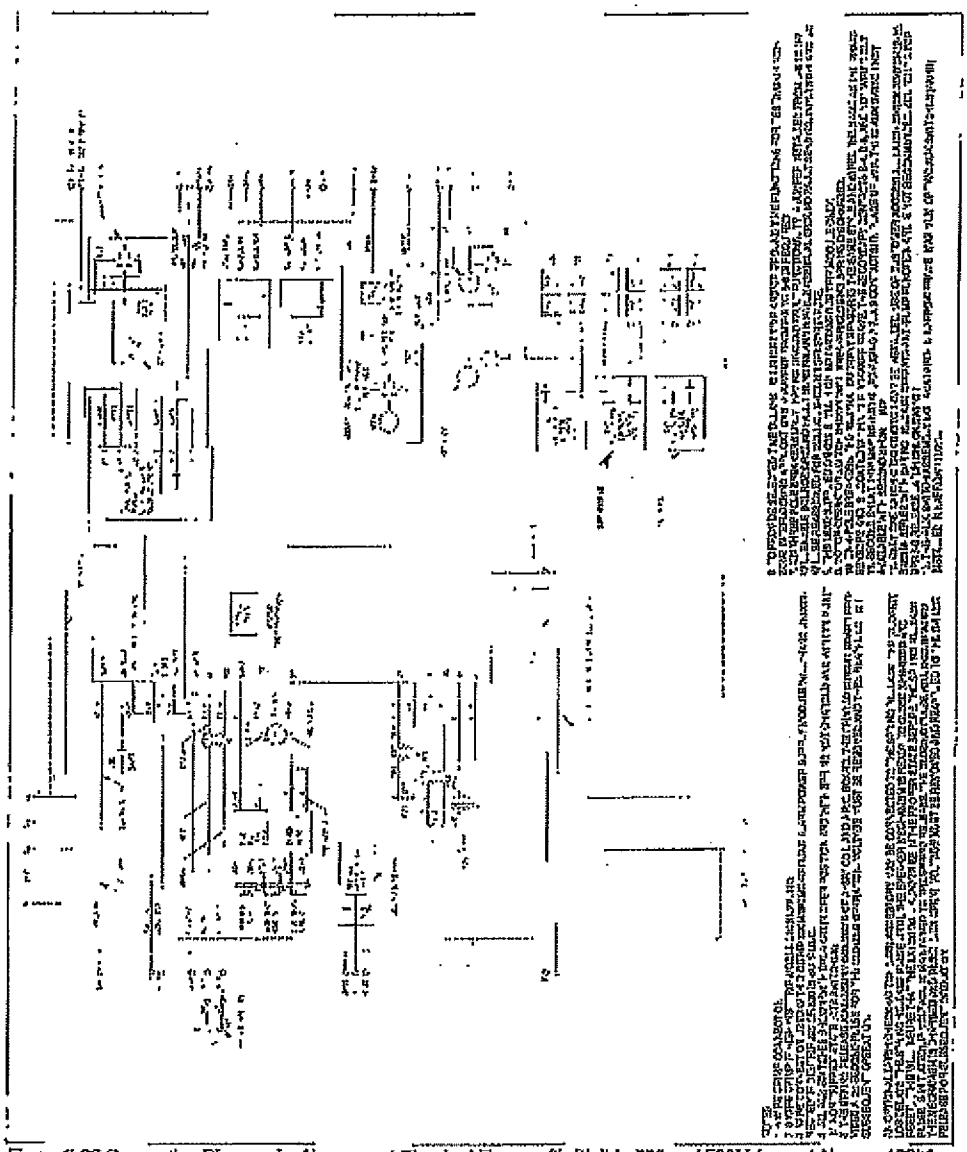


Figure 3-26 Connection Diagram for Narrow and Standard Frame with Digitrip 520 and 520M (except Narrow 100A ratings)

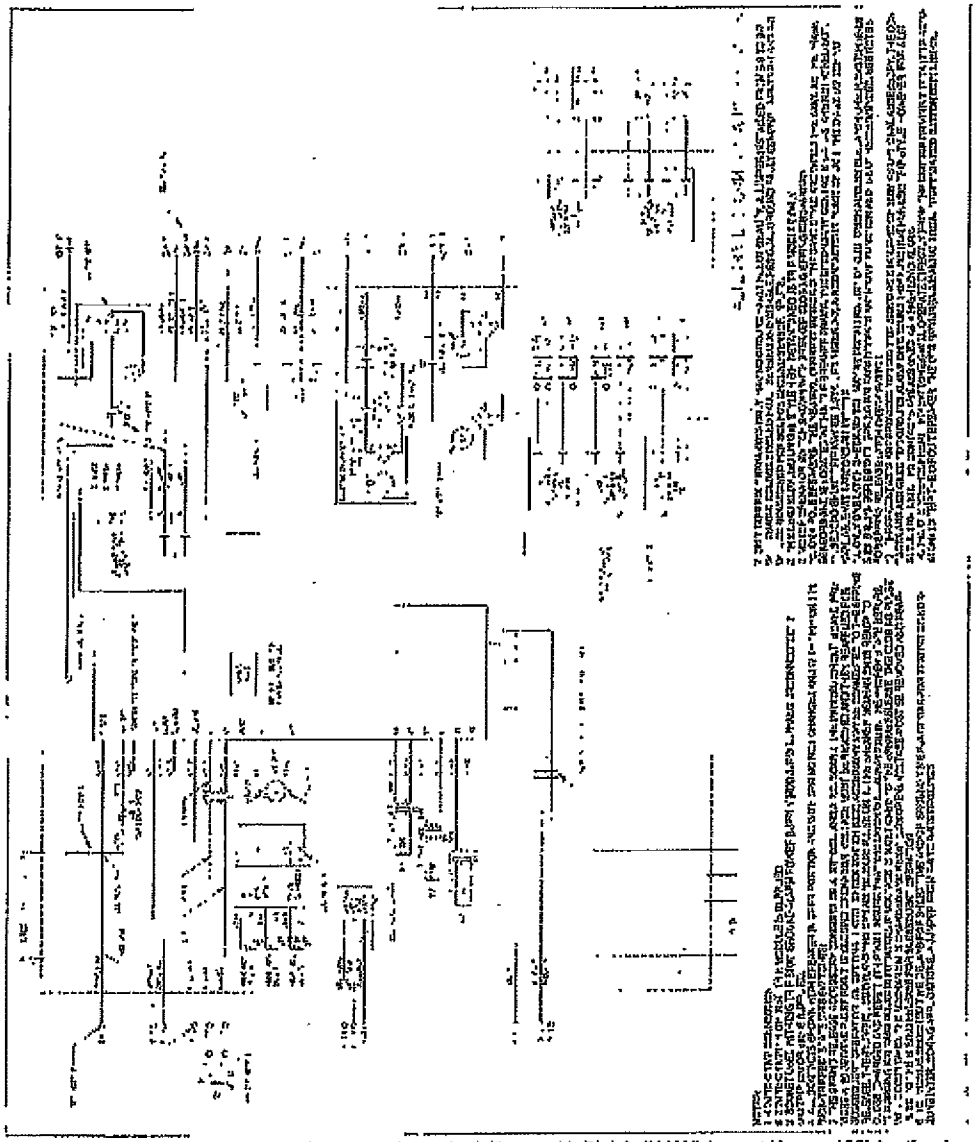


Figure 8-27 Connection Diagram for Narrow and Standard Frame with Digitrip 520MC (except Narrow 100kA ratings)

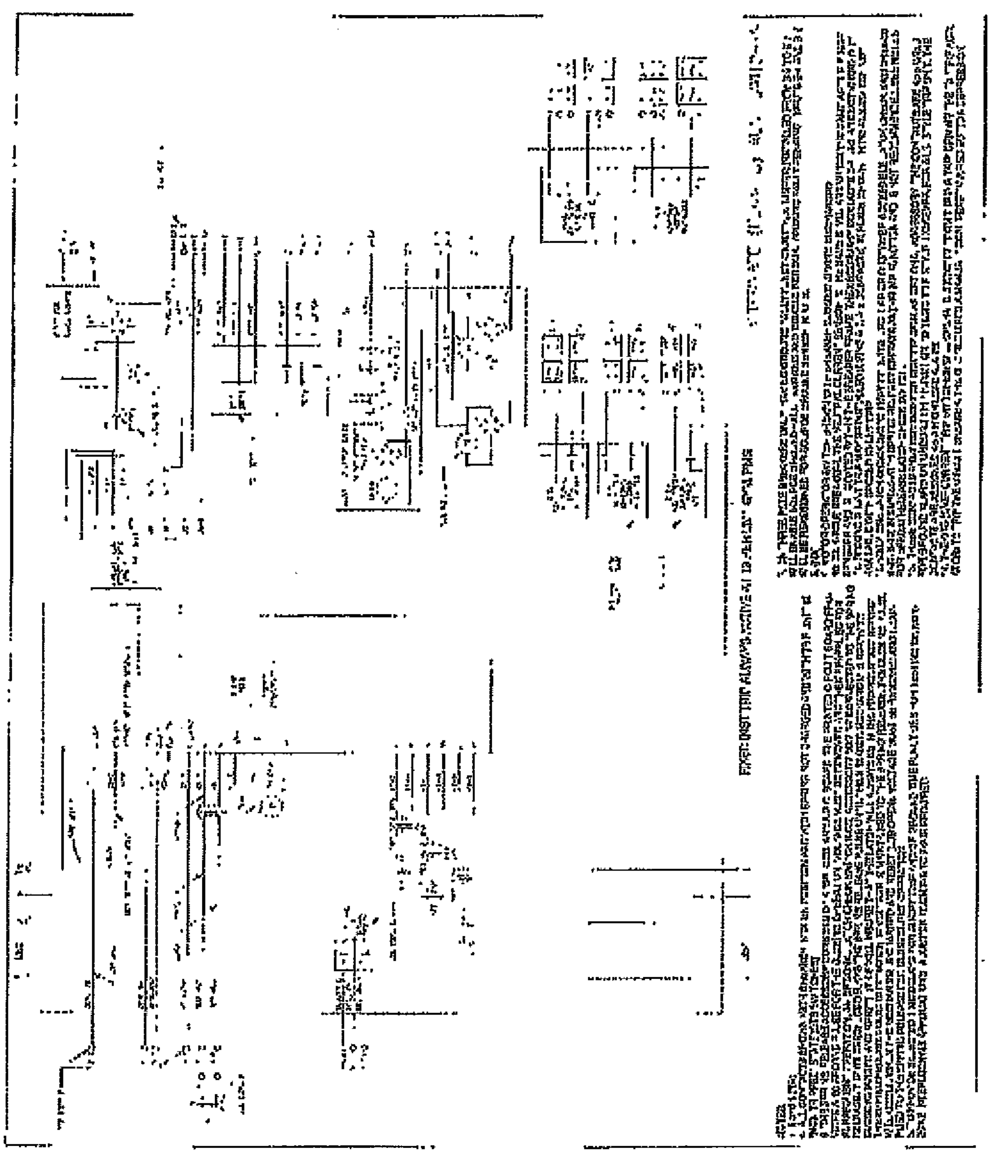


Figure 3-28 Connection Diagram for Narrow 100kA Rating Frame with Digitrip 520 and 520M

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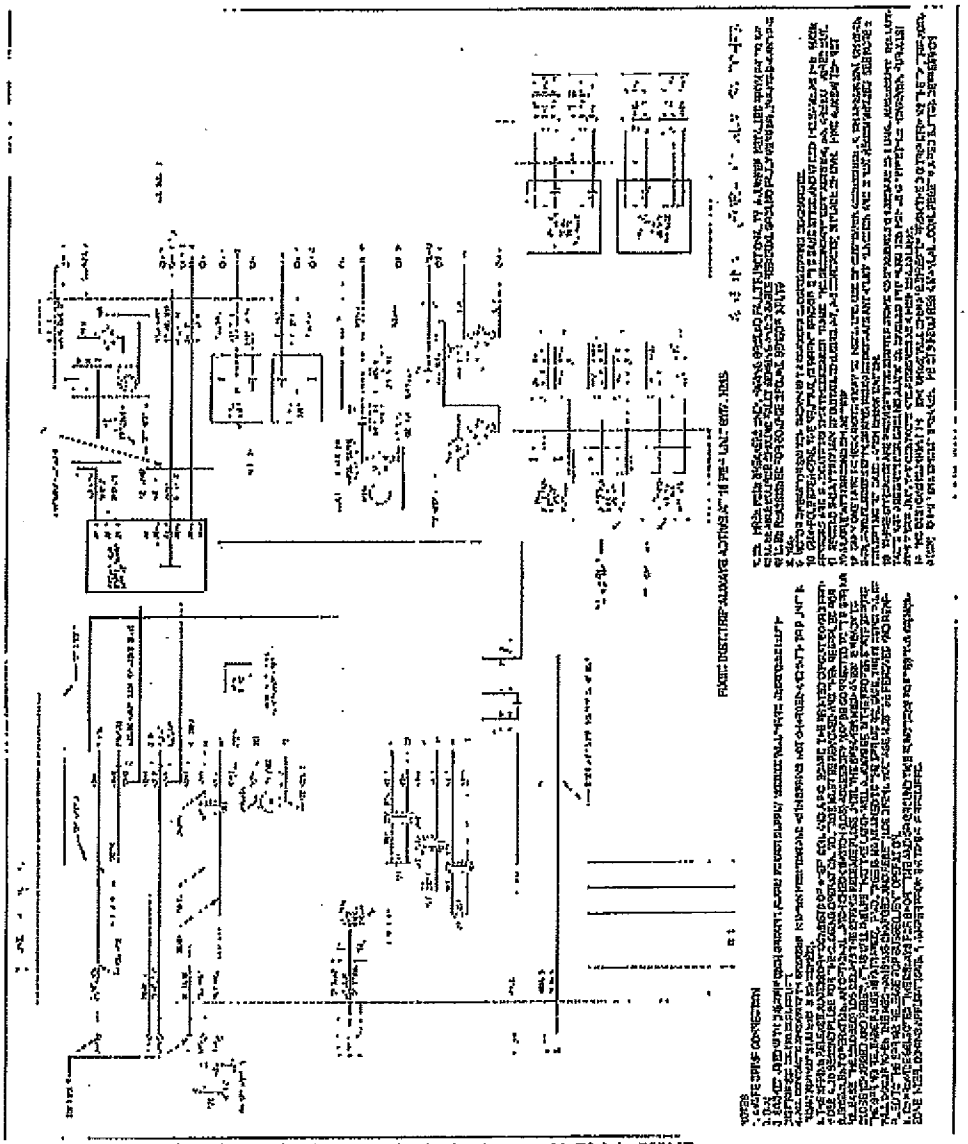

Figure 3-28 Connection Diagram for Narrow 100kA Rating Frame with Digitrip 520MC

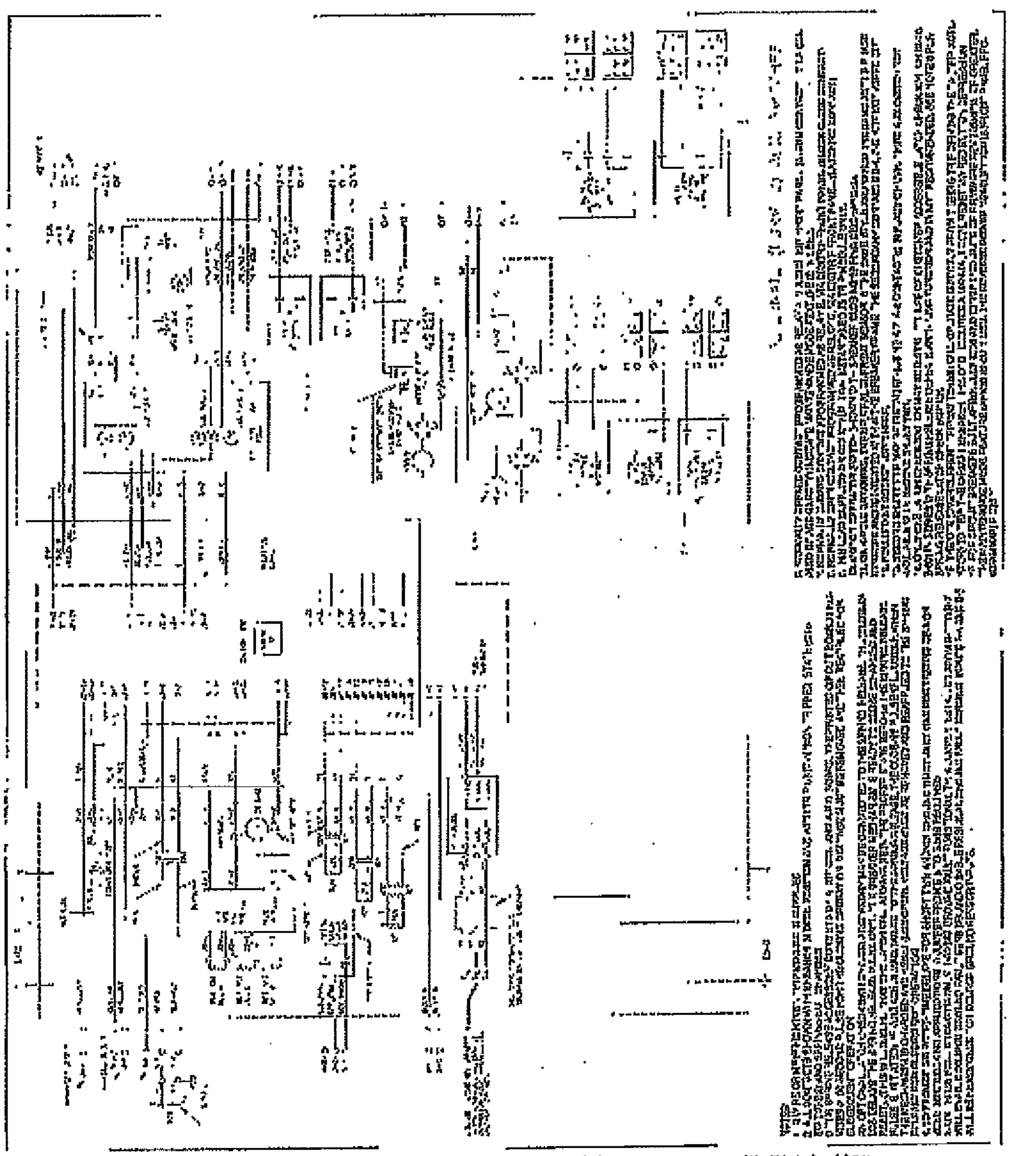

Figure 9-30 Connection Diagram for Standard and Narrow (except 100kA ratings) Frame with Digitrip 1150

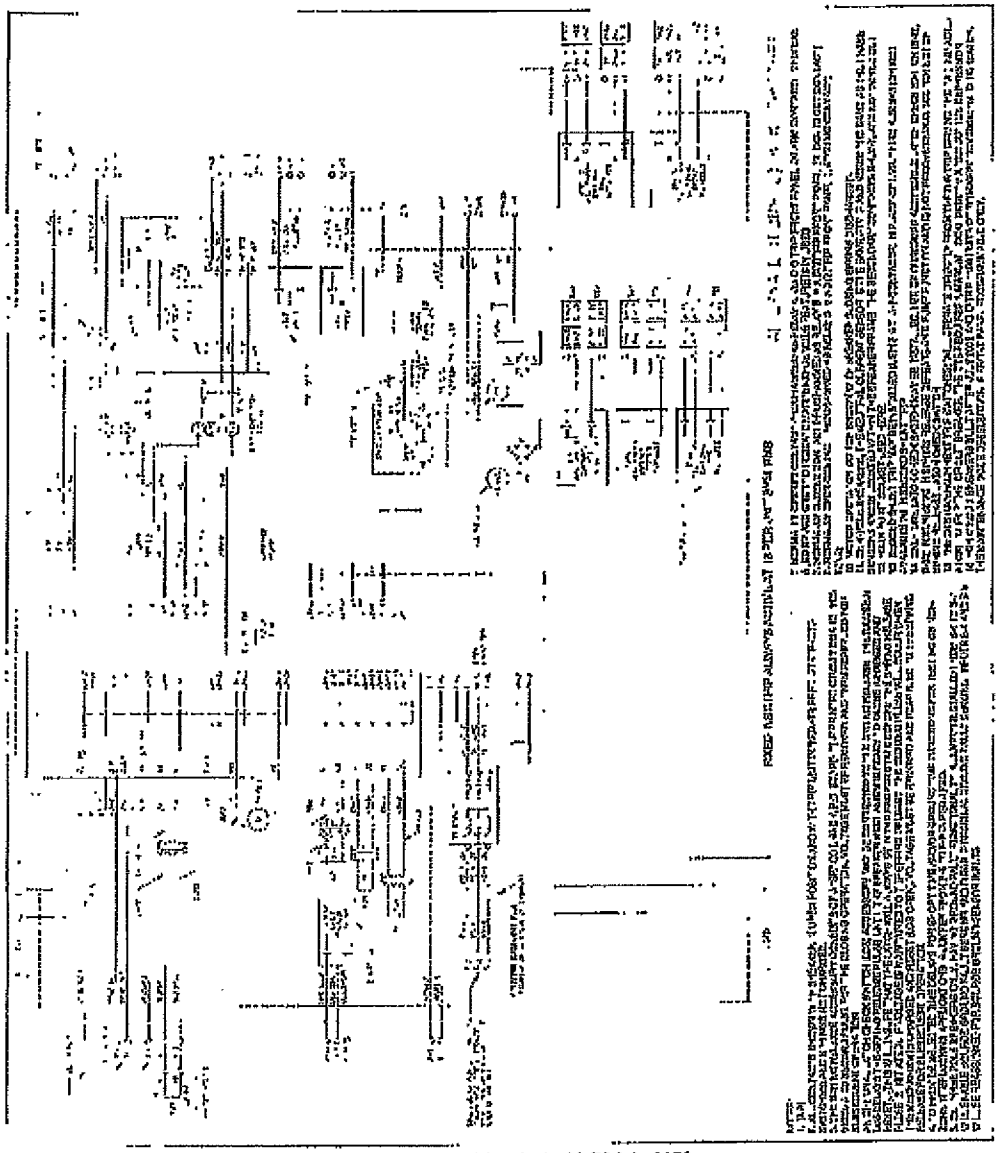

Figure 3-31 Connection Diagram for Narrow Frame (1000A rating) with Digitrip 1150

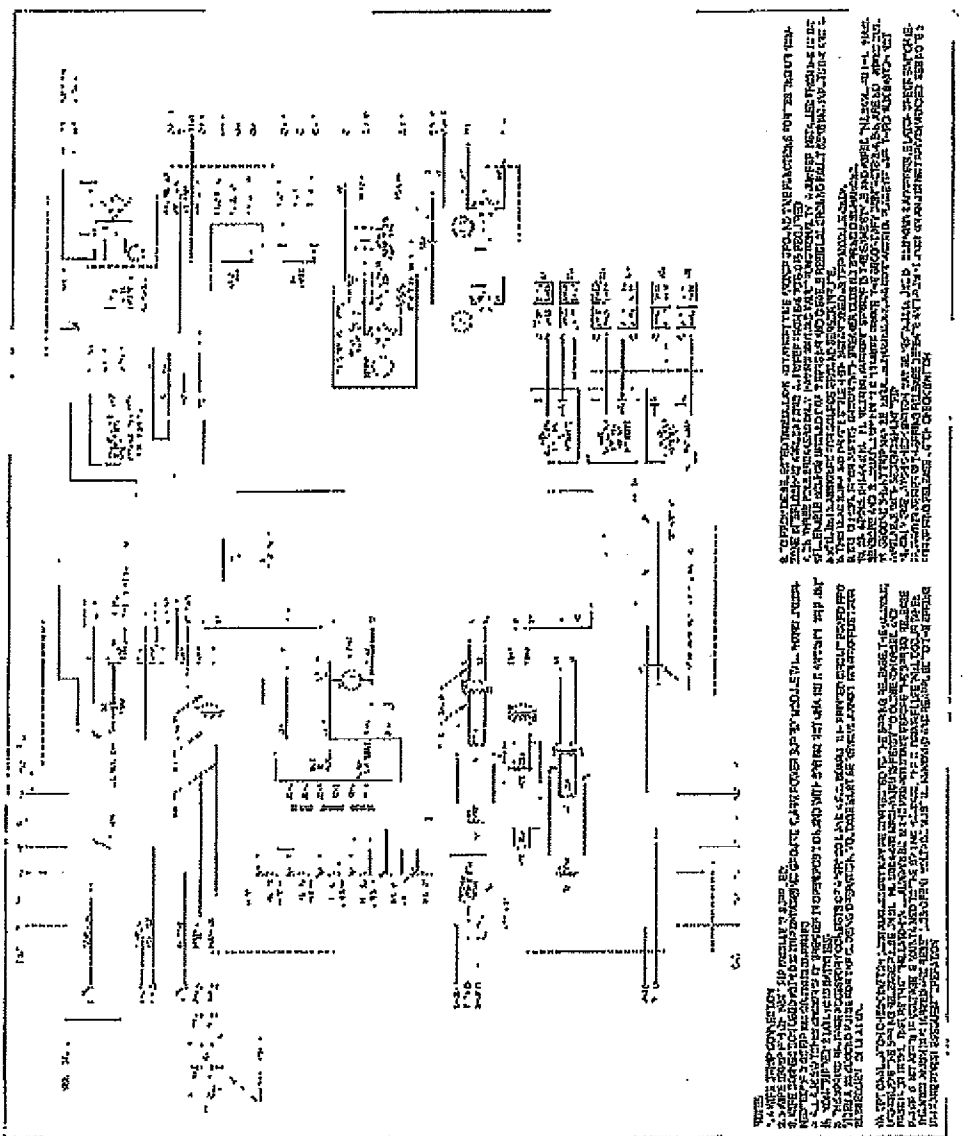

Figure 3-32 Connection Diagram for Double-wide Frame (except MDSX) with Digitrip 520 and 520M with ABCABC Configuration

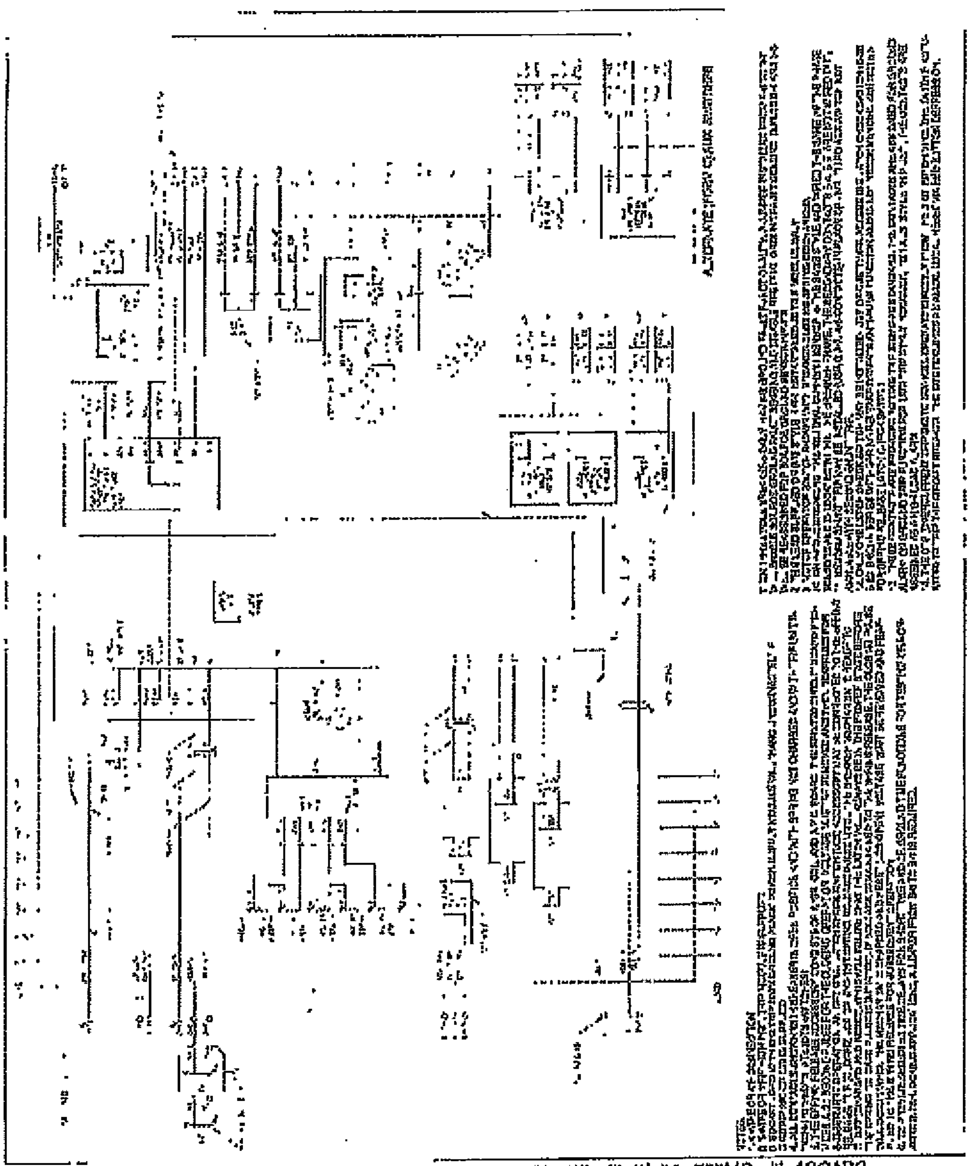

Figure 3-33 Connection Diagram for Double-wide Frame (except MDSX) with Digitrip 520MC with ABCABC Configuration

CUTLER HAMMER LV MAGNUM DS BREAKER MANUAL

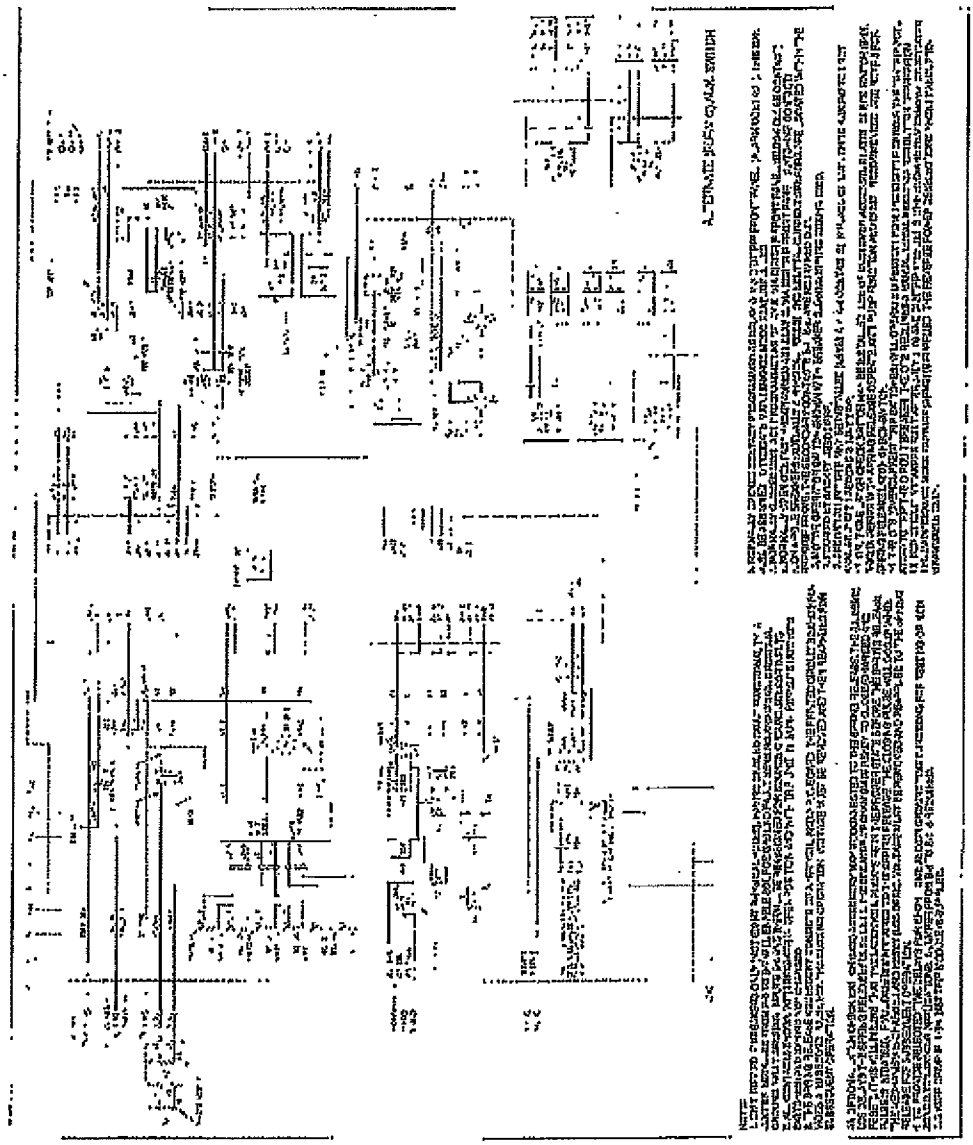

Figure B-34 Connection Diagram for Double-wide Frame (except MDSX) with Digitrip 1150 with ABCABC Configuration

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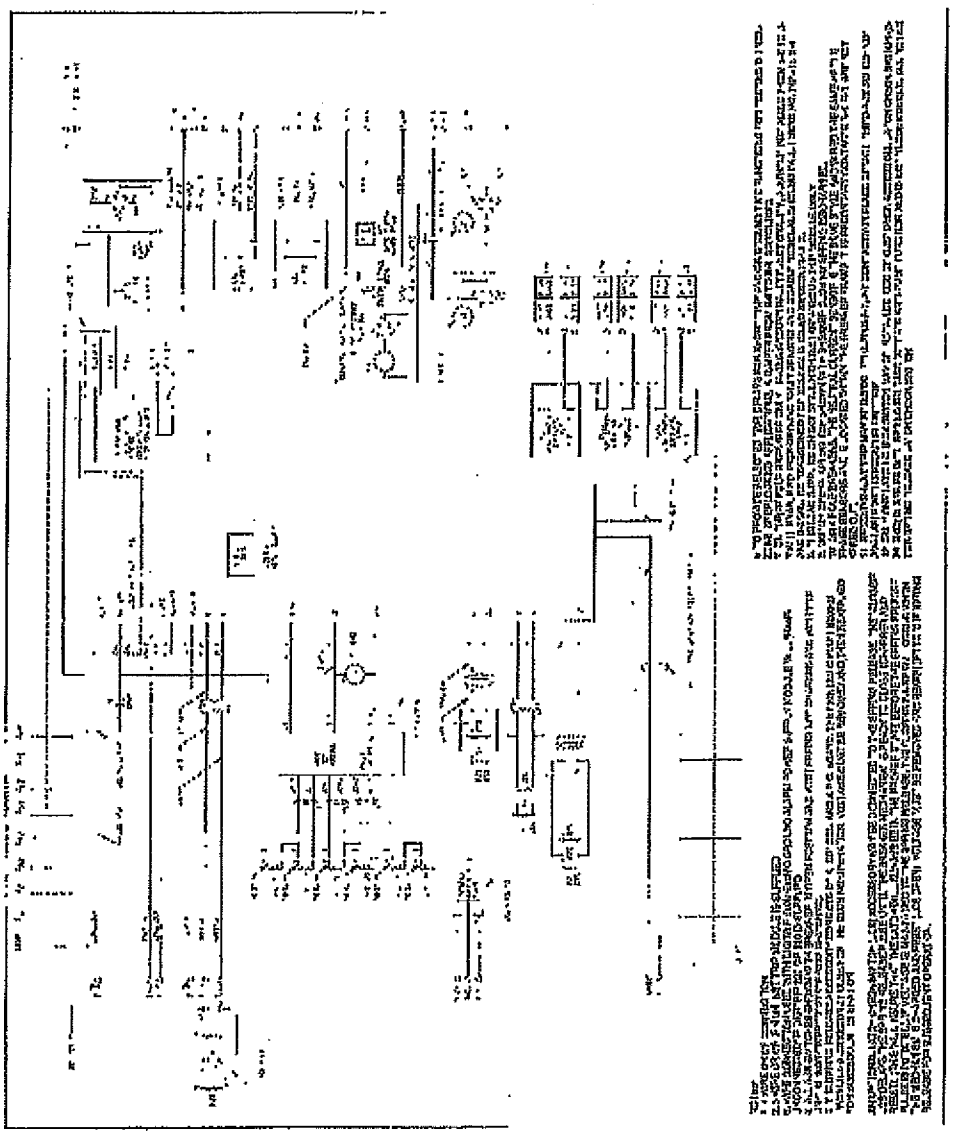

Figure 3-38 Connection Diagram for Double-wide Frame (except MDSX) with Digitrip 520 and 520M with AABBCC Configuration

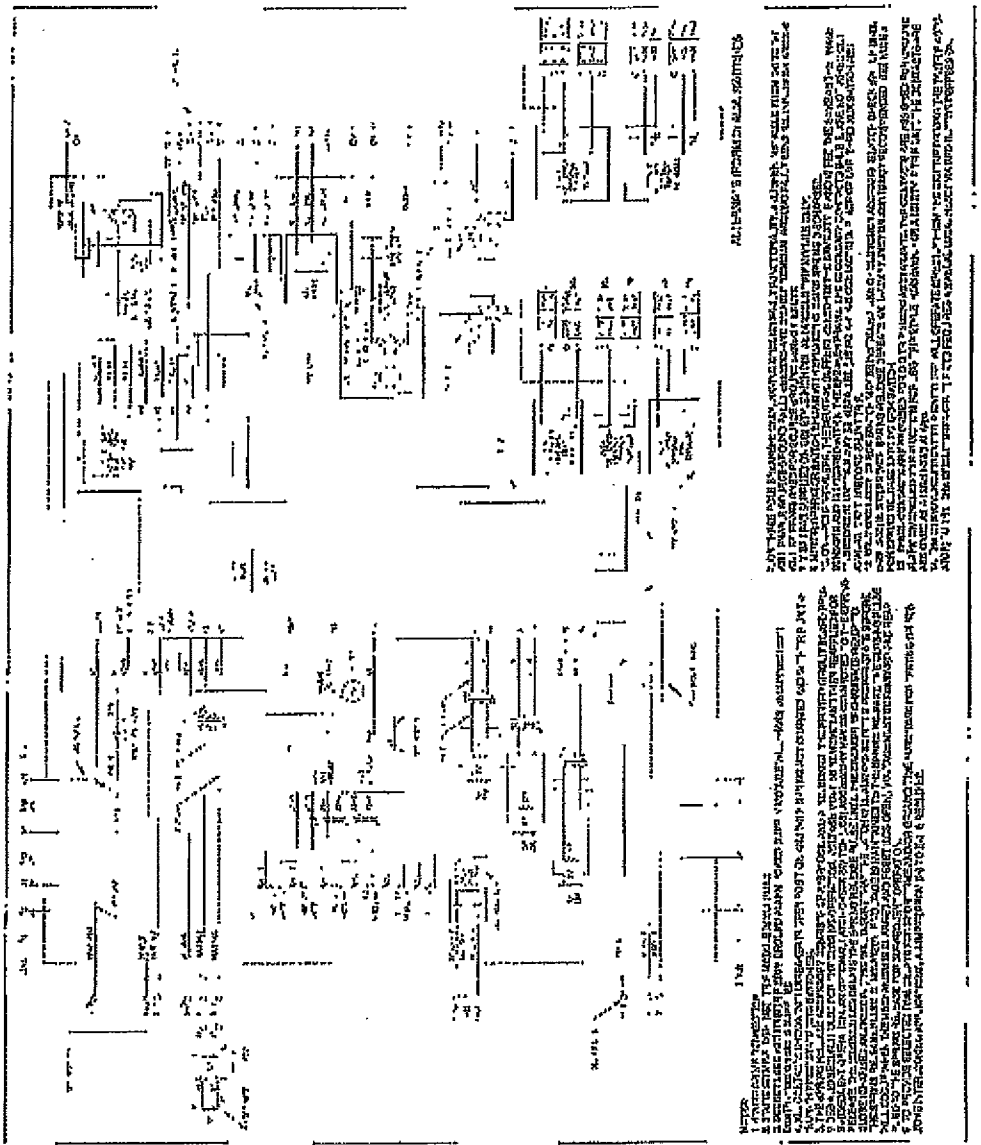

Figure 3-86 Connection Diagram for Double-Wide Frame (except MDSX) with Digitrip 520MC with AABBCC Configuration

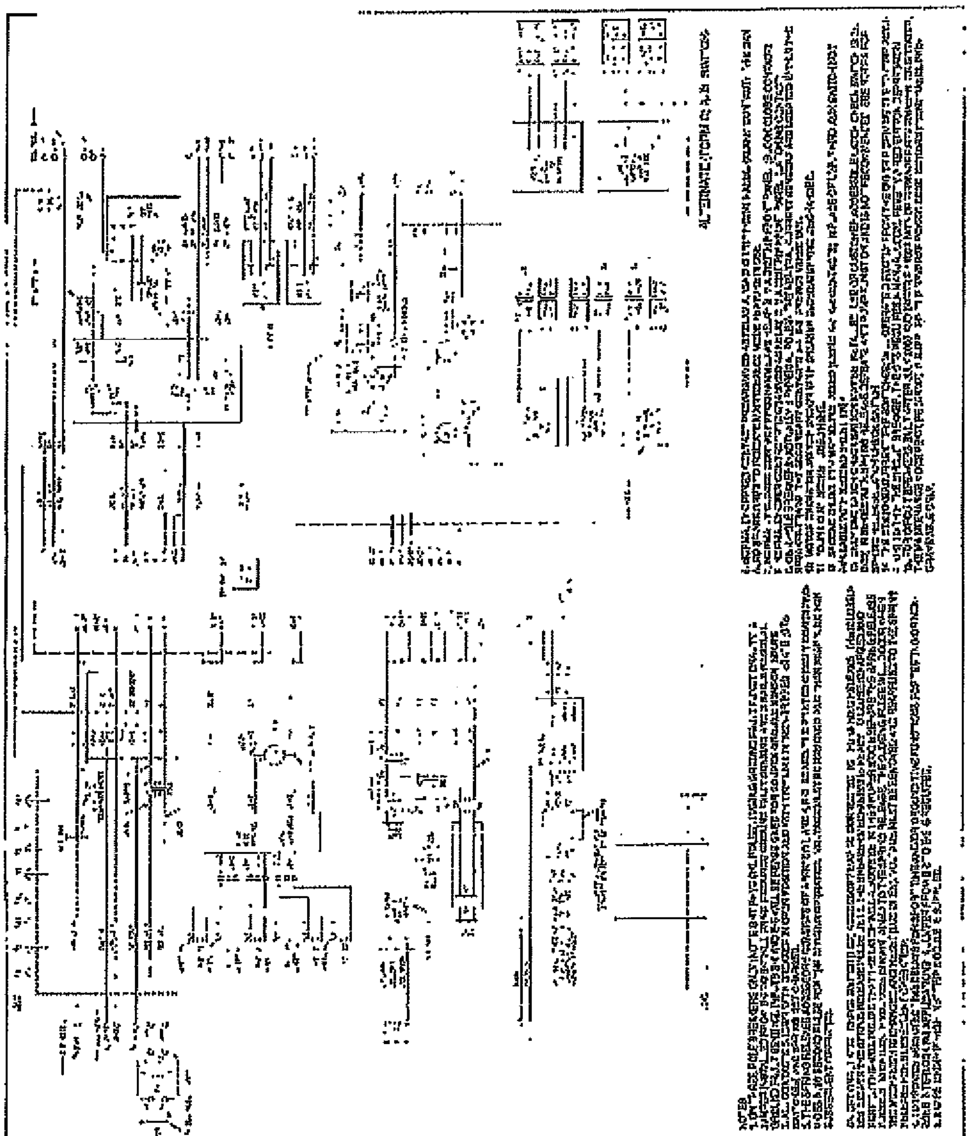

Figure 3-37 Connection Diagram for Double-wide Frame (except MDSX) with Digitrip 1150 with AABBCC Configuration

CUTLER HAMMER LV MAGNUM DS BREAKER MANUAL

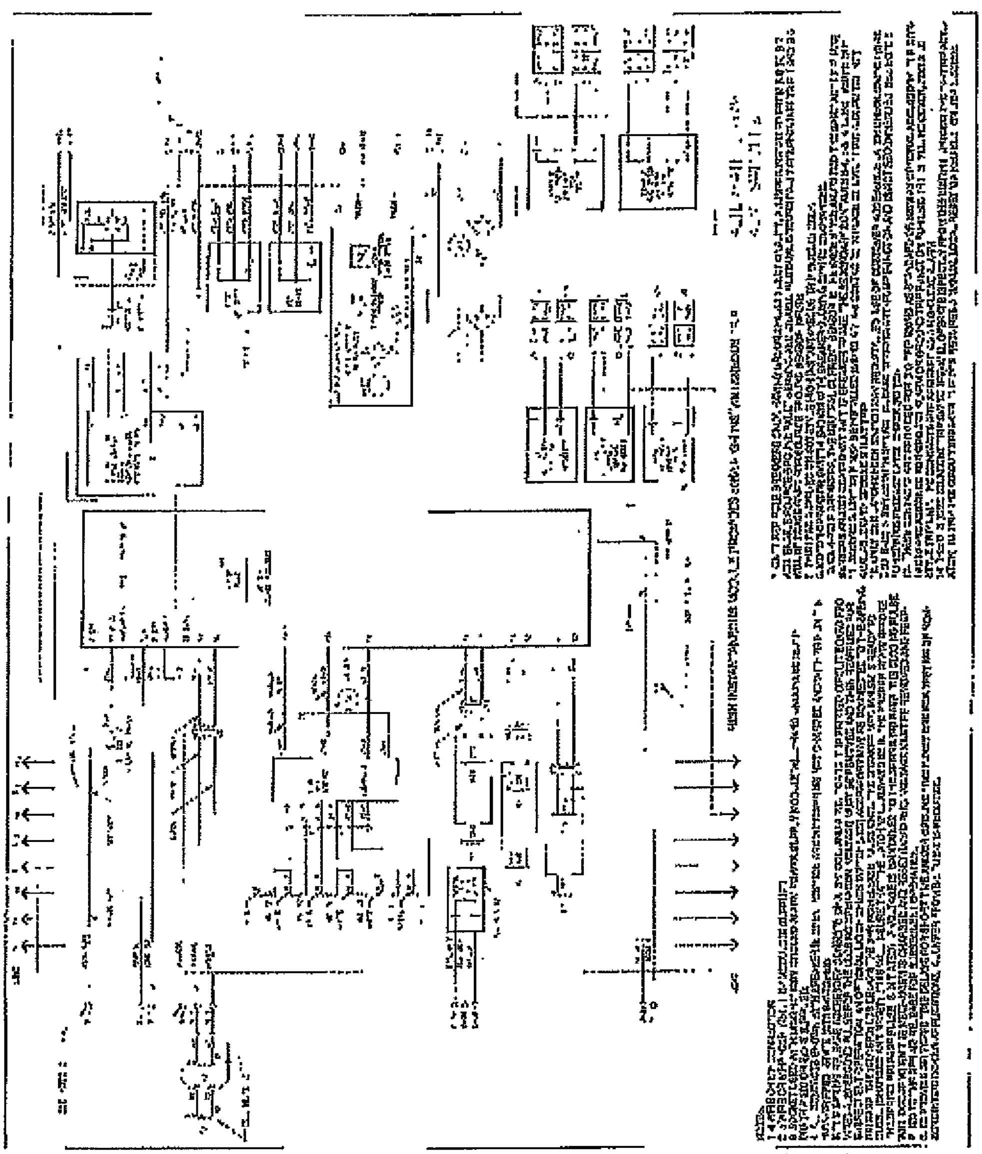

Figure 3-38 Connection Diagram for MDSX Double-Wide Frame with Digitrip 520 and 520M with ABCABC Configuration

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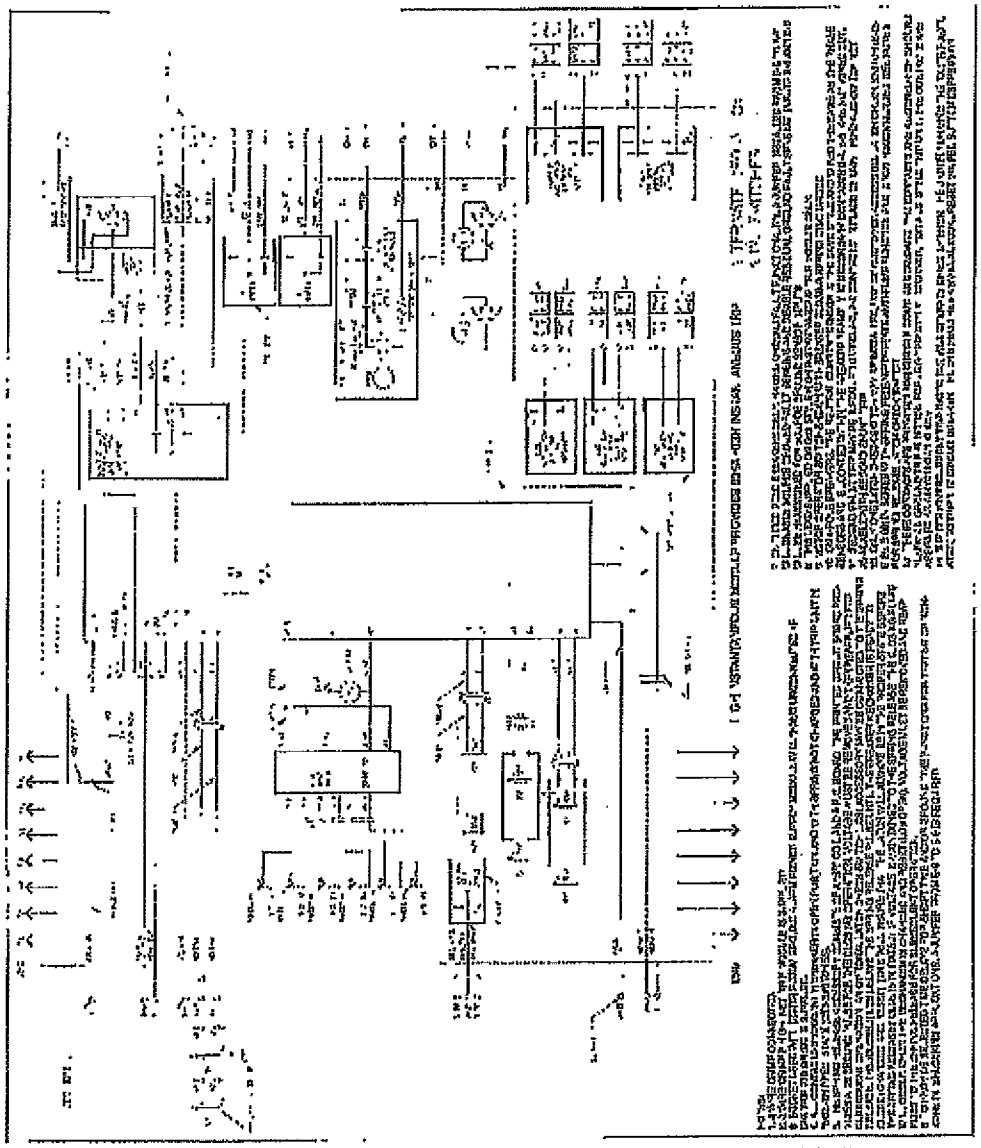

Figure 8-39 Connection Diagram for MDSX Double-wide Frame with Digitrip 520MC with ABCABC Configuration

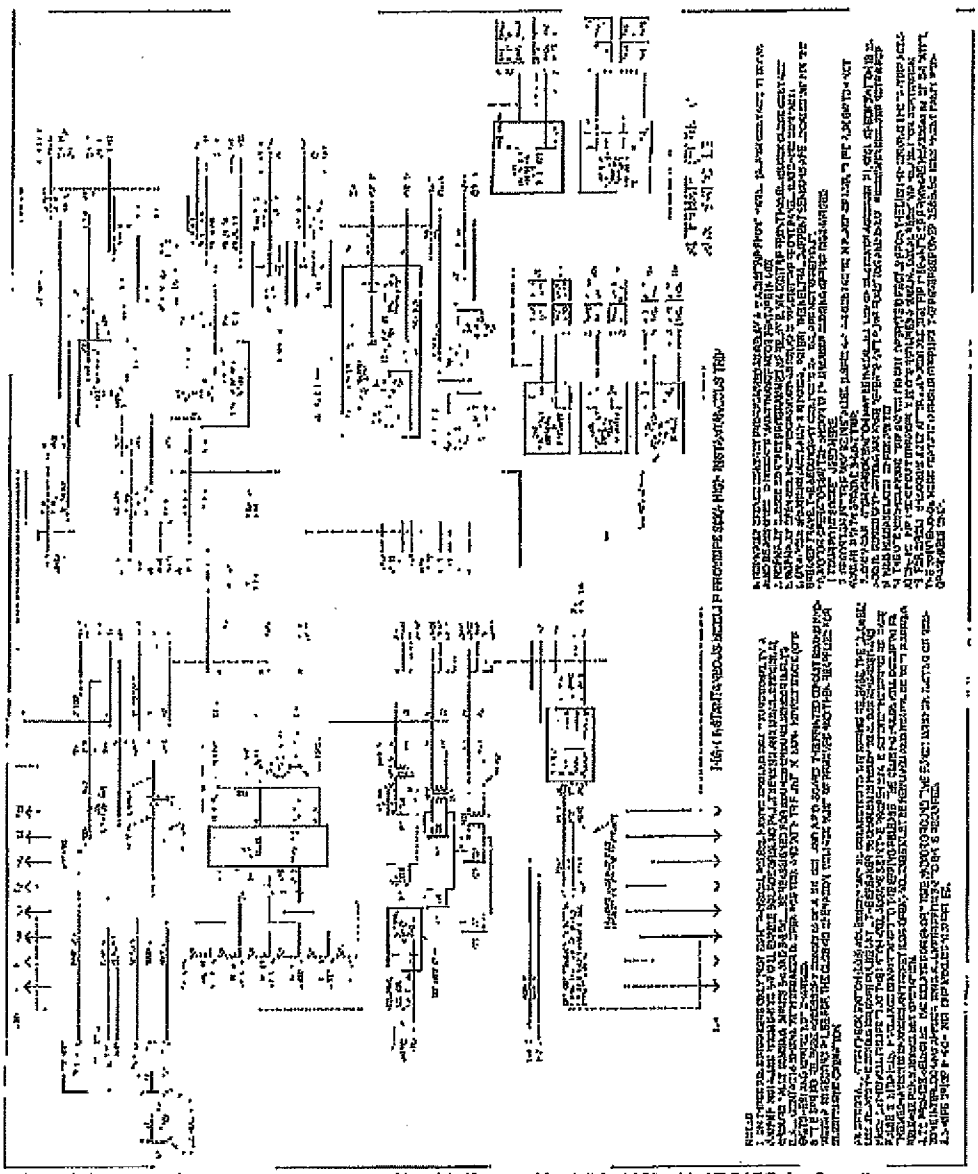

Figure 3-40 Connection Diagram for MDSX Double-wide Frame with Digitrip 1150 with ABCABC Configuration

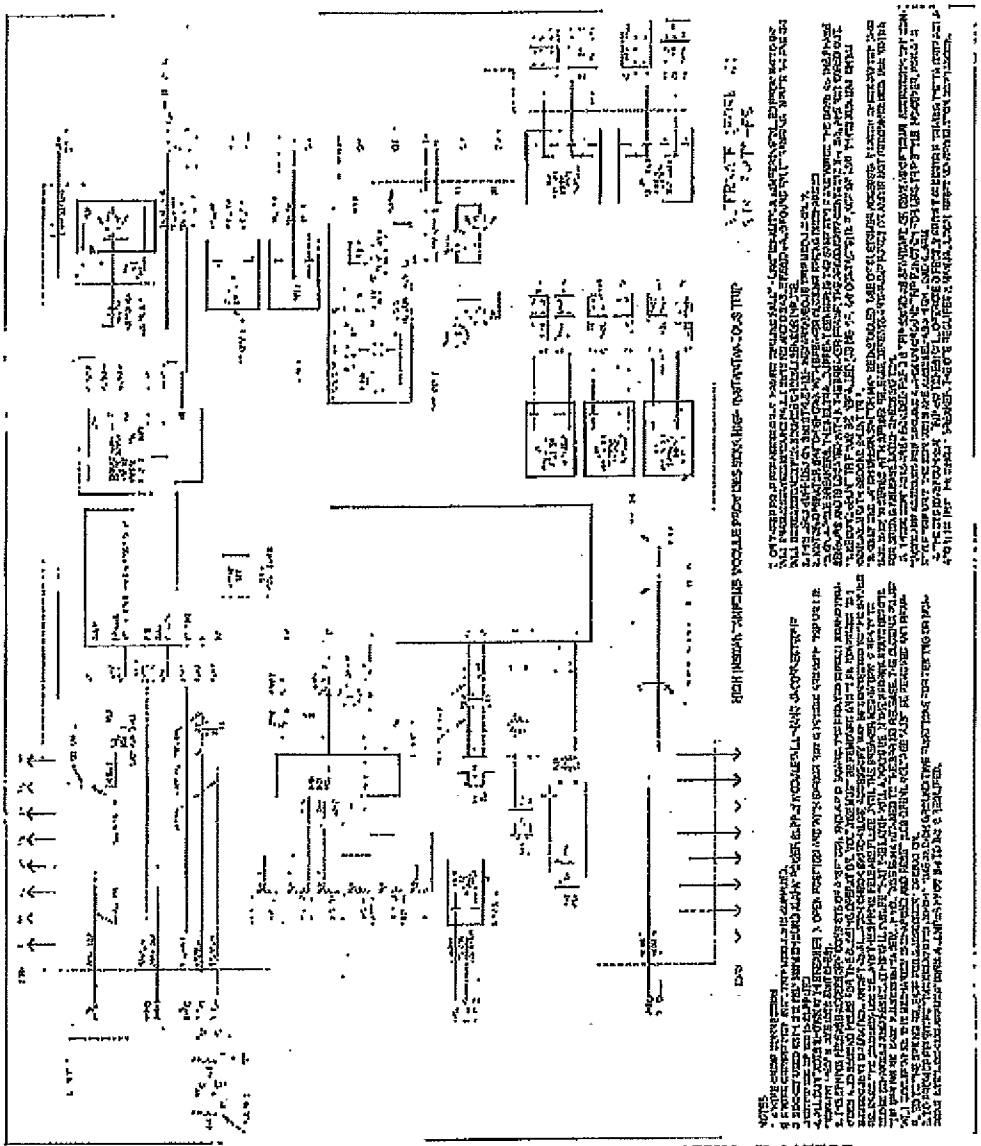

Figure 3-41 Connection Diagram for MDSX Double-wide Frame with Digitrip 520 and 520M with AABBCC Configuration

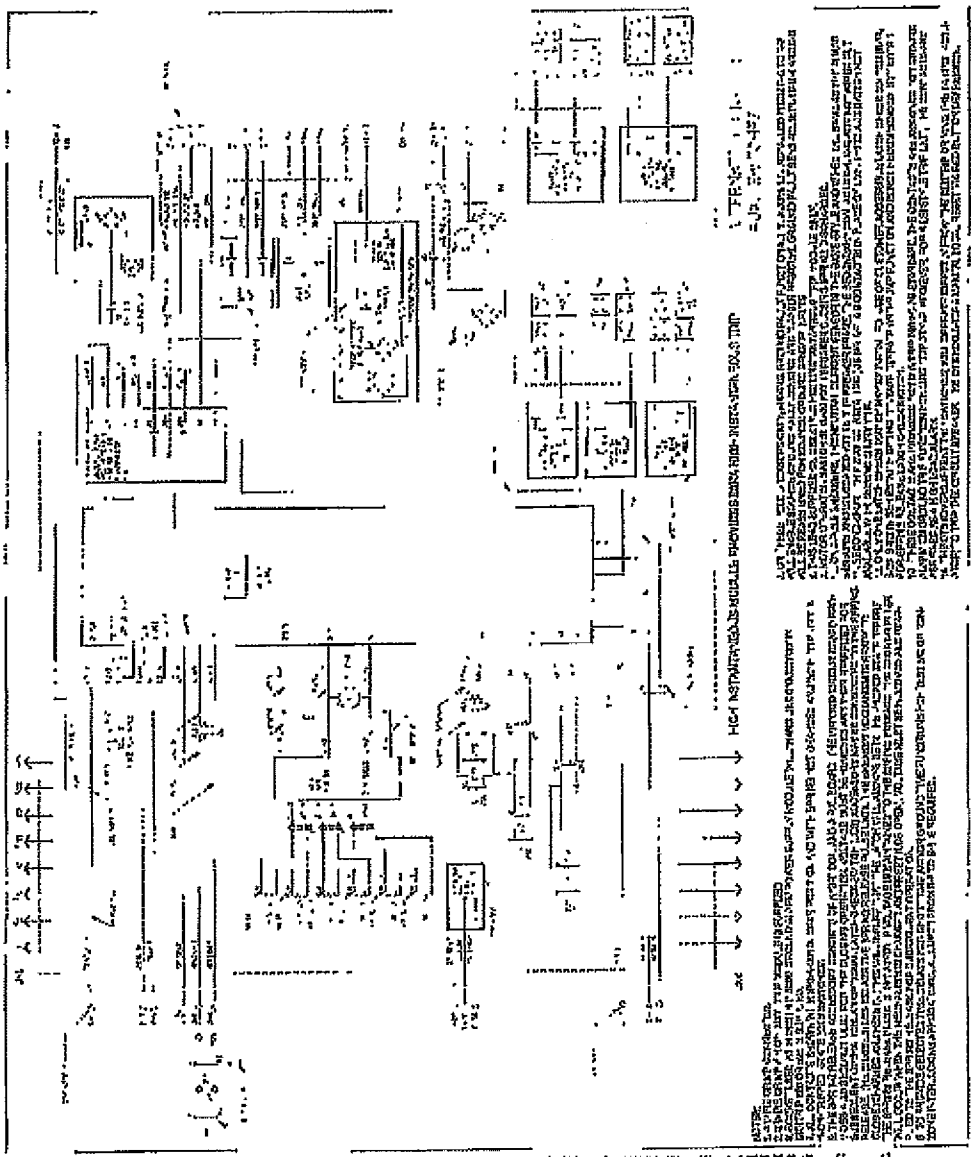

Figure 3-42 Connection Diagram for MDSX Double-wide Frame with Digitrip 520MC with AABBCC Configuration

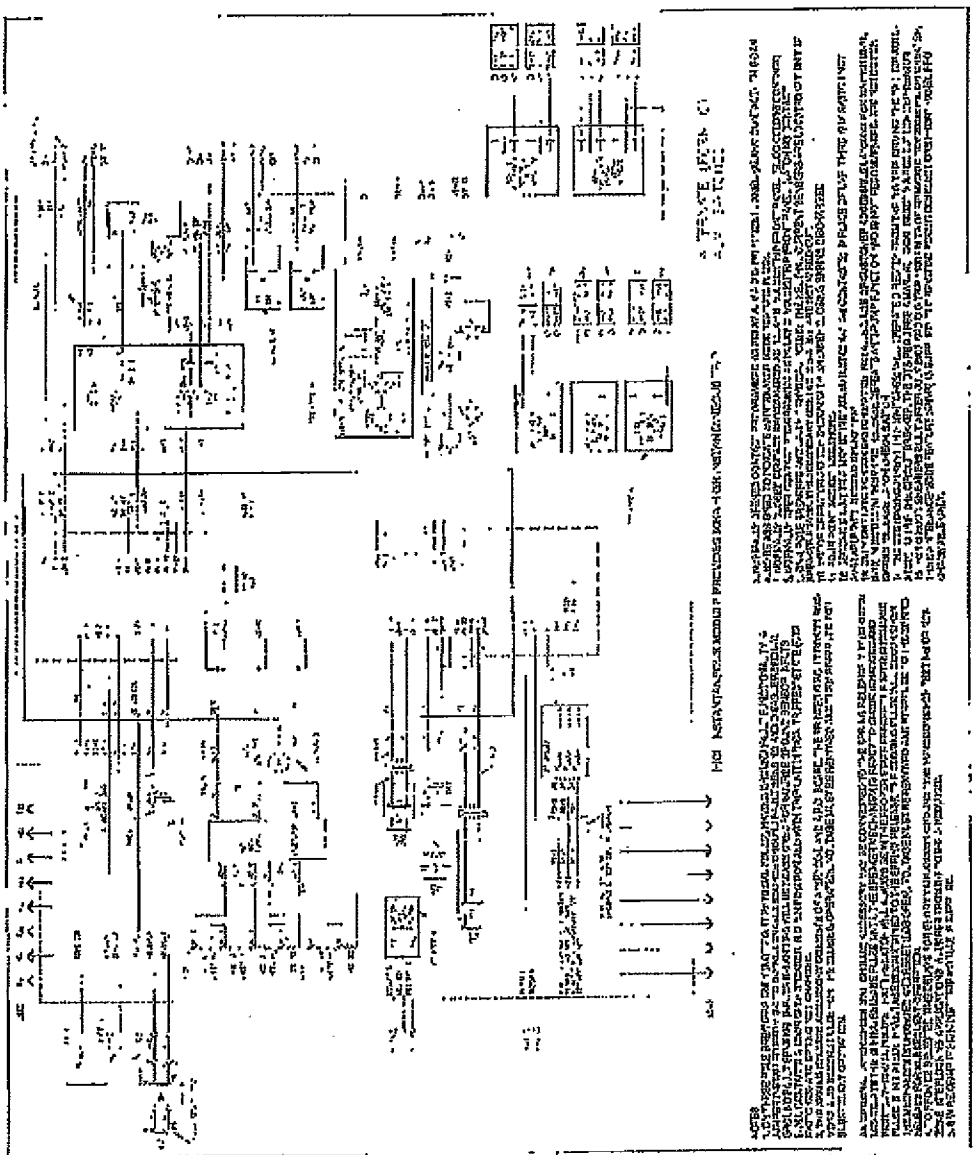

Figure 3-43 Connection Diagram for MDSX Double-wide Frame with Digitrip 1150 with AABBCC Configuration

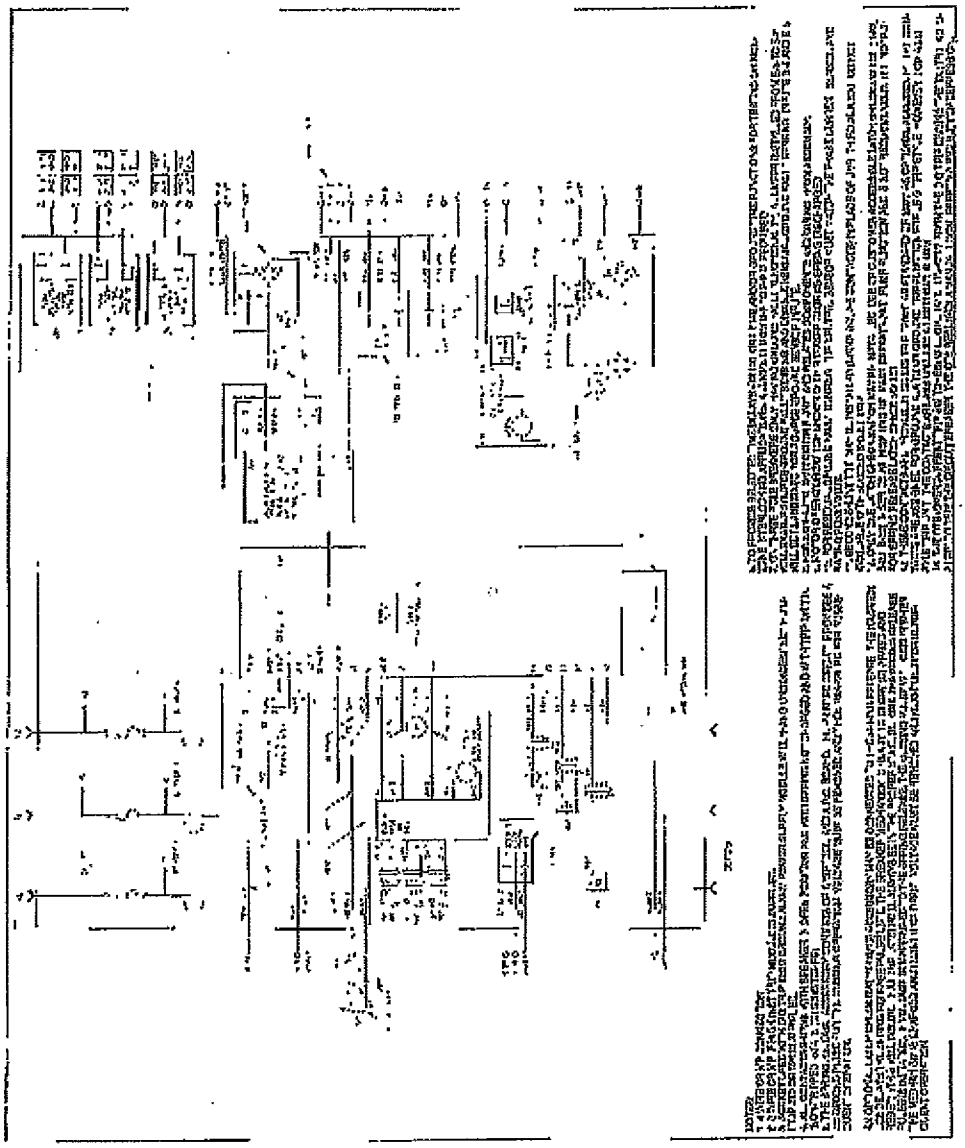

Figure 3-44 Magnum DSL Connection Diagram with Blown Fuse Trip Digitrip 520 and 520M

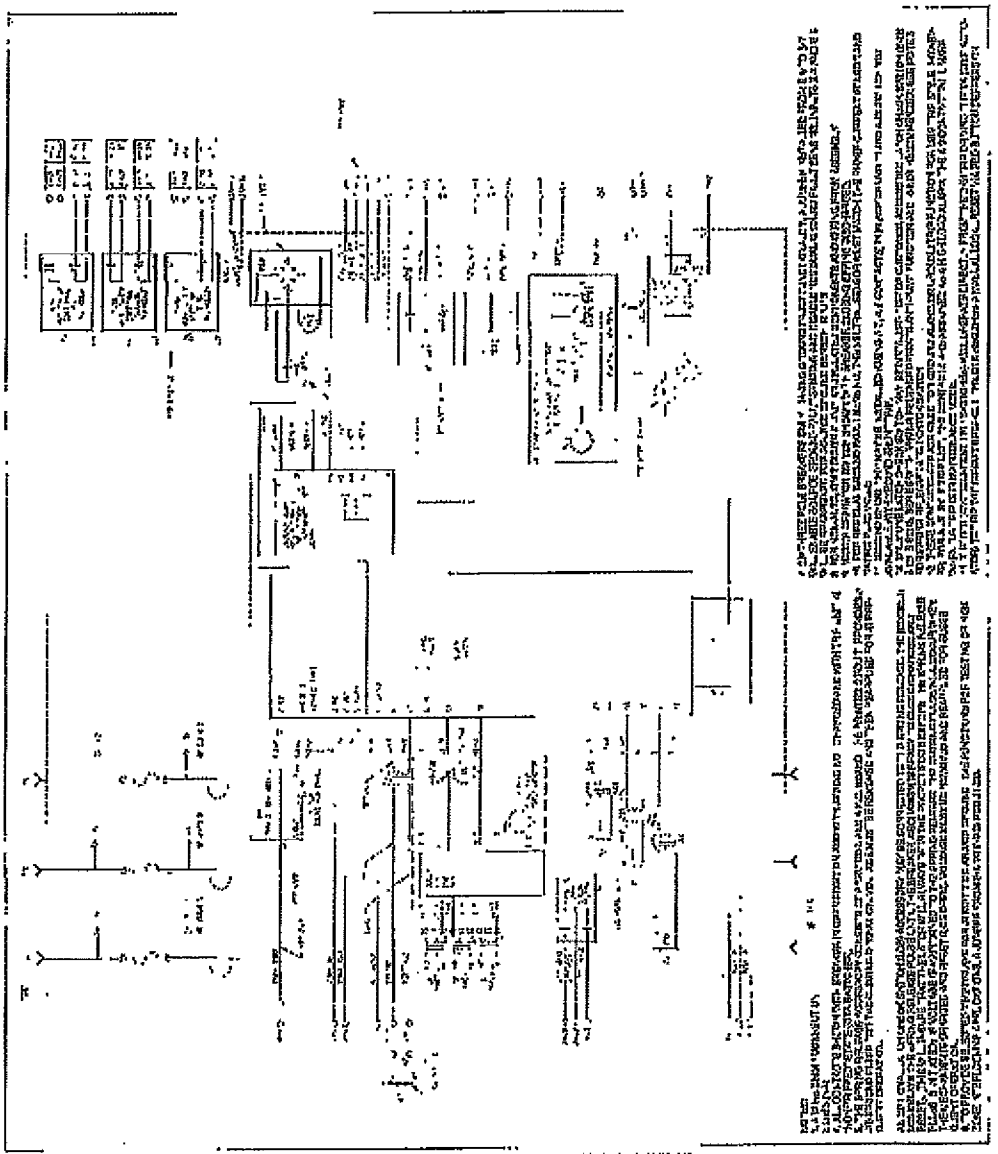

Figure 9-46 Magnum DSL Connection Diagram with Blown Fuse Trip Digitrip 520MC

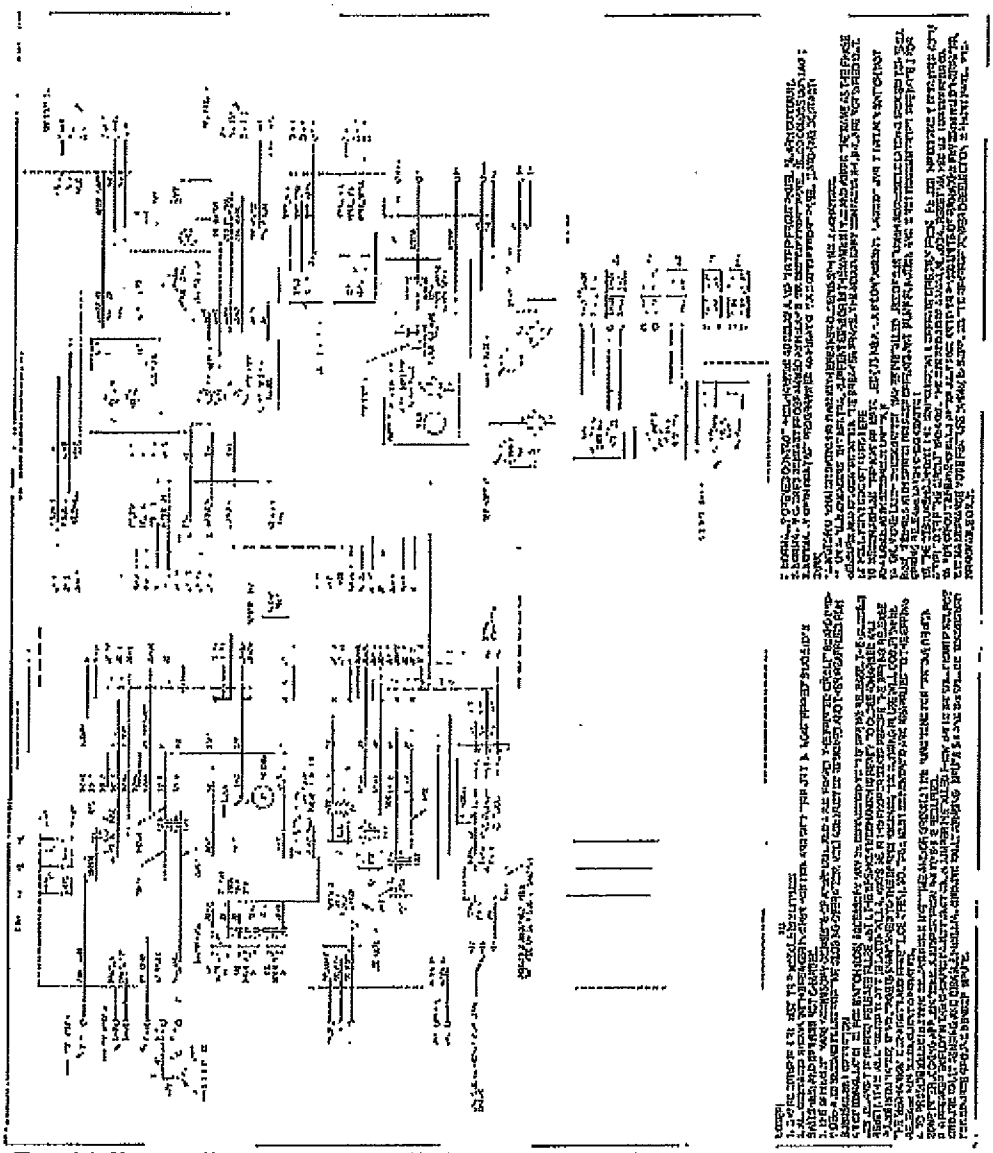

Figure 3-48 Magnum DSL Connection Diagram with Blown Fuse Trip Digitrip 1150

3-8 ACCESSORY DEVICES

A variety of accessory devices are available for use with Magnum circuit breakers. Unless otherwise stated, they are all considered optional devices in the sense that they are not provided as standard on a manually operated circuit breaker. Available accessories are identified here and discussed in general terms. For more detailed information and/or installation instructions, refer to individual instruction leaflets dedicated to the accessories.

Magnum circuit breaker accessories are designed to fit all frame sizes. The accessories fall into one of three categories:

- Plug-in electrical
- Internal electrical
- Mechanical

3-8.1 PLUG-IN ELECTRICAL ACCESSORIES

There are four Magnum Plug-in electrical accessories. Three can be viewed for identification by name and rating through viewing windows located in the right front of the circuit breaker (Figure 3-47). All four are plug-in type and can be factory installed or field installed using a UL listed kit.

The four Plug-in accessories are:

- Shunt Trip (ST)
- Spring Release (SR)
- Undervoltage Release (UVR)
- Auxiliary Switch

Shunt Trip - The shunt trip is an optional device on circuit breakers (Figures 3-48 and 3-49). It opens the circuit breaker instantaneously when its coil is energized by a voltage input (Table 3.3). A total of two shunt trips can be mounted on a Magnum circuit breaker.

Table 3.3 Shunt Trip Ratings

Control Voltages	Operational Voltage Range 70-110%	Inrush Power Consumption ①	Opening Time (ms)
24 Vdc	17-28 Vdc	250 W	35
48 Vdc	34-53 Vdc	250 W	35
110-125 Vdc	77-138 Vdc	450 W	35
220-250 Vdc	154-275 Vdc	450 W	35
110-127 Vac	77-140 Vac	450 VA	35
208-240 Vac	146-264 Vac	450 VA	35

① Sustained for less than 35 ms

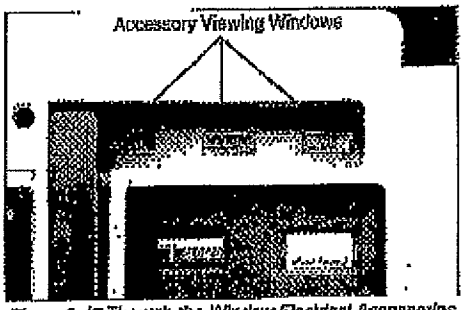

Figure 3-47 Through-the-Window Electrical Accessories

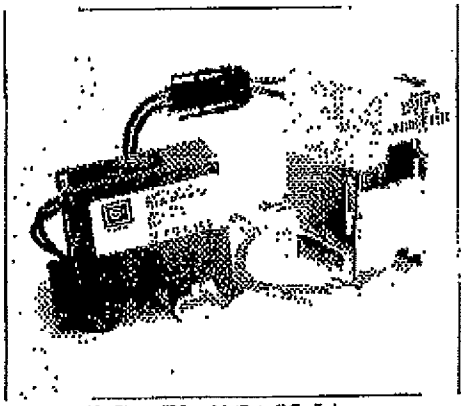

Figure 3-48 Shunt Trip with Cutoff Switch

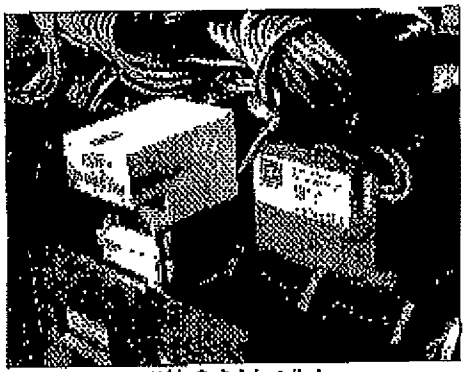

Figure 3-49 Shunt Trip Switch Installed

Spring Release - The spring release is an optional device (Figure 3-50). It remotely closes the circuit breaker when the coil is energized by a voltage input (Table 3.4). The closing spring must be fully charged and the trip latch reset (not held in the tripped position) for the SR to operate. If these two conditions are not met the close signal will be ignored until it is removed and re-applied.

An optional Latch Check Switch (LCS) can be installed to indicate when the circuit breaker is "ready to close". Two versions of the LCS are available.

The Latch Check Switch wired to the Spring Release will not permit activation of the Spring Release until the circuit breaker is fully charged and the trip latch is reset (Figure 3-50). If power is applied and maintained to the Spring Release, an activation will occur when the circuit breaker is "ready to close".

The Latch Check Switch for Remote Indication consists of 1 Form C contact wired to the circuit breaker secondary contacts for integration into external control schemes. Note that wiring the LCS for Remote Indication directly in series with the SR accessory is not recommended as this will override the "anti-pump" feature of the electrical charging/closing system.

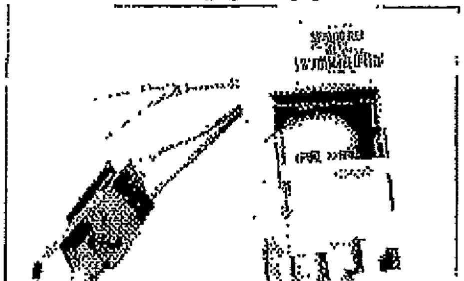

Figure 3-50 Spring Release with Optional Latch Switch

Table 3.4 Spring Release Ratings

Control Voltages	Operational Voltage Range 70-110%	Inrush Power Consumption ①	Closing Time (ms)
24 Vdc	17-26 Vdc	250 W	40
48 Vdc	34-53 Vdc	250 W	40
110-125 Vdc	77-138 Vdc	450 W	40
220-250 Vdc	154-275 Vdc	450 W	40
110-127 Vac	77-140 Vac	400 VA	40
208-240 Vac	146-264 Vac	450 VA	40

① Required for less than 200 ms

Undervoltage Release - The undervoltage release is an optional device on both manually and electrically operated circuit breakers (Figure 3-51). It opens the circuit breaker when its supply voltage falls to between 35-60% of rated voltage. If the release is not energized to 85% of its supply voltage, the circuit breaker cannot be closed electrically or manually (Table 3.5).

Auxiliary Switch - An auxiliary switch is an optional device providing remote electrical indication if the circuit breaker is open or closed (Figure 3-53). Up to 3 auxiliary switches can be mounted in the circuit breaker. Each switch has 2 normally open ("a") and 2 normally closed ("b") contacts for a total of 12 available contacts (Table 3.6).

Figure 3-51 Undervoltage Release

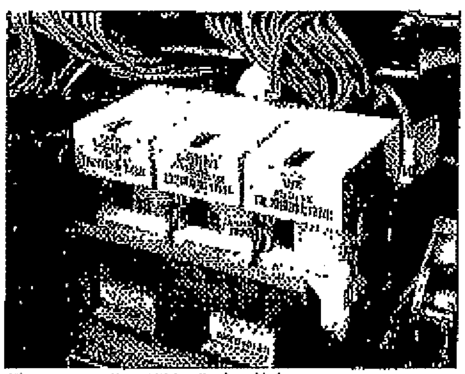

Figure 3-52 Shunt Trip, Spring Release and Undervoltage Release Installed

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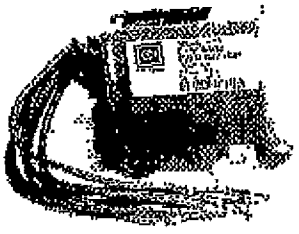

Figure 3-53 Auxiliary Switch (2A/2B)

Figure 3-54 Mechanical Trip Indicator with Associated Overcurrent Trip Switch

Table 3.6 Auxiliary Switch, Overcurrent Trip Switch and Cell Switch Contact Ratings

Control Voltages	Contact Rating Inductive Load (amperes)
250 Vac	10
125 Vdc	0.5
250 Vdc	0.25

3-8.2 INTERNAL ELECTRICAL ACCESSORIES

Other electrical accessories are mounted inside the circuit breaker. They can be factory or site installed. There are two different internally mounted accessories:

- Overcurrent Trip Switch (Bell Alarm)
- Motor Operator

Overcurrent Trip Switch (Bell Alarm) – An overcurrent trip switch (bell alarm) is an optional device (Figure 3-54). It provides an electrical indication when a circuit

Table 3.5 Undervoltage Release

Control Voltages	Operational Voltage Range 85-110%	Dropout Volts 30-60%	Inrush/Continuous Power Consumption	Opening Time (ms)
24 Vdc ①	20-26 Vdc	7-14 Vdc	250 W/15 W	70
32 Vdc ①	27-35 Vdc	10-19 Vdc	275 W/15 W	70
48 Vdc ①	41-53 Vdc	14-29 Vdc	275 W/15 W	70
110-125 Vdc ①	94-138 Vdc	33-75 Vdc	450 W/10 W	70
220-250 Vdc ①	187-275 Vdc	66-150 Vdc	450 W/10 W	70
110-127 Vac ②	94-140 Vac	38-78 Vac	450 VA/11 VA	70
208-240 Vac ②	177-264 Vac	62-144 Vac	400 VA/10 VA	70
380-415 Vac ②	323-457 Vac	114-249 Vac	480 VA/10 VA	70
480 Vac ②	408-528 Vac	144-288 Vac	460 VA/11 VA	70
600 Vac ②	510-660 Vac	180-360 Vac	480 VA/10 VA	70

① Required for 200 ms
② Required for 400 ms

breaker trips as a result of the trip unit reacting to an overcurrent condition. Opening as a result of a circuit breaker's manual open button, shunt trip or undervoltage release does not cause the overcurrent trip switch to operate. The overcurrent trip switch has (2a, 2b) Form C contacts (Table 3.6).

The status of the contacts changes when the trip indicator pops out. This permits the switch to be used as an alarm or in conjunction with a spring release to block a subsequent remote electrical closing signal.

Motor Operator - A Motor operator is an electric motor assembly internally mounted in the circuit breaker (Figures 3-55 and 3-56). It charges the closing springs electrically for remote or local operation. The motor operator can be factory or site installed (Table 3.7).

To convert a manually operated circuit breaker to an electrically operated circuit breaker, a UL listed motor operator kit is available.

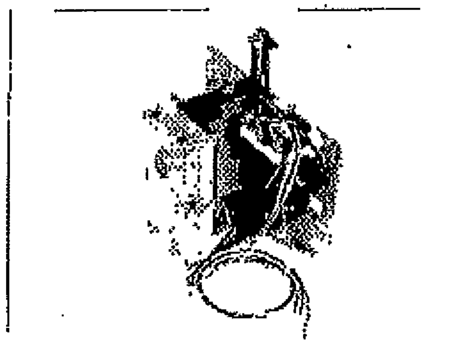

Figure 3-55 Motor Operator Kit

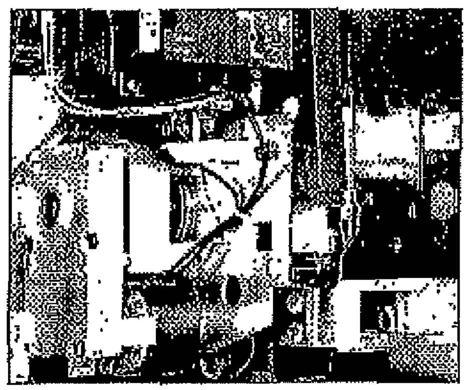

Figure 3-56 Motor Operator Installed in Narrow Frame Circuit Breaker

Table 3.7 Motor Operator

Control ① Voltages	Operational Voltage Range 85-110 %	Running Current (A avg.)	Typical Inrush Current	Power Consumption (watts or VA)	Maximum Charging Time (seconds)
24 Vdc	20-26	12.0	300% of Running	300	5
48 Vdc	41-53	6.0	500% of Running	250	5
110-125 Vdc	94-138	2.0	600% of Running	250	5
220-250 Vdc	187-225	1.0	600% of Running	250	5
110-127 Vac	94-140	2.0	600% of Running	250	5
208-240 Vac	177-264	1.0	600% of Running	250	5

① AC voltages are 50/60Hz

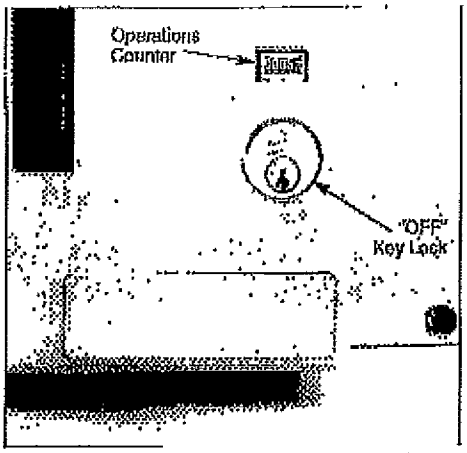

Figure 3-57 Cover Mounted Key Lock and Operations Counter

3-8.3 MECHANICAL ACCESSORIES

There are eight optional mechanical type accessories:

- Operations Counter
- Off Key Lock
- Cassette Lock
- Pushbutton Cover
- Prevent Close Cover
- Cassette Safety Shutters
- Cassette Cell Switch
- Door Escutcheon
- Waterproof Cover
- Mechanical Interlock

Operations Counter - The operations counter is a mechanical device used to provide a record of the number of circuit operations. It is mounted in the lower right portion of the circuit breaker and can be viewed through the front cover (Figure 3-57).

Off Key Lock - The off key lock secures the circuit breaker in the "OFF" position. It is mounted in the lower right portion of the circuit breaker and can be viewed through the front cover (Figure 3-57). The customer supplies the key lock. The provisions available are for Kirk, Castell or Ronis.

Cassette Lock - A cassette mounted lock can be used in conjunction with different interlocking schemes (such as main-tie-main) (Figure 3-58). The lock holds the circuit breaker trip-free in the connected position, preventing it from being closed.

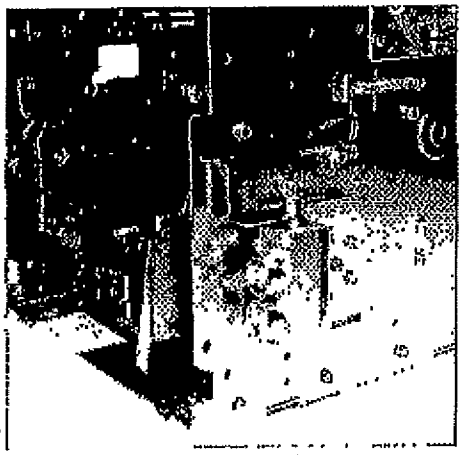

Figure 3-58 Cassette Mounted Key Lock

Up to three lock cylinders can be installed on one cassette. Cutler-Hammer supplies the lock provisions only. The customer is responsible for the locks, which can be Kirk or Castell.

Pushbutton Cover - Padlockable covers are available to limit access to the "ON" and "OFF" pushbuttons (Figure 3-59). They can be installed with either or both pushbutton covers in place.

Prevent Close Cover - All access to the "ON" pushbutton can be prevented by adding the fixed Prevent Close Cover to the pushbutton cover.

Lockout Cover - When padlocked, it maintains the "OFF" button in the actuated position which prevents closure of the breaker.

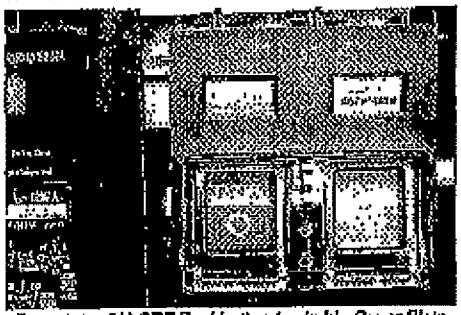

Figure 3-59 ON-OFF Pushbutton Lockable Cover Plate

Cassette Safety Shutters - Automatically operated insulating type safety shutters are available for use with the drawout cassette. When the drawout circuit breaker is levered from the CONNECT position, the shutters automatically close to cover the fixed primary contacts (Figure 3-60). When the circuit breaker is levered into the cassette, the shutters automatically open permitting primary connections to be made (Figure 3-61).

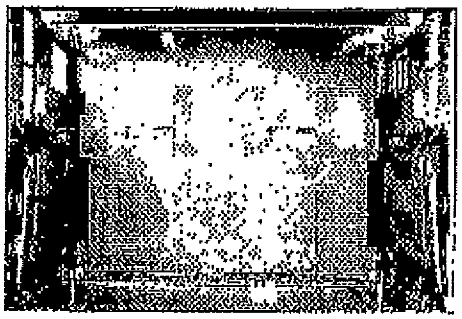

Figure 3-60 Typical Safety Shutters in Closed Position

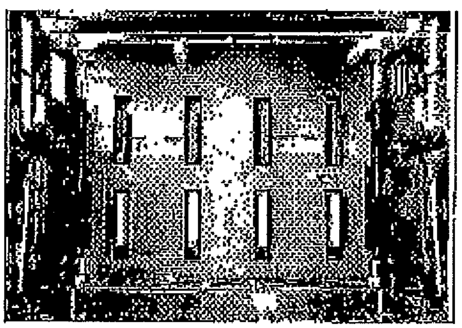

Figure 3-61 Typical Safety Shutters in Open Position

Cassette Cell Switch - The cassette cell switch is a compartment position switch for drawout circuit breakers. It is available in a 2a2b or 4a4b contact configuration, and mounts on the right side of the cassette (Figure 3-62 and 3-63). Refer to the Ratings Table 3.6 for cell switch contact information. The cell switch changes status between the TEST and CONNECT positions.

Door Escutcheon - The door escutcheon is a molded frame used to seal the space between the circuit breaker and the compartment door cutout. It is supplied with a mounting gasket (Figure 3-64).

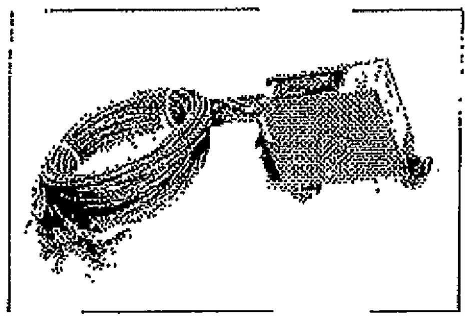

Figure 3-62 Cell Switch (Drawout Position Indicator) Unmounted

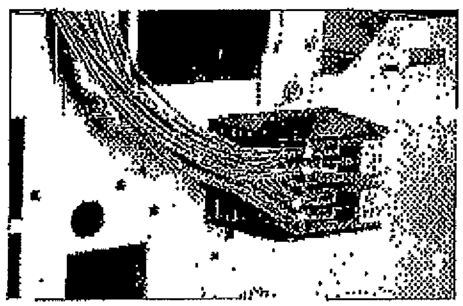

Figure 3-63 Cell Switches Mounted on Cassette

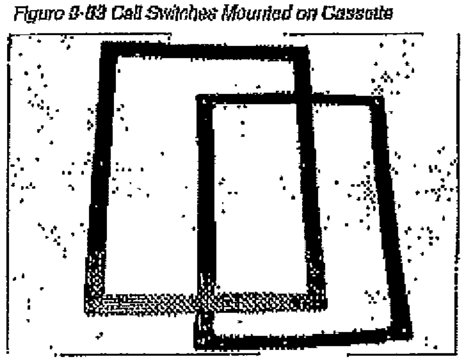

Figure 3-64 Door Escutcheon and Gasket

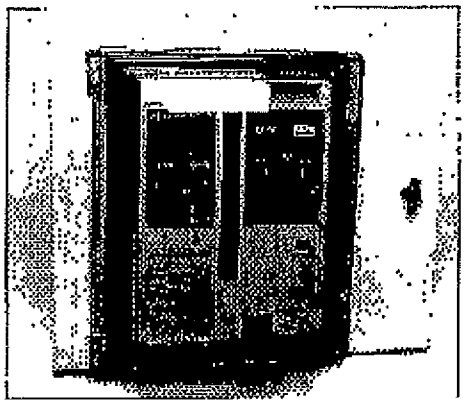

Figure 3-65 IP54 Waterproof Cover

IP54 Waterproof Cover – A hinged dome shaped waterproof cover attaches to the metal compartment door to provide waterproof protection for the circuit breaker (Figure 3-65).

Mechanical Interlock – A family of mechanical interlocks are available to interlock the closing of two or three Magnum circuit breakers. The mechanical interlock holds one or more circuit breakers tripped (prevents closure) when others are closed. A lever assembly is mounted on each breaker which interfaces with the pole shaft and the tripper bar. The lever assemblies are interconnected with either cables or rods, depending upon the relative orientation of the breakers. Rods can be used only when the circuit breakers to be interlocked are vertically stacked. Cables can be used for any orientation of the breakers. Mechanical interlocks are available for both fixed and drawout circuit breakers and in both 2-way and 3-way versions. An illustration of a 2-way cable interlock mounted on two drawout circuit breakers is shown in Figure 3-66.

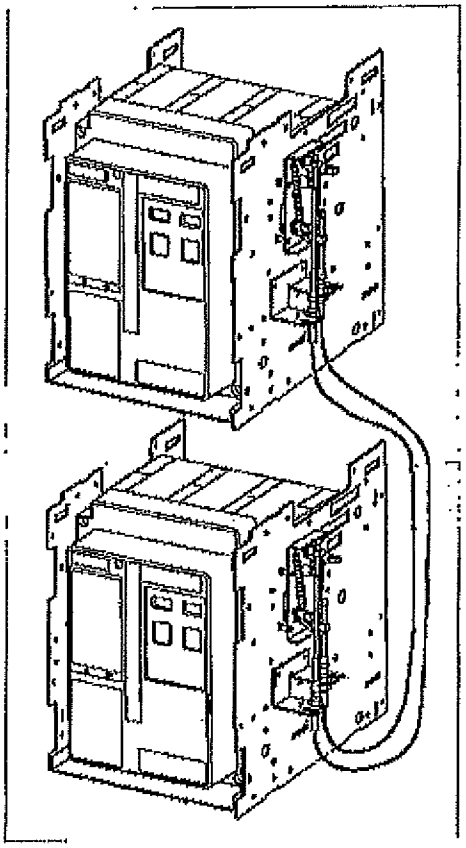

Figure 3-66 Cassette-Mounted 2-Way Cable Interlock

3-9 MDSL LIMITERS/BLOWN LIMITER INDICATION

An overall description of Magnum DSL circuit breakers was provided in sections 3-1 and 3-1.1. More detailed information is provided here relative to application, current limiters and blown limiter indication.

If current limiters are sized in keeping with Table 3.8 recommendations, the circuit breaker will function and interrupt routine fault currents. Infrequent high faults are cleared by the limiters. The limiters protect the circuit breaker on faults above the rating of the breaker. The limiters will blow below the circuit breaker short-time rating, if the fault currents equal the system maximum capacity.

In some applications the current limiters are sized smaller than necessary for protection of the MDSL circuit breaker in order to provide protection from downstream equipment. When this is done, the current limiter will blow on fault currents which could have been satisfactorily interrupted by the basic circuit breaker.

3-9.1 MDSL CURRENT LIMITERS

Do not replace limiters with sizes other than permitted by Table 3.8. MDSL current limiters have been tested and approved by Underwriters Laboratories, Inc. for use in MDSL circuit breakers when applied according to Table 3.8. They are not electrically or physically interchangeable with current limiting fuses of any other design.

The current limiters are held in place in an extension provided on the back of the circuit breaker (Figure 3-67). This extension makes the circuit breaker six inches deeper than the corresponding Magnum DS circuit breaker. The current limiters can only be removed from the circuit breaker and replaced when the MDSL circuit breaker is removed from its associated compartment. For this reason there is no fixed mounted version of the MDSL circuit breaker.

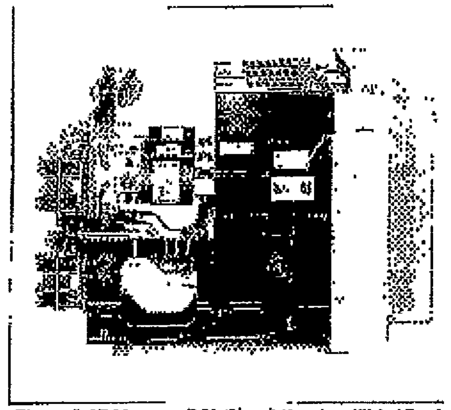

Figure 3-67 Magnum DSL Circuit Breaker (Side View)

3-9.2 BLOWN LIMITER SENSING

The blown limiter indicator provides a visual indication on the front of the MDSL circuit breaker when a current limiter in any phase has interrupted a short circuit. It is the visual element of the circuit that insures that the circuit breaker will be tripped when any current limiter has blown. This prevents single phase power from being applied to a three-phase load.

The indicator itself is a red pop out button located on the lower left portion of the breaker's front cover (Figure 3-68). A transformer is connected in parallel with the limiter. When a limiter is blown, the resulting voltage across the open limiter energizes the transformer. The transformer feeds a PC board to provide an output to the direct trip actuator to trip the circuit breaker, and an output to the indicator causing the button to pop out.

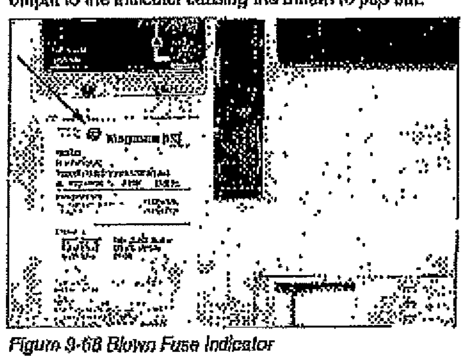

Figure 3-68 Blown Fuse Indicator

Table 3.8 MDSL Integral Current Limiter Selection (for Optimal Performance and Highest Fault Levels)

Magnum DSL Breaker Continuous Current Frame Rating (Amperes) ① 800	1200	1600	2000	Sensor & Rating Plug (I_n)	Available MDSL Current Limiters ② Minimum ③	Recommended ④	Maximum ⑤	Other Available Sizes (in addition to minimum, recommended and maximum sizes)					
MDSL08	MDSL12	MDSL16		200	MA200	MA600	MD3000	MA300	MA400	MA800	MB1200	MB1600	MB2000	MD2500
MDSL08	MDSL12	MDSL16		250	MA400	MA800	MD3000	MA600	MB1200	MB1600	MB2000	MD2500		
MDSL08	MDSL12	MDSL16		300	MA400	MA800	MD3000	MA600	MB1200	MB1600	MB2000	MD2500		
MDSL08	MDSL12	MDSL16		400	MA600	MB1200	MD3000	MA800	MB1600	MB2000	MD2500			
MDSL08	MDSL12	MDSL16		600	MA800	MB2000	MD3000	MB1200	MB1600	MD2500				
MDSL08	MDSL12	MDSL16		800	MB1200	MD2500	MD3000	MB1600	MB2000					
	MDSL12	MDSL16		1000	MB1600	MD2500	MD3000	MB2000						
	MDSL12	MDSL16		1200	MB2000	MD2500	MD3000							
		MDSL16	MDSL20	1600	MD3000	MD3000	MD3000							
			MDSL20	2000 ⑥	MD3000 ⑥	MD3000 ⑥	MD3000 ⑥							

① Select the Magnum breaker frame, then the current sensor and rating plug, and finally the current limiter. Current limiters are mounted integral to the breaker. Refer non-automatic MDSL breaker application requests to Eaton/Cutler-Hammer

② Refer to MDSL current limiter curves for let-through and time characteristics.

③ The minimum selection provides the lowest current let-through, but trip unit settings must be considered to avoid nuisance operation.

④ The recommended selection avoids nuisance limiter operation and allows for system coordination within the trip unit settings while minimizing let-through.

⑤ The maximum selection provides the maximum system coordination with let-through characteristics per the limiter selected.

⑥ Used sizes applied be sophisticated with current limiters on this breaker rating.

SECTION 4: DRAWOUT CIRCUIT BREAKER AND CASSETTE

4-1 GENERAL

Section 3 discussed topics and features common to all Magnum circuit breakers, no matter what the mounting configuration or type (drawout or fixed, MDS, MDSX or MDSL). In this section, features unique to the drawout type circuit breaker and drawout cassette, not covered elsewhere, are discussed. Section 5 covers features unique to MDS and MDSX fixed type circuit breakers only. Drawings and dimensions associated with all circuit breakers, drawout cassettes and any appropriate primary bus connections can be found in a separate document entitled *Engineering Data TD01301004E*. The installation and levering of a drawout circuit breaker were discussed in Section 2. If necessary, review that information, since it will not be repeated here.

4-1.1 DRAWOUT CASSETTE

A drawout circuit breaker is used in combination with a fixed drawout cassette (Figures 4-1 and 4-3); the drawout circuit breaker is equipped with automatic primary disconnects (Figure 4-2). The cassette provides all of the necessary interfaces to the drawout circuit breaker including automatic primary and secondary connections. For the MDS narrow frame circuit breaker a single cassette style using horizontal stabs and horizontal customer bus bar terminals is available (Figure 4-4). For the MDS and MDSX standard and double-wide circuit breakers three cassette styles, all with vertical stabs, are available: basic, standard, and universal. The standard cassette supplies vertical stab/terminals only (Figure 4-5). The basic cassette omits the copper stab/terminals so that these pieces can be integrated with vertical bus bars provided by the switchgear builder (Figure 4-6). The universal cassette provides a set of flat pad terminals on the rear of the cassette that can be adapted to vertical, horizontal or front connection (Figures 4-7). The MDSL circuit breaker with integral current limiters is six inches deeper than the MDS or MDSX circuit breaker and utilizes a cassette similar to the MDS and MDSX standard type cassette except six inches deeper (Figure 4-8 and 4-9). Mounting locations for cell (TOC) switches, safety shutters, mechanical interlocks and key interlocks are provided on the cassette.

Figure 4-1 MDS/MDSX Drawout Circuit Breaker in Cassette

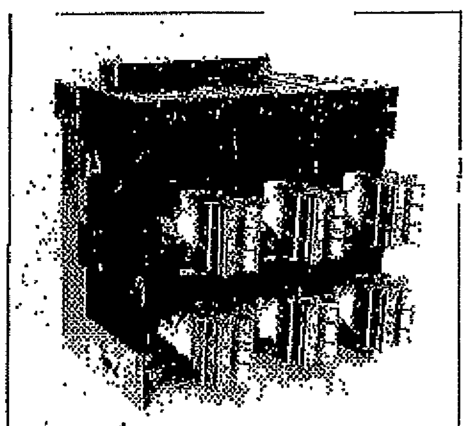

Figure 4-2 MDS/MDSX Drawout Circuit Breaker with Automatic Primary Disconnects

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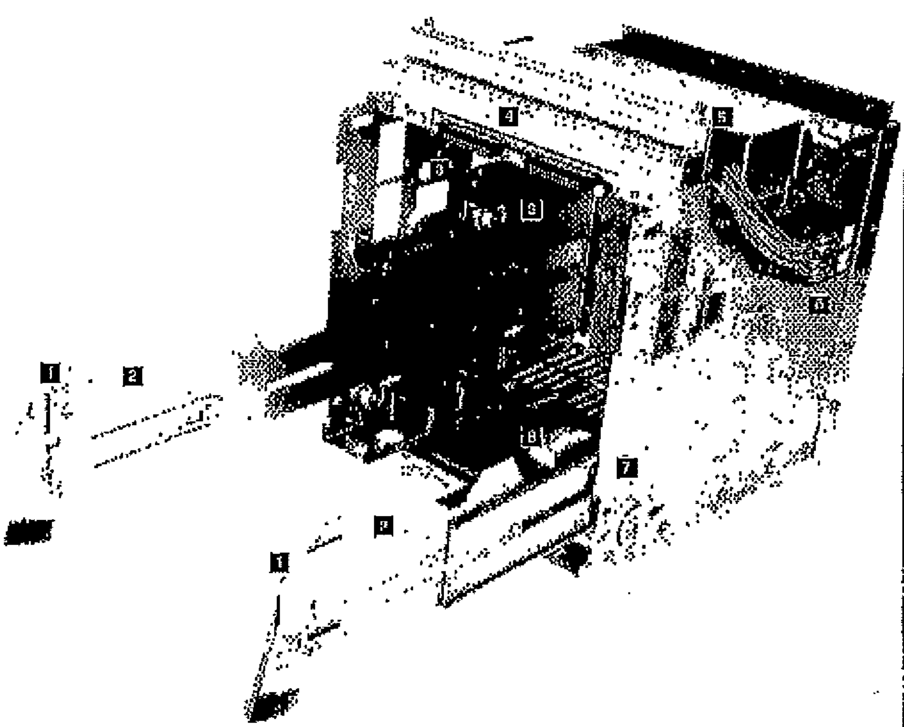


1 Extension Rails
2 Extension Rail Cutout
3 Secondary Plug-in Connectors
4 Secondary Terminal Blocks
5 Arc Hood
6 Optional Cell (TOC) Switch Mounting
7 Optional Key Interlock Mounting Location
8 Grounding Bar

Figure 4-3 Typical Drawout Cassette Features

4-2 DRAWOUT CIRCUIT BREAKER DIMENSIONS

The Magnum drawout circuit breaker connects to the fixed primary stabs of the drawout cassette through the primary finger clusters attached to the rear of the circuit breaker. Three different frame sizes cover all Magnum circuit breakers from an overall dimensional standpoint. Circuit breaker drawings can be found in *Engineering Data TD01301004E.*

4-3 DRAWOUT CASSETTE DIMENSIONS

Cassette drawings provide all the dimensional information required for all mounting configurations and can also be found in *Engineering Data TD01301004E.* Review carefully for a specific installation.

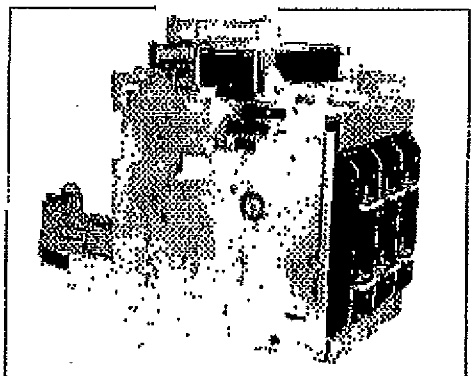


Figure 4-4 Typical MDS Narrow Frame Cassette (Horizontal Terminals)

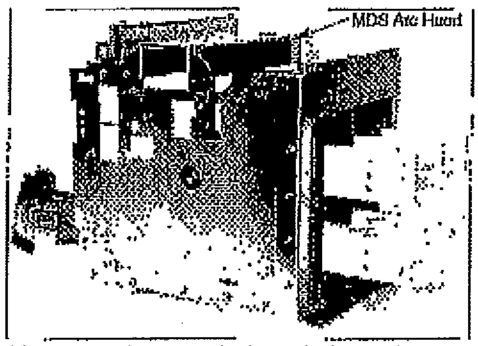


Figure 4-5 Typical MDS /MDSXStandard Cassette (Vertical Terminals) (Shown with MDS Type Arc Hood)

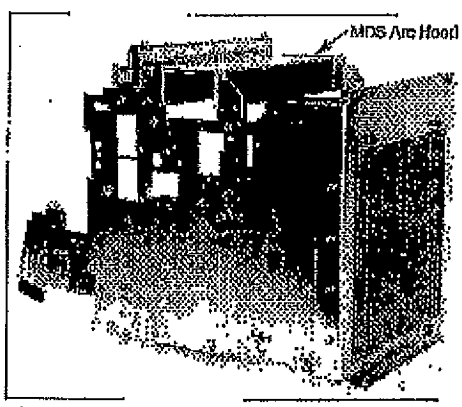


Figure 4-6 Typical MDS/MDSX Basic Cassette (Without Stabs) (Shown with MDS Type Arc Hood)

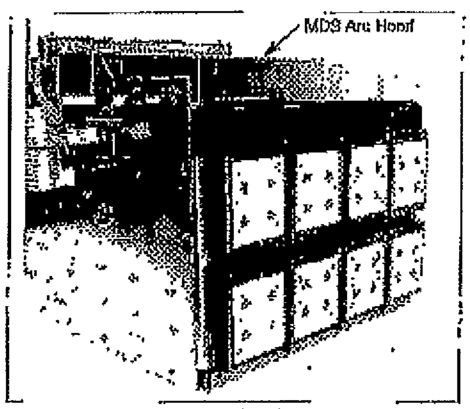


Figure 4-7 Typical MDS/MDSXUniversal Cassette, 4-Pole (Flat Terminal Pads) (Shown with MDS Type Arc Hood)

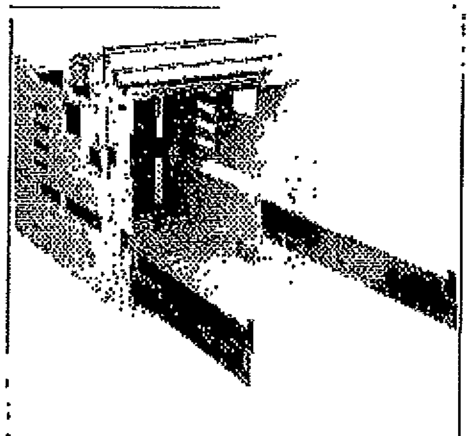


Figure 4-8 Typical MDSL Standard Cassette (Front View)

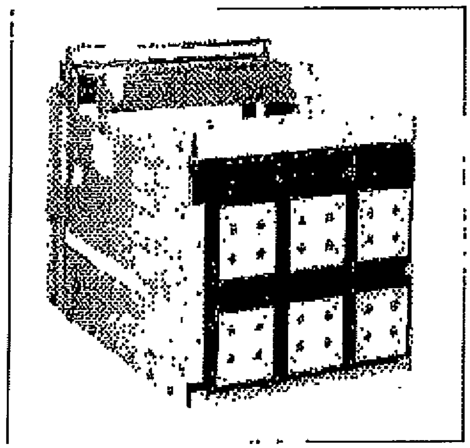
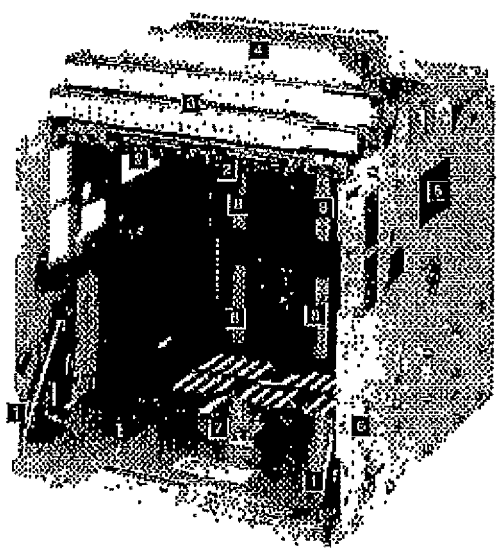


Figure 4-9 Typical MDSL Standard Cassette (Rear View)



1. Extension Rails
2. Secondary Plug-in Connectors
3. Secondary Terminal Blocks
4. Arc Hood
5. Optional Cell (TOC) Switch Location
6. Optional Key Interlock Location
7. Grounding Bar
8. Fixed Primary Connections

Figure 4-10 Typical MDSX Type Drawout Cassette

SECTION 5: FIXED CIRCUIT BREAKER

5-1 GENERAL

Section 3 discussed topics and features common to all Magnum circuit breakers, no matter what the mounting configuration or type. In this section, features unique to the fixed configuration (MDS/MDSX only) not covered elsewhere are covered. Drawings and dimensions associated with all fixed circuit breakers and any appropriate primary bus connections can be found in a separate document entitled *Engineering Data TD012D1004E*. The installation of a fixed circuit breaker was discussed in Section 2. If necessary, review that information, since it will not be repeated here.

WARNING

FAILURE TO COMPLY WITH INSTALLATION OF THE FIXED MOUNTED MDSX ARC HOOD ASSEMBLY COULD RESULT IN EQUIPMENT DAMAGE, BODILY INJURY OR EVEN DEATH.

The MDSX fixed mounted breaker is shipped with a factory installed arc hood assembly. This assembly is required to be installed on the top of the breaker prior to the unit being placed in service.

5-2 FIXED CIRCUIT BREAKER DIMENSIONS

The standard fixed circuit breaker is supplied with horizontally mounted primary connections (Figure 5-1). Optional vertical primary adaptors are available for different bus configurations. Refer to *Engineering Data TD012D1004E* for fixed circuit breaker dimensions, vertical adaptor dimensions and vertical adaptor assembly details.

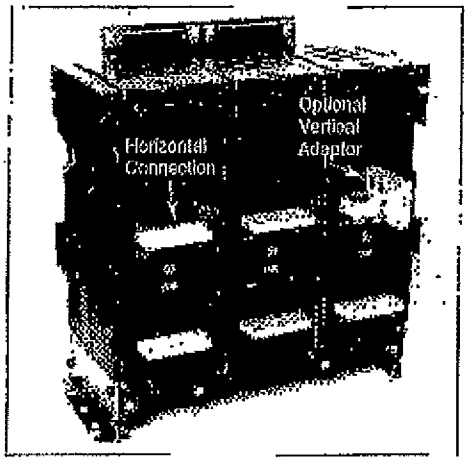


Figure 5-1 Fixed MDS/MDSX Circuit Breaker with Available Vertical Adaptor

SECTION 6: INSPECTION AND MAINTENANCE

6-1 GENERAL

WARNING

FAILURE TO INSPECT, CLEAN AND MAINTAIN CIRCUIT BREAKERS CAN REDUCE EQUIPMENT LIFE OR CAUSE THE EQUIPMENT NOT TO OPERATE PROPERLY UNDER FAULT CONDITIONS. THIS COULD RESULT IN EQUIPMENT DAMAGE, BODILY INJURY OR EVEN DEATH.

CAUTION

INSPECTION AND MAINTENANCE PROCEDURES SHOULD BE CARRIED OUT ONLY BY PERSONNEL FAMILIAR WITH THE HAZARDS ASSOCIATED WITH WORKING ON POWER CIRCUIT BREAKERS. ADDITIONALLY, THEY SHOULD BECOME FAMILIAR WITH THE SPECIFICS ASSOCIATED WITH TYPE MAGNUM DS CIRCUIT BREAKERS AS PRESENTED IN THIS INSTRUCTION BOOK.

Magnum Circuit Breakers are "Top of the Line" equipment. This means they are manufactured under a high degree of quality control, with the best available materials and with a high degree of tooling for accuracy and parts interchangeability. Design tests and actual installation experience show them to have durability well beyond minimum standards requirements. However, because of the variability of application conditions and the great dependance placed upon these circuit breakers for protection and the assurance of service continuity, inspection and maintenance activities should take place on a regularly scheduled basis.

Since maintenance of these circuit breakers consists mainly of keeping them clean, the frequency of scheduled inspection and maintenance depends to some degree on the cleanliness of the surroundings. Cleaning and preventive measures are a part of any good maintenance program. Plant operating and local conditions can vary to such an extent that the actual schedule should be tailored to the conditions. When the equipment is subject to a clean and dry environment, cleaning is not required as frequently as when the environment is humid with a significant amount of dust and other foreign matter.

It is recommended that maintenance record sheets be completed for the equipment. Careful and accurate documentation of all maintenance activities provides a valuable historical reference on equipment condition over time.

6-2 GENERAL CLEANING RECOMMENDATIONS

Circuit breaker cleaning activities should be a part of an overall activity that includes the assembly in which the circuit breaker is installed. Loose dust and dirt can be removed from external surfaces using an industrial quality vacuum cleaner and/or lint free cloth. Unless otherwise indicated, never use high pressure blowing air, since dirt or foreign objects can be driven into areas, such as the breaker mechanism, where additional insulation sources could create problems. Never use a wire brush to clean any part of the circuit breaker.

6-3 WHEN TO INSPECT

Do not wait for specific scheduled periods to visually inspect the equipment, if there are earlier opportunities. If possible, make a visual inspection each time a circuit breaker compartment door is opened, and especially when a circuit breaker is withdrawn on its compartment extension rails. This preventive measure could help to avoid future problems.

Industry standards for this type of equipment recommend a general inspection and lubrication after the number of operations listed in Table 6.1 of this section. This should also be conducted at the end of the first six months of service, if the number of operations has not been reached.

Table 6.1 Inspection Frequency

Breaker Frame Size	Interval ① (Breaker Cycles)
800 amperes and below	1750
Between 800 and 3000 amperes	500
3000 amperes and above	250

① Breaker Cycle one no load open/close operation

After the first inspection, inspect at least once a year. If these recommended inspections show no maintenance requirements, the period may be extended to a more economical point. Conversely, if the recommended inspection shows, for instance, a heavy accumulation of dirt or other foreign matter that might cause mechanical, insulation or other electrical damage, the inspection and maintenance interval should be decreased.

8-4 WHAT TO INSPECT

What to inspect and to what extent is dictated by the nature of the maintenance function. Routine inspections require one type of observation. Inspections following a known high level fault require more detailed inspections.

A drawout type circuit breaker should first be withdrawn from its compartment onto the compartment's extension rails. When the inspection is complete, the circuit breaker can be levered to the TEST position to check the electrical operations of the circuit breaker. During the levering out and levering in of the circuit breaker, be aware for any signs that would indicate that this process is not working properly.

During the inspection of fixed type circuit breakers, bus systems supplying the fixed circuit breakers should be de-energized for convenience and safety.

For functional testing of the trip unit, refer to the separate detailed instruction book dedicated to the trip unit.

Once the circuit breaker has been cleaned as described in paragraph 8-2, visually inspect it for any signs of damage, missing or loose parts and unusual wear. Be especially alert for foreign matter that must be removed. On drawout circuit breakers, inspect the primary disconnect finger clusters for signs of wear and erosion. Make appropriate corrections to anything found out of order.

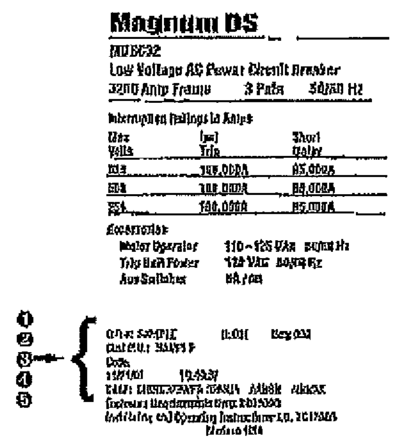
8-4.1 FUNCTIONAL FIELD TESTING

NOTICE

Before doing any work on drawout type circuit breakers, make sure the breaker is levered out to the TEST or DISCONNECT position. During the levering out and levering in of the circuit breaker, be aware of any signs that would indicate that the levering process is not working properly. If working on a fixed circuit breaker, bus systems should be de-energized for convenience and safety. The circuit breaker should be switched to the OFF position and the mechanism springs discharged.

Eaton Cutler-Hammer recommends that the following functional tests be performed on Magnum circuit breakers as part of any maintenance procedure. The circuit breaker should be removed from service and Cutler-Hammer notified if the circuit breaker fails to perform any of these tests successfully. Please be prepared to provide the number of operations the circuit breaker has to date as well as the following nameplate information:

① G.O.#: It: Seq: ③ Code:
② Cust. P.O.: ④ Date of Manufacture
⑤ Cat#:



Manual Operation Functional Test

Charge the breaker mechanism springs either using the charging handle or the motor operator. Press the ON pushbutton to close the breaker manually and verify closing by noting the state of the indicating flag. Charge the breaker mechanism springs either using the charging handle or the motor operator. If using the motor operator, disconnect power to it to prevent automatic recharging. Press the OFF pushbutton to manually open the breaker. Press the ON pushbutton to manually close the breaker. Is the breaker closed? Press the OFF pushbutton to manually open the breaker. Is the breaker open? Repeat this entire described test procedure three times.

Electrical Operation Functional Test

This test procedure is based on the assumption that the breaker is equipped with optional shunt trip and spring release accessories. If one accessory is missing, substitute the manual button to replace the accessory's function.

Charge the breaker mechanism springs either using the charging handle or the motor operator. Close the breaker by applying rated voltage to the spring release accessory and verify closing by noting the state of the indicating flag. Charge the breaker mechanism springs either using the charging handle or the motor operator. If using the motor operator, disconnect power to it to prevent automatic recharging. Open the breaker by applying rated voltage to the shunt trip accessory. Close the breaker using the spring release accessory. Is the breaker closed? Open the breaker using the shunt trip accessory. Is the breaker open? Repeat this entire described test procedure three times.

Trip Unit Overload Functional Test

This test uses the Digitrip 1150 self test function, the Digitrip Test Kit or the handheld Magnum Functional Test Kit. Review test kit instructions for the trip unit. Instruction leaflet 5720B55, section 1.2 or 1.3 applies for instantaneous test procedures or paragraph 5.2.1 "1150 Self Testing, Trip Mode" in the trip unit instruction leaflet 70C1036.

Charge the breaker mechanism springs either using the charging handle or the motor operator. Press the ON pushbutton to close the breaker manually and verify closing by noting the state of the indicating flag. Charge the breaker mechanism springs either using the charging handle or the motor operator. If using the motor operator, disconnect power to it to prevent automatic recharging. Trip the breaker with a trip unit test. Verify that the trip indicator pop out button (if so equipped) is "out" and then reset it. Press the ON pushbutton to manually close the breaker. Is the breaker closed? Trip the breaker with a trip unit test. Verify that the trip indicator pop-out button (if so equipped) is "out" and then reset it. Repeat this entire described test procedure three times. Reset the blinking red cause of trip LED on the trip unit by pressing the Reset/Battery Test pushbutton.

6-4.2 ARC CHUTE INSPECTION

When a circuit breaker experiences a high level fault or during regularly scheduled maintenance periods, the circuit breaker's arc chutes and arc chambers should be inspected for any kind of damage or dirt. Be especially alert for signs of significant erosion of the V-shaped plates inside the arc chute.

Arc chutes fit inside the arc chambers and down over a the primary contacts. Each arc chute is held in place by either 1 (MDS) or 4 (MDSX) top inserted screws (Figure 6-1 shows MDS). Begin by removing the arc chute screws and all three arc chutes. Turn each arc chute upside down to visually inspect the inside (Figure 6-2).

Since the arc chutes are removed, this is an ideal time to inspect primary contacts for wear using the circuit breaker's contact wear indicators. The details associated with primary contact inspection are presented in the next paragraph.

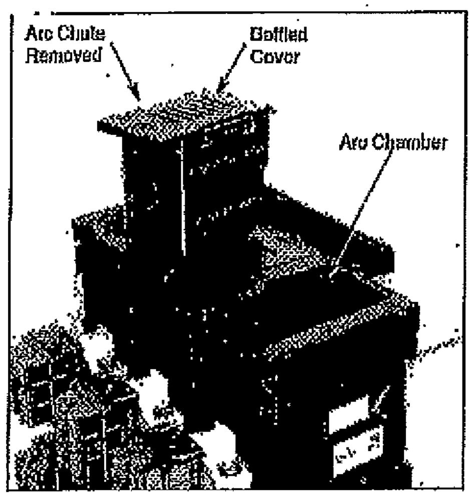


Figure 6-1 Top Rear View of Circuit Breaker with One Arc Chute Removed

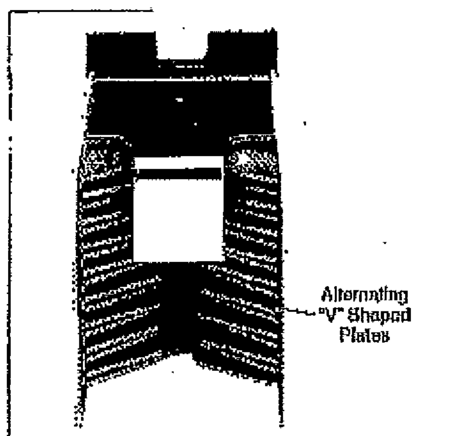


Figure 6-2 Bottom View of Arc Chute

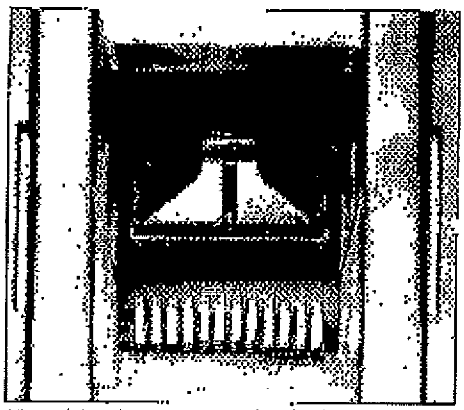


Figure 6-3 Primary Contacts with Circuit Breaker Open (Not Used for Contact Wear Inspection)

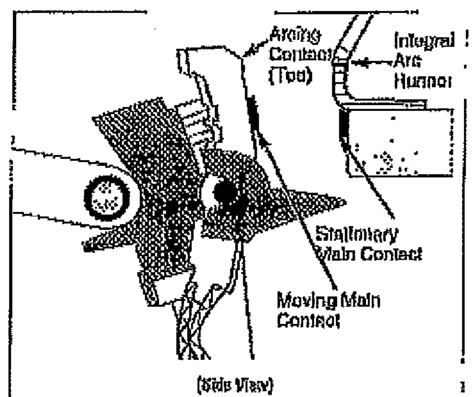


Figure 6-4 Contact Inspection Area with Circuit Breaker Open

⚠ WARNING

ARC CHUTES MUST ALWAYS BE SECURED PROPERLY IN PLACE BEFORE A CIRCUIT BREAKER IS INSTALLED IN A CIRCUIT BREAKER COMPARTMENT. FAILURE TO DO THIS COULD RESULTS IN EQUIPMENT DAMAGE, BODILY INJURY OR EVEN DEATH.

When the inspections are complete, position each arc chute down over its respective set of primary contacts, and secure in place with the screw removed earlier. Torque the arc chute screws to 35 to 45 in-lb.

6-4.3 PRIMARY CONTACT INSPECTION

With the arc chutes removed, visually inspect each primary contact structure for signs of wear and/or damage. The primary contacts with the circuit breaker open can be viewed by looking directly down into the arc chamber (Figure 6-3 and 6-4).

A contact wear indicator is provided for each primary contact and indicates whether or not the contact should be replaced. Inspection of the contacts using the contact wear indicators is conducted only with the circuit breaker closed (Figures 6-5).

NOTICE

When making a contact wear inspection, always make the inspection by looking straight down into the arc chamber for the proper perspective. Viewing the contact wear area from an angle could distort the view.

The contact wear indicator is the relative position of the individual contact fingers to a narrow, side-to-side ledge inside the arc chamber. The ledge is actually part of the arc chamber. When the circuit breaker is closed and the contacts are in good condition, the narrow ledge is covered by the back end of the contacts (Figure 6-5). If the back end of the contacts do not totally cover the ledge, the contacts should be replaced.

⚠ WARNING

ARC CHUTES MUST ALWAYS BE SECURED PROPERLY IN PLACE BEFORE A CIRCUIT BREAKER IS INSTALLED IN A CIRCUIT BREAKER COMPARTMENT. FAILURE TO DO THIS COULD RESULTS IN EQUIPMENT DAMAGE, BODILY INJURY OR EVEN DEATH.

Once the inspection is complete, be sure the arc chutes are properly replaced as previously described in paragraph 6-4.1.

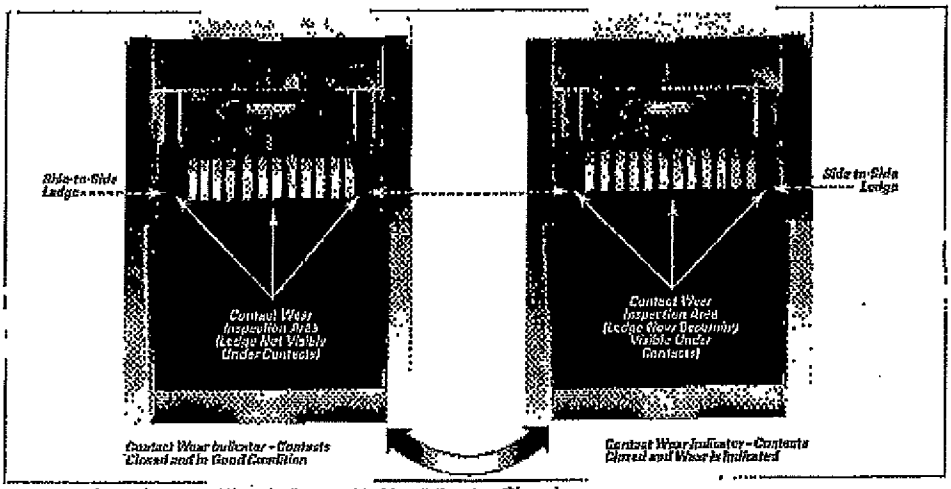


Figure 6-5 Use of Contact Wear Indicator with Circuit Breaker Closed

6-6 CIRCUIT BREAKER MODIFICATIONS AND CHANGES

The topics discussed here will relate to those actions that can be taken in the field to change, update, maintain or repair a Magnum circuit breaker. This information does not, however, include most accessory devices. Their installation is covered by separate instruction leaflets dedicated to the individual devices. The tasks described here do not, under ordinary circumstances, require any assistance beyond the appropriate instructional material. If further assistance is required, however, contact your Cutler-Hammer representative.

6-6.1 RATING PLUG REPLACEMENT

NOTICE

If a rating plug is not installed in the trip unit, the trip unit will trip when energized. Also remember that the trip unit's rating plug and the circuit breaker's current sensors must have matching ratings.

To remove the rating plug from the trip unit, open the small rating plug door located on the right side of the trip unit (Figure 6-6). The trip unit's battery cavity is also located behind this door. Use a 1/8" wide screwdriver to remove the M4 screw holding the rating plug in position. Pull the door to release the rating plug from the trip unit.

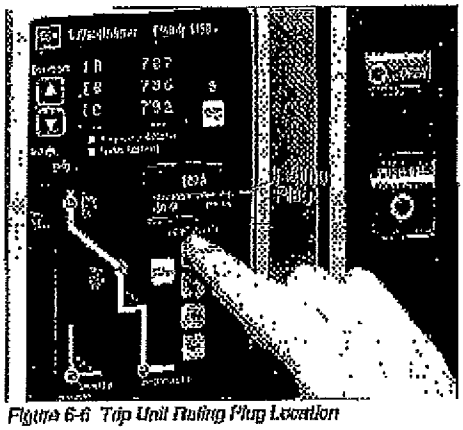


Figure 6-6 Trip Unit Rating Plug Location

To install a new rating plug, insert the rating plug into the cavity where the other rating plug was removed. Make sure the three pins on the rating plug are aligned with the sockets in the cavity. The rating plug should fit with a slight insertion force.

CAUTION

TO PREVENT DAMAGE TO THE RATING PLUG, DO NOT FORCE IT INTO THE MOUNTING CAVITY.

Use the same 1/8" screwdriver to tighten the M4 screw and secure the rating plug in the trip unit. The maximum torque on the mounting screw is 15 in-oz. Close the rating plug door.

6-5.2 CURRENT SENSOR REPLACEMENT

NOTICE

Remember that the trip unit's rating plug and the circuit breaker's current sensors must have matching ratings.

The three current sensors are installed at the rear of the circuit breaker on the lower terminals. A cover with sensor rating viewing windows covers the sensors and is held in place with screws (Figure 6-7). Remove the cover by removing the screws.

If the circuit breaker is a drawout configuration, the lower primary disconnect finger clusters and the vertical adaptors must first be removed from frame sizes up to 3000/3200A. On the 3000/3200A frame, both the upper and lower primary disconnects and vertical adaptors must be removed. Each primary disconnect finger cluster is removed by loosening the two hex-head bolts with a 10 mm wrench. These bolts do not have to be completely removed to slide the primary disconnects off of the terminals. Remove the vertical adaptors next from the circuit breaker terminals by removing the two or three 10 mm bolts holding them in place (Figure 6-8).

The current sensors are removed by pulling them off of the terminals and unplugging the wiring plugs from the sensors (Figure 6-8).

Install new current sensors by connecting the wiring plugs to the sensors and sliding the sensors over the terminals. Reinstall the cover over the sensors and secure in place with the screws previously removed.

Reinstall the previously removed vertical adaptors to the terminals using the removed hardware and 40 ft-lb of tightening torque. Make sure the vertical adaptors are square to the rear housing. Slip the primary disconnects on to the vertical adaptors. Make sure the primary disconnects are fully inserted on to the vertical adaptors. Tighten the two retention bolts to 40 in-oz of torque. Properly engaged and secured retention bolts should engage the slots or holes in the vertical adaptors.

Figure 6-7 Current Sensor Cover in Place Over Sensors

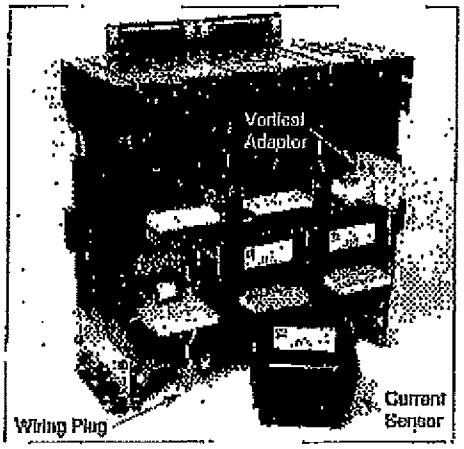


Figure 6-8 One Current Sensor Shown Removed and Disconnected

6-5.3 CURRENT LIMITER REPLACEMENT (MDSL)

NOTICE

Do not replace limiters with sizes other than permitted by Table 3.8. MDSL current limiters have been tested and approved by Underwriters Laboratories, Inc. for use in MDSL circuit breakers when applied according to Table 3.8. They are not electrically or physically interchangeable with current limiting fuses or any other design.

The current limiters are held in place in an extension provided on the back of the circuit breaker (Figure 6-9). They can only be removed from the circuit breaker and replaced when the MDSL circuit breaker is removed from its associated compartment.

6-5.3.1 REPLACING TYPE MA AND MB CURRENT LIMITERS

The Type MA and MB current limiters have a single hole in each end blade for attaching the limiters to the breakers. Removal of the limiters is easily accomplished by simply removing the hardware.

Replacement of limiters should be performed as follows:

Note: Replace the center phase limiter first.

Step 1: Place the Belleville washer on the hex head bolt such that the dome of the washer is towards the head of the bolt.
Step 2: Place a flat washer on next.
Step 3: Place each of these hardware assemblies through the holes in the limiter end blades, and put one end through the center hole of the breaker's fixed horizontal primary terminal. The other end attaches to the center hole on the rear stab.
Step 4: Place a lockwasher and a hex nut onto each bolt and tighten by hand.
Step 5: The first bolt to torque is the one attaching the limiter to the breaker's fixed, horizontal, primary terminal (torque to 40 ft-lbs).
Step 6: Torque the remaining bolt to 40 ft-lbs.

6-5.3.2 REPLACING TYPE MD CURRENT LIMITERS

Type MD current limiters have three holes in each of the end blades for attaching the limiters to the breakers. Removal of the limiters is easily accomplished by simply removing the hardware.

Replacement of limiters should be performed as follows:

Note: Replace the center phase limiter first.

Step 1: Place the Belleville washer on the hex head bolt such that the dome of the washer is towards the head of the bolt.
Step 2: Place a flat washer on next.
Step 3: Place three of these hardware assemblies through the holes in one of the limiter end blades, and put this end blade on the breaker's fixed horizontal primary terminal. These three bolts can be threaded into the nut plate that was originally installed and tighten by hand. The other end of the limiter will attach to the rear stab.
Step 4: Put the remaining three bolt assemblies through the holes in the other end blades and secure them with lockwashers and hex nuts. Hand tighten only.
Step 5: First torque the bolts attaching the limiter to the breaker's fixed, horizontal, primary terminal (torque to 40 ft-lbs).
Step 6: Torque the remaining bolts to 40 ft-lbs.
Step 7: Install the phase barriers between the limiters.

6-5.3.3 REPLACING TYPE MD CURRENT LIMITERS ON MDSL20 BREAKERS

Replacement of MD limitors on the MDSL20 circuit breaker is exactly the same as previously described in Paragraph 6-5.3.2, except that the heat sinks (Figure 6-9) must be installed with the bolt assemblies on each of the breaker's fixed, horizontal, primary terminals.

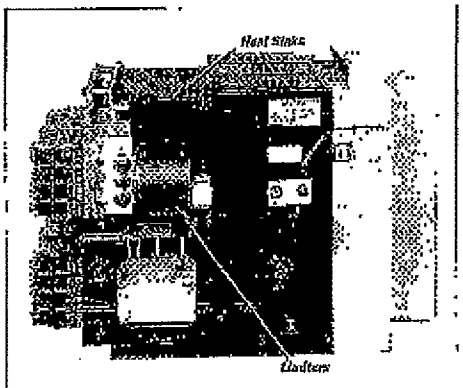


Figure 6-9 MD Limiters Shown Mounted in Extension

SECTION 7: TROUBLESHOOTING

7-1 INTRODUCTION

Table 7.1 will help to determine the probable causes of simple circuit breaker problems and possible corrective actions. Possible problems associated with the electronic trip unit are covered in companion publications, I.L. 70C1037H04 and I.L. 70C1036H05. If the problem cannot be resolved with the aid of one or both of these guides, contact the Cutler-Hammer service center for more in-depth assistance.

Table 7.1 Circuit Breaker Troubleshooting Guide (continued on next page)

Symptom	Probable Cause	Corrective Actions
The circuit breaker *trips* open (red fault trip indicator button is *out* and/or fault indicator LED is *lighted*) when closed on a load current	Rating plug not installed and load current through the breaker	Install rating plug that corresponds to current sensors
	Repeated closing on transient (in-rush) current with thermal memory active	Wait for circuit breaker (and loads) to cool before re-closing
	An overload or fault current condition	Use status and fault indicators to help locate and remove overload or fault condition
Circuit breaker *opens* (fault trip indicator button is *not* out)	Undervoltage release operates; voltage too low or zero	Check and correct the UVR supply voltage (85-110% rated voltage)
	Shunt trip operates	Check control signal(s) to shunt trip; correct if necessary
	Trip latch is defective	Inspect latch condition and engagement before closing; consult Cutler-Hammer service center

Table 7.1 Circuit Breaker Troubleshooting Guide (continued from previous page)

Symptom	Probable Cause	Corrective Actions
Circuit breaker cannot be opened remotely, but can be opened locally	Shunt trip control signal absent or too low	Check supply voltage exceeds 70% of rated voltage when signal is applied to shunt trip
	Shunt trip is faulty or improperly installed	Remove front cover; check voltage supplied to shunt trip; make sure shunt trip is seated and retainer snapped into place. Check for shunt trip motion; replace shunt trip if faulty
	Secondary contact wiring problem	Make sure electrical pin and socket connectors are properly seated in molded plug. Verify proper wiring
Circuit breaker cannot be opened locally	OPEN pushbutton locked	Remove lock
	Faulty mechanism or main contacts welded	Contact Cutler-Hammer service center
Circuit breaker makes no attempt to close with either local (manual) or remote controls; springs do not discharge	Closing spring not fully charged (check SPRING CHARGED indicator)	Charge spring manually; check voltage to electrical operator; replace electrical operator if faulty
	If equipped with undervoltage release, undervoltage release is not energized or is faulty	Unplug undervoltage release from mounting deck and retry closing operation; if OK, check voltage supply to undervoltage release (>85%); replace undervoltage release if faulty
	Circuit breaker locked in OPEN position	Check reason for lock
	Drawout position interlock is operating; levering screw	Make sure that circuit breaker is at a position that permits closure; door is open check that shutter (door) over the levering screw is fully closed
	Circuit breaker interlocked with another circuit breaker or device	Check for presence of an interlocking scheme (cable interlock or key interlock); check to see if interlocked circuit breaker is CLOSED

Table 7.1 Circuit Breaker Troubleshooting Guide (continued from previous page)

Symptom	Probable Cause	Corrective Actions
Circuit breaker cannot be closed remotely (can be closed locally)	Spring release (closing) coil supply voltage low or spring release faulty	Check power supply voltage; replace spring release if faulty
	Secondary contact wiring problem	Make sure electrical pin and socket connectors are properly seated in molded plug. Verify proper wiring
	Spring release closing coil signal blocked	Clear Digitrip 1150 relay contact
Circuit breaker cannot be closed locally (but can be closed remotely)	Opening and/or closing pushbuttons locked	Check reason for lock
Circuit breaker does not recharge electrically but will recharge manually	Charging motor supply voltage absent or too low (<85%)	Check charging motor electrical circuit voltage (check under load)
	Charging motor faulty	Replace charging motor assembly
Drawout circuit breaker will not lever-in	Circuit breaker will not fully enter cell (cell rejection code plate)	Circuit breaker ratings do not correspond to the cassette requirements
	Levering-in screw not in fully DISCONNECT position at insertion	Rotate levering-in screw counterclockwise to DISCONNECT position, then insert breaker fully into cassette
	Levering-in screw in DISCONNECT position but not pushed in far enough	Push circuit breaker in as far it will go, cover should be flush with front of cassette side plate
	Protective boots covering stationary disconnects	Remove boots
	Shutter jammed or locked	Clear problem

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JA 00003442

SECTION 8: RENEWAL PARTS

8-1 GENERAL

All renewal parts and/or spare parts recommendations for Type Magnum DS, Magnum DSX and Magnum DSI Circuit Breakers are supplied in separate Renewal Parts Documentation, not this instruction manual. Refer to the most recent version of this documentation for specific assistance.

When ordering parts, always specify, if known, the part name and style number. If the style number is not known, it would help to refer to a pictorial and/or graphic reference. Also include the circuit breaker type, General Order number and other information as shown on the nameplate on the front cover of the circuit breaker (Figures 1-2 and 3-5).

Some detailed parts shown in the figures in this manual may only be available as a part of a sub-assembly. Certain parts may not be available at all for field installation. Some parts in the figures are illustrated just to show their function and location in the assembly. The Renewal Parts Documentation indicates which parts are available and in what form. For additional information, visit the Cutler-Hammer website at www.EatonElectrical.com

Instruction Book
Effective: May 2006

Instructions for for Installation, Operation and Maintenance of Magnum DS, DSX and DSL Low Voltage Power CircuitBreakers

This instruction booklet is published solely for information purposes and should not be considered all inclusive. If further information is required, you should consult Cutler-Hammer.

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NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY, OR WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OF TRADE, ARE MADE REGARDING THE INFORMATION, RECOMMENDATIONS AND DESCRIPTIONS CONTAINED HEREIN. In no event will Cutler-Hammer be responsible to the purchaser or user in contract, in tort (including negligence), strict liability or otherwise for any special, indirect, incidental or consequential damage or loss whatsoever, including but not limited to damage or loss of use of equipment, plant or power system, cost of capital, loss of power, additional expenses in the use of existing power facilities, or claims against the purchaser or user by its customers resulting from the use of the information, recommendations and description contained herein.

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Moon Township, PA 15108-4312
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1-800-525-2000
www.eaton.com

EATON | Cutler-Hammer

CATERPILLAR®

Preventive Maintenance Specifications

Qualified Personnel

Qualifications:

For the purpose of maintaining your Caterpillar Switchgear assembly, a qualified Caterpillar Technician should be contacted for maintenance work. Qualified Dealer Technicians are those who have participated in all the required training and qualification programs through Cat Electric Power.

Recommended Intervals

Note:

Your Caterpillar Switchgear should be maintenance free for up to 12 months from start up. This takes into consideration that the project was properly handled, installed, started up and commissioned in accordance with the factory recommendations.

In the event there were any variances in the process Dealer's discretion is advised:

1. The environment is:
   a. Not clean
   b. Not temperature controlled
2. Site has 24X7 critical application

In the event the installation or start up was executed under a rigid schedule, the customer should perform maintenance performed within the first year from start up to ensure everything was performed properly.

Reliability	Poor	Average	Good
Low	.6	1	2
Medium	.5	1	1.5
High	.25	.5	1

Example:

1. Project is in poor environment and low reliability requirement:
   a. Multiply .5 x 24 Months = 12 Months between maintenance intervals
2. Project is in good condition/environment and high reliability:
   a. Multiply 1 X 24 Months = 24 Months

CATERPILLAR PREVENTATIVE MAINTENANCE SPECIFICATIONS

Intervals:

Equipment	Visual	Visual and Mechanical	Visual, Mechanical, and Electrical
Switchgear	12	24	After 24; annually
Circuit Breakers	12	24	After 24; annually
Protective Relays	12	24	After 24; annually
PLC's	12	N/A	N/A

Inspection Guide

Paralleling Switchgear

Visual Inspection Only:

1.1 Switchgear Enclosure

- ☐ Verify system is level; doors are aligned and open and close properly
- ☐ Verify enclosures are properly anchored to the floor or switchgear pad
- ☐ Verify enclosures are free from all moisture
- ☐ Verify enclosures are properly coated and free from all rust or other corrosion
- ☐ Verify enclosures are clean and free from all dust or other foreign debris
- ☐ Verify enclosures are free from all signs of flash over or tracing
- ☐ If supplied, verify filters are in place and vents are not obstructed to air flow

1.2 Layout

- ☐ Verify system layout corresponds with system one line located in the "G" drawings
- ☐ Verify breaker cells are properly identified and match system one line
- ☐ Verify breaker Amp frame and Amp trip match breaker schedule located in the "G" drawings

1.3 Controls

- ☐ For PowerLynx 3000 controls download all alarm logs for further review
- ☐ For Powerlynx PLC based controls verify Modbus Plus lights on the PLCs are on
- ☐ For Powerlynx PLC based controls verify PLC "RUN" light is on
- ☐ For Powerlynx PLC based controls verify Modbus Plus cables are secured properly
- ☐ Verify protective settings are in accordance with coordination study (If available)
- ☐ Log all settings for the following items:

  - System
  - Utility
  - Generators
  - Load Shed
  - Gen Demand Priority

- ☐ Verify system metering is accurate
- ☐ Verify generator metering is accurate
- ☐ Verify utility metering is accurate (if available)
- ☐ Verify Tie metering is accurate (If available)
- ☐ Verify Distribution metering is accurate (if available)

1.4 Circuit Breakers

- ☐ For DigiTrip 1100 and 520 check for any logged faults (record as needed)
- ☐ Verify protective settings are in accordance with coordination study

1.5 Protective Relays

- ☐ Record the following:
  - Model Number
  - Serial Number
  - Firmware Revision
  - Software Revision
  - Control Voltage
- ☐ Download all logged events (filtered and unfiltered)
- ☐ Inspect relay and cases for physical damage
- ☐ Verify protective settings are in accordance with coordination study

Annual Preventive Maintenance Guide

Paralleling Switchgear

Inspection, Testing, and Maintenance:

2.1 Switchgear Enclosure

- ☐ Verify system is level; doors are aligned and open and close properly
- ☐ Verify enclosures are properly anchored to the floor or switchgear pad
- ☐ Verify enclosures are free from all moisture
- ☐ Verify heaters are operational
- ☐ Verify enclosures are properly coated and free from all rust or other corrosion
  - Use touch up paint to cover any blatant scratches or bare metal as agreed to by site personnel
- ☐ Verify enclosures are clean and free from all dust or other foreign debris
  - Clean as needed
- ☐ Verify enclosures are free from all signs of flash over or tracing
- ☐ If supplied verify filters are in place and vents are not obstructed to air flow
- ☐ Verify bus connections; splice bolts and mounting insulator
  - Tighten where necessary
    - If allowed by customer

2.2 Layout

- ☐ Verify system layout corresponds with system one line located in the "G" drawings
- ☐ Verify breaker cells are properly identified and match system one line
- ☐ Verify breaker Amp frame and Amp trip match breaker schedule located In the "G" drawings

2.3 Controls

- ☐ For Powerlynx 3000 controls download all alarm logs for further review
- ☐ For Powerlynx PLC based controls verify Modbus Plus lights on the PLCs are on
- ☐ For Powerlynx PLC based controls verify PLC "RUN" light is on
- ☐ For Powerlynx PLC based controls verify Modbus Plus cables are secured properly
- ☐ Verify protective settings are in accordance with coordination study
- ☐ Log all settings for the following items:
  - System Settings
  - Utility Settings
  - Generators
  - Generator Demand Priority
  - Load Shed
- ☐ Verify system metering is accurate
- ☐ Verify generator metering is accurate
- ☐ Verify utility metering is accurate (if available)
- ☐ Verify Tie metering is accurate (if available)
- ☐ Verify Distribution metering is accurate (if available)
- ☐ Verify control wires are torqued properly
  - Terminal blocks
  - All Components
  - Circuit breaker terminal blocks
  - CTs, VTs, PTs
- ☐ Inspect metering PTs and control power transformers
- ☐ Verify manual switches for free movement and contact continuity
- ☐ Perform visual inspection of all wiring and connections for the following:
  - Tracking
  - Overheating
  - Insulation deterioration
  - Arcing
  - Corona

2.4 Circuit Breakers

Discuss Circuit Breaker Testing with customer. At this time we will be performing the maintenance of the breakers only.

- ☐ For DigiTrip 1100 and 520 check for any logged faults (record as needed)
- ☐ Verify protective settings are in accordance with coordination study
- ☐ Remove breakers (if allowed by customer)
  - Reference manufacturers maintenance guide prior to testing
    - Perform their recommendations for maintenance

Perform the following:

- Pre-cleaning inspection
- Using a DLRO test each breaker for contact resistance
  - Record reading on each breaker
- Using a meggar; test each breaker for di-electric insulation resistance
  - Record readings on each breaker
- Clean and lubricate each breaker
- Return breaker to service

- ☐ Replace breakers and check electrical and manual close and trip operations

2.5 Protective Relays

Discuss testing the protective relays with the customer. At this point we are not testing the relays; we are performing maintenance on them.

- ☐ Record the following:
  - Model Number
  - Serial Number
  - Firmware Revision
  - Software Revision
  - Control Voltage
- ☐ Download all logged events (filtered and unfiltered)
- ☐ Inspect relay and cases for physical damage
- ☐ Verify protective settings are in accordance with coordination study
- ☐ Using the test button on the relay, test the relay

2.6 Grounds

- ☐ Verify all commons and grounds
- ☐ Tighten as needed
- ☐ Verify 24VDC negative is grounded to earth ground

2.7 Batteries

Discuss with the customer battery testing; at this time we will be performing maintenance only.

- ☐ Inspect station batteries
- ☐ Inspect and load test 24VDC best source
- ☐ Replace PLC batteries annually

2.8 Modbus Network

- ☐ Using software such as MB State, Modscan 32, or Kepware, monitor the network for error packets
  - Document finding for field report

2.9 Remote PC's and Touchscreen Panels

- ☐ Verify all screens match what is displayed at the remote
- ☐ Verify the system does not lock up and update times are acceptable
  - Note that PowerLynx 2000 and 1000 controls have an expected delay update

2.10 Mode Testing

Reference Sequence of Operations Page in the "G" Drawing Package
Using the Master Mode selector switch; test each mode that is applicable to the project
Advise the customer that the utility must be removed from service to test the E-Mode and Load Shed

- Testing the emergency response mode (E-Mode) can be done by one of the following:
  - Test with load switch (If supplied)
  - Individual ATSs
    - Test with load
  - Pulling the line jacks
    - Use extreme caution
  - Opening the utility breaker or switch
    - If the utility breaker is controlled by PowerLynx the system will re-close the utility breaker soon after opening. This should be expected
  - Removing the Secondary VT fuses

Semi-Annual Preventive Maintenance Guide

Paralleling Switchgear

Inspection; Testing and Maintenance:

3.1 Switchgear Enclosure

- ☐ Verify system is level; doors are aligned and open and close properly
- ☐ Verify enclosures are free from all moisture
- ☐ Verify heaters are operational
- ☐ Verify enclosures are properly coated and free from all rust or other corrosion
- ☐ Verify enclosures are clean and free from all dust or other foreign debris
- ☐ Verify enclosures are free from all signs of flash over or tracing
- ☐ If supplied verify filters are in place and vents are not obstructed to air flow

3.2 Layout

- ☐ Verify system layout corresponds with system one line located in the "G" drawings
- ☐ Verify breaker cells are properly identified and match system one line
- ☐ Verify breaker Amp frame and Amp trip match breaker schedule located in the "G" drawings

3.3 Circuit Breakers

- ☐ For DigiTrip 1100 and 520 check for any logged faults (record as needed)
- ☐ Verify protective settings are in accordance with coordination study

3.4 Controls

- ☐ For Powerlynx 3000 controls download all alarm logs for further review
- ☐ For Powerlynx PLC based controls verify Modbus Plus lights on the PLCs are on
- ☐ For Powerlynx PLC based controls verify PLC "RUN" light is on
- ☐ For Powerlynx PLC based controls verify Modbus Plus cables are secured properly
- ☐ Verify protective settings are in accordance with coordination study
- ☐ Log all settings for the following items:
  - System Settings
  - Utility Settings
  - Generators
  - Generator Demand Priority
  - Load Shed
- ☐ Verify system metering is accurate
- ☐ Verify generator metering is accurate
- ☐ Verify utility metering is accurate (if available)
- ☐ Verify Tie metering is accurate (if available)
- ☐ Verify Distribution metering is accurate (if available)
- ☐ Verify control wires are torqued properly
  - Terminal blocks
  - All Components
  - Circuit breaker terminal blocks
  - CTs, VTs, PTs
- ☐ Inspect metering PTs and control power transformers
- ☐ Verify manual switches for free movement and contact continuity
- ☐ Perform visual inspection of all wiring and connections for the following:
  - Tracking
  - Overheating
  - Insulation deterioration
  - Arcing
  - Corona

3.5 Protective Relays

- ☐ Record the following:
  - Model Number
  - Serial Number
  - Firmware Revision
  - Software Revision
  - Control Voltage
- ☐ Download all logged events (filtered and unfiltered)
- ☐ Inspect relay and cases for physical damage
- ☐ Verify protective settings are in accordance with coordination study

3.6 Grounds

- ☐ Verify all commons and grounds
- ☐ Verify 24VDC negative is grounded to earth ground
- ☐ Tighten as needed

3.7 Batteries

- ☐ Inspect station batteries
- ☐ Inspect and load test 24VDC best source
- ☐ Replace PLC batteries annually

3.8 Remote PC's and Touchscreen Panels

- ☐ Verify remotes operate properly

Quarterly Preventive Maintenance Guide

Paralleling Switchgear

Inspection; Testing and Maintenance:

4.1 Switchgear Enclosure

- ☐ Verify system is level; doors are properly aligned and open and close as they should
- ☐ Verify enclosures are properly anchored to the floor or switchgear pad
- ☐ Verify enclosures are free from all moisture
- ☐ Verify heaters are operational
- ☐ Verify enclosures are properly coated and free from all rust or other corrosion
- ☐ Verify enclosures are clean and free from all dust or other foreign debris
- ☐ Verify enclosures are free from all signs of flash over or tracing

4.2 Controls

- ☐ For Powerlynx PLC based controls verify Modbus Plus lights on the PLCs are on
- ☐ For Powerlynx PLC based controls verify PLC "RUN" light is on
- ☐ Verify protective settings are in accordance with coordination study
- ☐ Verify all metering screens
- ☐ Perform visual inspection of all wiring and connections for the following:
  - Tracking
  - Overheating
  - Insulation deterioration
  - Arcing
  - Corona

4.3 Circuit Breakers

- ☐ For DigiTrip 1100 and 520 check for any logged faults (record as needed)
- ☐ Verify protective settings are in accordance with coordination study

4.4 Protective Relays

- ☐ Inspect relay and case for physical damage and cleanliness

4.5 Grounds

- ☐ Verify all commons and grounds

4.6 Batteries

- ☐ Inspect station batteries

4.7 Remote PC's and Touchscreen Panels

- ☐ Verify remotes operate properly

4.8 Mode Testing

Reference Sequence of Operations Page in the "G" Drawing Package
Using the Master Mode selector switch, test each mode that is applicable to the project
Advise the customer that the utility must be removed from service to test the E-Mode and Load Shed

- Testing the emergency response mode (E-Mode) can be done by one of the following:
  - Test with load switch (if supplied)
  - Individual ATSs
    - Test with load
  - Pulling the line jacks
    - Use extreme caution
  - Opening the utility breaker or switch
    - If the utility breaker is controlled by PowerLynx the system will re-close the utility breaker soon after opening.
      This should be expected
  - Removing the Secondary VT fuses

Report Out

5.0 Documentation and Report Out

In order to validate the extended warranty annually our organization requires that all CSA reports and supporting documentation are sent to our attention upon completion of the agreement:

- Maintenance reports
  - Including all testing data
- Drawing mark ups
- PLC changes
- HMI changes

The information should be sent to the following:

helpdesk@isopowerlynx.com

Caterpillar Switchgear Organization
Attention: Product Support
Reference: Project Number
4955 Marconi Drive
Alpharetta, GA 30005

Report any unsafe conditions to the customer immediately. Note any corrective action steps.

CATERPILLAR STANDARD 2-YEAR WARRANTY

CAT Switchgear Organization warrants its products and materials to be free of defects in material and workmanship for the lesser period of (1) two years from the date of equipment startup, (2) two years from date of beneficial use, or (3) 30 months from the date of shipment from its factory. This warranty applies to all equipment and materials supplied by the CAT Switchgear Organization. This warranty expressly excludes all materials and equipment supplied by others, whether new or existing, which are incorporated in CAT Switchgear equipment, whether installed by CAT Switchgear Organization or not.

CAT Switchgear Organization reserves the right of final acceptance of any and all claims for warranty. The Customer is responsible for any and all charges related to a warranty claim should the claim be disallowed. Equipment will, at CAT Switchgear Organization option, be replaced, or repaired FOB CAT Switchgear's facility, freight prepaid, and in accordance with the following:

CAT Switchgear Organization requires all non-conforming goods be returned at CAT Switchgear's expense for evaluation, unless specifically stated otherwise in writing by CAT Switchgear Organization. Unless otherwise agreed in writing, CAT Switchgear Organization assumes no responsibility with respect to the suitability of the Customer's equipment or with respect to any latent defects in the same. This warranty does not cover damage to Customer's equipment, components or parts resulting in whole or in part from their deteriorated condition. This warranty does not cover failure or damage due to accident, misuse, abuse or negligence. This warranty does not cover reimbursement for access, removal, installation, temporary power or any other expense, which may be incurred in connection with repair or replacement. The correction of any defects by repair or replacement by CAT Switchgear Organization shall constitute fulfillment of all obligations and liability of CAT Switchgear Organization to the purchaser under this warranty.

Warranty service is provided at no charge during normal business hours. Warranty service provided outside normal business hours is chargeable at published rates less the cost of normal business hours execution. Standby time is billable at published rates regardless of time of day. Warranty includes parts and labor for CAT Switchgear material and equipment for the stated warranty period. A replacement part is warranted for the remainder of the warranty period and expressly does not extend the warranty period.

CAT Switchgear Organization is not responsible for failure of or damage to its equipment as a result of improper environment, storage, handling, installation, maintenance, operation, repair or adjustment; or as a result of acts of God, such as but not limited to lightning, fire, wind or flood. Further, any damage or subsequent failure as a result of operation of equipment above its' rated capacity, or voltage for any reason, intentional or otherwise, is specifically excluded. Unauthorized repair or adjustment of CAT Switchgear equipment will void this warranty.

No other representations, guarantees or warranties, whether expressed or implied, are made by the seller and the foregoing Warranty is in Lieu of all other representations and warranties, whether expressed or implied, which are hereby expressly disclaimed and waived by Buyer, including any warranty of merchantability or of fitness for particular purpose.

WARRANTED EQUIPMENT AND LOCATION:
ISO Manufacturing ID #: **36267**
End User Name: **New Las Vegas City Hall**
Equipment Location Street Address: **400 South Main Street**
Equipment Location City, State & Zip Code: **Las Vegas, NV**
WARRANTY EXPIRATION DATE: **TBD**

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Submittal Transmittal

Project Name : Las Vegas New City Hall
Project Number : 12600
Package Name: Electrical Submittals Book 4 of 4

WHITING-TURNER

Mojave Electric, Inc.
3755 W. Hacienda Ave.
Las Vegas, NV 89118
Tel: 702-798-2970
Fax: 702-798-0547

Attn: Chris Meiers
Delivered Via: Hand

The Whiting-Turner Contracting Company
6720 Via Austi Parkway
Suite 300
Las Vegas, NV 89119
Tel: 702-650-0700
Fax: 702-650-2650

From: David Lee
Tracking Number:

Spec Section	Submittal Number	Title	Type	Copies	Sent Date	Due Date	Action
264313	0781	Transient Voltage Suppression for Low Voltage: Data Sheets	Product Data	2	05/19/2010	05/07/2010	Revise and Resubmit
265100	0785	Interior Lighting	Product Data	2	05/19/2010	05/07/2010	Approved as Noted
265600	0789	Exterior Lighting	Product Data	2	05/19/2010	05/07/2010	Approved as Noted
271100	0793	Comm. Equipment Room Fittings	Product Data	2	05/19/2010	05/07/2010	Approved
271300	0795	Comm. Backbone Cabling	Product Data	2	05/19/2010	05/07/2010	Approved
271500	0797	Comm. Horizontal Cabling	Product Data	2	05/19/2010	05/07/2010	Approved
265600	0790	Exterior Lighting	Shop Drawing	2	05/19/2010	05/07/2010	Approved as Noted
266000	1061	Sustainability - Public Interface	LEED	2	05/19/2010	05/07/2010	Revise and Resubmit
265100	1062	Interior Lighting	Warranty	2	05/19/2010	05/07/2010	Approved as Noted

Subcontractor : Mojave Electric, Inc.

Contractor Comments:

Transmittal Remarks:

Package Reviewers					
To Company	To:	From	Date Rcv'd	Date Sent	Action Taken
JMA Architects	Robert Messiana	David Kotsakas	05/18/2010	04/16/2010	Submitted
Mojave Electric, Inc.	Chris Meiers	David Lee	05/19/2010	05/19/2010	Revise and Resubmit

A/E Remarks :

5.20.10

Copies To:

jma

elevated architecture

TRANSMITTAL
No. 00237

PROJECT: City of Las Vegas City Hall

DATE: 6/19/2010

TO: The Whiting-Turner Contracting Co.
8720 Via Austi Parkway
Suite 300
Las Vegas, NV 89119

REF: Electrical Submittals Books 1-4

JMA Project number: 2007315

ATTN: David Kortekaas

Phone: 702-660-0700 Fax: 702-660-2650

WE ARE SENDING:	SUBMITTED FOR:	ACTION TAKEN:
☑ Shop Drawings	☐ Approval	☐ Approved as Submitted
☐ Letter	☐ Your Use	☐ Approved as Noted
☐ Prints	☑ As Requested	☐ Returned After Loan
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☐ Samples	SENT VIA:	☐ Returned
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☑ Other: Made from Submittal	☐ Separate Cover Via: Mail	☐ Due Date:

ITEM NO.	COPIES	DATE	ITEM	NUMBER	REV. NO.	DESCRIPTION	STATUS
1061	3	6/18/2010	SUT	26 60 00-1061	001	Dwg: Title: Sustainability - Public Interface Desc: LEED Form	RRS
1062	3	6/18/2010	SUT	26 51 00-1062	001	Dwg: Title: Interior Lighting Desc: Warranty	AAN

CC:

Signed: ELAINE FOR:
Robert Messana

jma

elevated architecture

TRANSMITTAL
No. 00237

PROJECT: City of Las Vegas City Hall

DATE: 6/19/2010

TO: The Whiting-Turner Contracting Co.
6720 Via Austi Parkway
Suite 300
Las Vegas, NV 89119

REF: Electrical Submittals Books 1-4

JMA Project number: 2007316

ATTN: David Kortekaas

Phone: 702-650-0700 Fax: 702-650-2650

WE ARE SENDING:	SUBMITTED FOR:	ACTION TAKEN:
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ITEM NO.	COPIES	DATE	ITEM	NUMBER	REV. NO.	DESCRIPTION	STATUS
0712	3	6/18/2010	SUT	26 05 00-0712	001	Dwg: Title: Sleeve Seals Desc: Product Data	AAN
0713	3	6/18/2010	SUT	26 05 19-0713	001	Dwg: Title: Low Voltage Conductors & Cables Desc: Product Data	RRS
0715	3	6/18/2010	SUT	26 05 26-0715	001	Dwg: Title: Grounding & Bonding for Electrical Desc: Product Data	RRS
0717	3	6/18/2010	SUT	26 05 29-0717	001	Dwg: Title: Steel Slotted Supports Desc: Product Data	RRS
0721	3	6/18/2010	SUT	26 05 33-0721	001	Dwg: Title: Raceway & Boxes for Elec Systems Desc: Product Data	RRS
0724	3	6/18/2010	SUT	26 05 53-0724	001	Dwg: Title: Seismic Certification Desc: Certification	RRS
0726	3	6/18/2010	SUT	26 05 53-0726	001	Dwg: Title: Manufacturers Data Desc: Product Data	AAN
0729	3	6/18/2010	SUT	26 05 73-0729	001	Dwg: Title: Overcurrent Protective Device Study Desc: Product Data	RRS
0732	3	6/18/2010	SUT	26 09 23-0732	001	Dwg: Title: Lighting Control Devices Desc: Product Data	AAN
0734	3	6/18/2010	SUT	26 09 24-0734	001	Dwg: Title: Lighting Control Panels Desc: Product Data	RRS

CC:

jma

elevated architecture

TRANSMITTAL
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PROJECT: City of Las Vegas City Hall

DATE: 5/19/2010

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ITEM NO.	COPIES	DATE	ITEM	NUMBER	REV. NO.	DESCRIPTION	STATUS
0735	3	5/18/2010	SUT	26 09 24-0735	001	Dwg: Title: Complete Shops & 1-Line Diagrams Desc: Shop Drawings	RRS
0736	3	5/18/2010	SUT	26 09 25-0736	001	Dwg: Title: Data Sheets Desc: Product Data	RRS
0737	3	5/18/2010	SUT	26 09 25-0737	001	Dwg: Title: Complete Shops & 1-Line Diagrams Desc: Shop Drawings	RRS
0738	3	5/18/2010	SUT	26 22 00-0738	001	Dwg: Title: Data Sheets Desc: Product Data	AAN
0739	3	5/18/2010	SUT	26 22 00-0739	001	Dwg: Title: Low Voltage Transformers Desc: Shop Drawings	AAN
0740	3	5/18/2010	SUT	26 22 00-0740	001	Dwg: Title: Factory Sound Data Desc: Certification	AAN
0742	3	5/18/2010	SUT	26 22 00-0742	001	Dwg: Title: Seismic Qualification Certification Desc: Qualification Data	AAN
0743	3	5/18/2010	SUT	26 24 16-0743	001	Dwg: Title: Switchboards Desc: Product Data	RRS
0744	3	5/18/2010	SUT	26 24 16-0744	001	Dwg: Title: Switchboards Desc: Shop Drawings	RRS
0746	3	5/18/2010	SUT	26 24 16-0746	001	Dwg: Title: Seismic Certification Desc: Certification	RRS
0747	3	5/18/2010	SUT	26 24 16-0747	001	Dwg: Title: Panelboards Desc: Product Data	RRS

CC:

jma

elevated architecture

TRANSMITTAL
No. 00237

PROJECT: City of Las Vegas City Hall

DATE: 5/19/2010

TO: The Whiting-Turner Contracting Co.
6720 Via Austi Parkway
Suite 300
Las Vegas, NV 89119

REF: Electrical Submittals Books 1-4

JMA Project number: 2007315

ATTN: David Kortekaas

Phone: 702-650-0700 Fax: 702-650-2650

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☐ Letter	☐ Your Use	☐ Approved as Noted
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☑ Other: Mails from Submittal	☐ Separate Cover Via: Mail	☐ Due Date:

ITEM NO.	COPIES	DATE	ITEM	NUMBER	REV. NO.	DESCRIPTION	STATUS
0748	3	5/18/2010	SUT	26 24 16-0748	001	Dwg: Title: Panelboards Desc: Shop Drawings	RRS
0760	3	5/18/2010	SUT	26 24 16-0760	001	Dwg: Title: Seismic Certificates Desc: Certification	RRS
0761	3	5/18/2010	SUT	26 27 26-0761	001	Dwg: Title: Wiring Devices Desc: Product Data	AAN
0762	3	5/18/2010	SUT	26 27 26-0762	001	Dwg: Title: Wiring Devices Desc: Shop Drawings	AAN
0764	3	5/18/2010	SUT	26 28 13-0764	001	Dwg: Title: Fuses Desc: Product Data	APP
0765	3	5/18/2010	SUT	26 28 16-0765	001	Dwg: Title: Enclosed Switches and Circuit Break Desc: Product Data	AAN
0766	3	5/18/2010	SUT	26 28 16-0766	001	Dwg: Title: Enclosed Switches and Circuit Break Desc: Shop Drawings	AAN
0768	3	5/18/2010	SUT	26 29 13-0768	001	Dwg: Title: Enclosed Controllers Desc: Product Data	AAN
0769	3	5/18/2010	SUT	26 29 13-0769	001	Dwg: Title: Enclosed Controllers Desc: Shop Drawings	AAN
0783	3	5/18/2010	SUT	26 32 13-0783	001	Dwg: Title: Packaged Engine Generator Systems Desc: Product Data	RRS
0784	3	5/18/2010	SUT	26 32 13-0784	001	Dwg: Title: Packaged Engine Generator Systems Desc: Shop Drawings	RRS

CC:

jma

elevated architecture

TRANSMITTAL
No. 00237

PROJECT: City of Las Vegas City Hall

DATE: 5/19/2010

TO: The Whiting-Turner Contracting Co.
6720 Via Austi Parkway
Suite 300
Las Vegas, NV 89119

REF: Electrical Submittals Books 1-4

JMA Project number: 2007315

ATTN: David Kortekaas

Phone: 702-650-0700 Fax: 702-650-2650

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ITEM NO.	COPIES	DATE	ITEM	NUMBER	REV. NO.	DESCRIPTION	STATUS
0767	3	5/18/2010	SUT	26 33 53-0767	001	Dwg: Title: Static Uninterruptible Power Supply Desc: Product Data	AAN
0768	3	5/18/2010	SUT	26 33 53-0768	001	Dwg: Title: Static Uninterruptible Power Supply Desc: Shop Drawings	AAN
0770	3	5/18/2010	SUT	26 33 53-0770	001	Dwg: Title: Static Uninterruptible Power Supply Desc: Factory Test Reports	AAN
0771	3	5/18/2010	SUT	26 35 00-0771	001	Dwg: Title: Generator Power Parallel Switchgear Desc: Product Data	APP
0772	3	5/18/2010	SUT	26 35 00-0772	001	Dwg: Title: Generator Power Parallel Switchgear Desc: Shop Drawings	APP
0773	3	5/18/2010	SUT	26 35 00-0773	001	Dwg: Title: Generator Power Parallel Switchgear Desc: Schedules of Equipment	APP
0777	3	5/18/2010	SUT	26 36 00-0777	001	Dwg: Title: Transfer Switches Desc: Shop Drawings	RRS
0779	3	5/18/2010	SUT	26 41 13-0779	001	Dwg: Title: Lightning Protection Desc: Product Data	AAN
0781	3	5/18/2010	SUT	26 43 13-0781	001	Dwg: Title: Transient Voltage Supression Desc: Product Data	RRS
0783	3	5/18/2010	SUT	26 51 00-783	001	Dwg: Title: Interior Lighting Desc: Product Data	AAN

CC:

jma

elevated architecture

TRANSMITTAL
No. 00237

PROJECT: City of Las Vegas City Hall

DATE: 5/19/2010

TO: The Whiting-Turner Contracting Co.
6720 Via Austi Parkway
Suite 300
Las Vegas, NV 89119

REF: Electrical Submittals Books 1-4

JMA Project number: 2007815

ATTN: David Kortekaas

Phone: 702-650-0700 Fax: 702-650-2660

WE ARE SENDING:	SUBMITTED FOR:	ACTION TAKEN:
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ITEM NO.	COPIES	DATE	ITEM	NUMBER	REV. NO.	DESCRIPTION	STATUS
0789	3	5/18/2010	SUT	26 56 00-0789	001	Dwg: Title: Exterior Lighting Desc: Product Data	AAN
0790	3	5/18/2010	SUT	26 56 00-0790	001	Dwg: Title: Exterior Lighting Desc: Shop Drawing	AAN
0795	3	5/18/2010	SUT	27 13 00-0795	001	Dwg: Title: Communications Backbone Cabling Desc: Product Data	APP
1003	3	5/18/2010	SUT	07 84 00-1003	001	Dwg: Title: Firestopping Desc: Product Data	AAN
1004	3	5/18/2010	SUT	07 84 00-1004	001	Dwg: Title: Firestopping Desc: Shop Drawings	APP
1005	3	5/18/2010	SUT	07 84 00-1005	001	Dwg: Title: Firestopping Desc: Qualification Data	APP
1006	3	5/18/2010	SUT	07 84 00-1006	001	Dwg: Title: Firestopping Desc: Test Reports	APP
1007	3	5/18/2010	SUT	07 84 00-1007	001	Dwg: Title: Firestopping Desc: LEED Data	APP
1009	3	5/18/2010	SUT	26 05 48-1009	001	Dwg: Title: Seismic Controls Desc: Product Data	RRS
1010	3	5/18/2010	SUT	26 05 53-1010	001	Dwg: Title: Raceway & Boxes LEED Desc: LEED Data	RRS
1020	3	5/18/2010	SUT	26 25 11-1020	001	Dwg: Title: Busway and Busway Plug-In Equipment Desc: Product Data	APP

CC:

jma

elevated architecture

TRANSMITTAL
No. 00236

PROJECT: City of Las Vegas City Hall

DATE: 6/18/2010

TO: The Whiting-Turner Contracting Co.
6720 Via Austi Parkway
Suite 300
Las Vegas, NV 89119

REF: Electrical Submittals Books 1-4

JMA Project number: 2007815

ATTN: David Kortekaas

Phone: 702-650-0700 Fax: 702-650-2660

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ITEM NO.	COPIES	DATE	ITEM	NUMBER	REV. NO.	DESCRIPTION	STATUS
0793	3	6/18/2010	SUT	27 11 00-0793	001	Dwg: Title: Comm Equipment Room Fittings Desc: Product Data	APP
0797	3	6/18/2010	SUT	27 15 00-0797	001	Dwg: Title: Communications Horizontal Cabling Desc: Product Data	APP

CC:

Signed: ELAINE Feb.
Robert Messiana

10150 Covington Cross Drive Las Vegas NV 89144 702-731-2033 T 702-731-2039 F www.jmaarch.com

RECEIVED

MAY 18 2010

JMA

jba consulting engineers

May 17, 2010

JMA Architecture Studios
10150 Covington Cross
Las Vegas, NV 89144

Attention: Mr. Robert Messiana

Subject: Las Vegas City Hall
Our Project No. 08.0214

Dear Michael:

We have completed our review of the electrical submittal books for the subject project. Our comments follow:

Div 078400-Fire Stop System- Reviewed

1. Architect shall review for compliance with specifications and drawing details.

Div 260500- Sleeve and Seals- Reviewed

1. No submittal for seals or grout submitted.

Div 260519- Low Voltage Conductors and Cable- Revise and Resubmit

1. Metal clad cable is not approved per City of Las Vegas Standards.
2. Provide information regarding protection of emergency feeders per NEC 700.9(D)(1)- note #10 on sheet E5.03 core and shell package.

Div 260526- Grounding and Bonding- Revise and Resubmit

1. Submittal sheets indicate type GR, GT, GY, NC and ND exothermic welds but all part numbers are "x" out. Why are these submitted? Indicate actual products to be used on project.
2. Submit for bolted connectors.

Div 260529- Hangers and Supports- Revise and Resubmit

1. Indicate actual products to be used on this project.

Div 260533- Raceways and Boxes- Revise and Resubmit

1. Indicate actual products to be used on this project.
2. PVC risers are not allowed.
3. Flex metallic conduit shall be zinc-coated steel.

4. Swimming pool junction boxes are not required.
5. Weatherproof lamp holders and garden lights are not required.
6. Submit for precast handholes and pullboxes.
7. Provide cable tray for wall applications as shown on the telecom drawings.
8. Provide open style cable tray in the studio areas as shown on the telecom drawings.

Div 260548- Vibration and Seismic Controls- Revise and Resubmit

1. Submit for vibration isolation devices at transformers.
2. Submit for seismic restraint equipment at importance factor 1.5 serving emergency power distribution and fire alarm systems (where applicable).

Div 260553- Identification- Reviewed

1. Remove park sign.

Div 260573- Coordination Study- Revise and Resubmit

1. Provide coordination study specialist qualifications- professional engineer licensed in the state of Nevada.

Div 260923- Lighting Control Devices- Reviewed

1. Finishes by architect.
2. Resubmit switch with digital timer. Needs to be manual on and auto off.

Div 260924- Lighting Control Panels- Revise and Resubmit

1. Lighting control station missing on second floor. Correct area designations.
2. Sheets E4.00 are from two packages (core/shell package and build-out package). Both are correct.
3. Provide interface with security system and provide corresponding control wiring to emergency lighting relays.
4. Emergency lighting relays indicated on sheet E4.01 are not transfer devices (see diagram B on sheet E4.00). Refer to diagram A for this emergency lighting relay.
5. Time clock schedule by City of Las Vegas.
6. Project is LEED Silver.
7. Control stations are used for lighting override only. Provide appropriate button configuration. Engraving shall indicate "lighting override".
8. Zoning shall be by floor and area.
9. Correct relay panel schedules LR0A and LR6A. Refer to revised drawings dated 4/16/10.
10. There shall be one lighting control override button located on the eighth floor. This will be clarified on a future drawing revision.

Div- 260925- Dimming Control Panel- Revise and Resubmit

1. Dimmer feeders shall be copper only.
2. Control station finishes by Architect (confirm white).
3. RS-232 interface to AV equipment shall be located in the control room.
4. Clarify why two master control stations are indicated on system riser diagram- drawing #662093-101.
5. Coordinate dimmer module types with lamps furnished. Provide information/cut-sheets on dimmer modules.

Div 262200- Low Voltage Transformers- Furnish as Corrected

1. Correct designation for transformer T-L3AB.
2. Submit qualification data for independent testing agency.

Div 262413- Switchboards- Revise and Resubmit

1. Correct bussing diagram for SEA. Extra connection between utility meter and outgoing lugs.
2. Coordinate nameplate requirements with specification section 260553.
3. Coordinate bussing diagram for MSA with actual equipment sections. Clarify section #6 with feed from IMDB on bussing diagram.
4. Correct MSB elevations for circuits #1, 2 and 3 (225A CB).
5. 1600A and 2000A fire pump disconnects do not meet physical space requirements. Resubmit equipment meeting physical space requirements and submit shop drawings of electrical room with equipment layout.
6. Provide main circuit breaker in EHDPA with long time delay, short time delay and instantaneous trip functions independent and fully adjustable of each other.
7. Revise circuit breakers in EHDPA serving elevators. Refer to revised drawings dated 4/16/10.
8. 800A circuit breaker in XHDPA serves the UPS (not main CB).
9. Provide equipment room layout shop drawings.
10. Provide testing agency qualifications.
11. Label in LDPBBA for panel LTVC needs to be corrected.

Div 262416- Panelboards- Revise and Resubmit

1. Submit for panels LBBE and ULTVA. Refer to the build-out package.
2. Submit for fused coordination panels EH1A, EH4A, EH7A, EHBA, EHBAS, EHRA, EL1A, EL4A, EL7A, ELBA, ELFCC and ELRA. Provide specific sheet for each panel.
3. Panels EH1A, EH4A, EH7A, EHBA and EHRA shall be rated 225A.
4. Provide panel EH4A with subfeed lugs or feed through lugs.
5. Panel EHBAS shall be NEMA 3R rated.
6. Panel EHBA shall be 25 KAIC rated.
7. Refer to revised drawings for branch circuit breaker quantities and ratings. Panels H3AA, XH2A, L5AAS and LBBBS have been revised recently. Some of the submitted panels incorrectly indicate 30A/1P circuit breakers where 20A/1P are indicated.

8. Provide circuit breaker handle ties for multi-wire circuits to system furniture per NEC 605.7 and NEC 210.4(B).
9. Provide panel LBBB with subfeed lugs.
10. Provide panel LTVA with 400A main circuit breaker and isolated ground bus.
11. Provide panels LTVB, XLBA and XLTV with isolated ground bus. Why is every panel furnished with insulated ground connector?
12. Circuit breakers for heat trace shall be GFP type in panel LBBBS.

Div 262511- Busway and Busway Plug-Ins- Reviewed

Div 262726- Wiring Devices- Reviewed

1. Architect shall indicate finish.
2. Incandescent dimmer shall be furnished with on/off switch.
3. Submit for 30 amp, 120 volt maintenance receptacles and clock type receptacles.

Div 262813- Fuses- Reviewed

Div 262816- Enclosed Switches and Breakers- Furnish as Corrected

1. Coordinate fusible disconnects for elevators with revised electrical drawings and elevator shop drawings. Provide auxiliary contacts required.
2. Confirm 60A/3P and 125A/3P circuit breakers are furnished with shunt trip function.

Div 262913- Enclosed Controllers- Furnish as Corrected

1. Furnish starters with (2) NO and (2) NC contacts.
2. Coordinate NEMA 3R enclosure requirements with the electrical drawings.
3. Confirm solid state overloads are furnished with single phase protection.

Div 263213- Packaged Engine Generator Systems- Revise and Resubmit

1. 9KW jacket heaters require circuit revisions to the drawings.
2. Generators shall be furnished with upturn radiator exhaust scoops.
3. Provide shop drawing of generator yard layout. Provide minimum of 42" clear on the sides of the generators.

Div 263353- Static Uninterruptible Power Supply- Furnish as Corrected

1. Furnish with network monitoring via Ethernet cable connection.

Div 263600- Generator Paralleling Switchgear- Reviewed

Div 263600- Transfer Switches- Revise and Resubmit

1. Provide information for remote status panel.
2. Provide equipment room layouts.

3. Indicate automatic transfer features as indicated in specifications.

Div 264113- Lightning Protection- Reviewed

1. Submit manufacturers generated drawings (project specific) with plan view and elevations per specifications.

Div 264313- Transient Voltage Suppression- Revise and Resubmit

1. Provide information specific for each unit indicated on single line diagrams. Indicate quantities and locations.
2. Submit for 120/208V unit.

Div 265100- Interior Lighting- Furnish as Corrected

1. All T8 florescent ballasts shall be rated and labeled NEMA-PREMIUM.
2. All T8 fluorescent lamps shall be Super T8 32 watt with 3100 initial lumens.
3. Fixture E- refer to restroom lighting plan for row information.
4. Fixture J- furnish with rocker switch and 120V ballasts.
5. Exit sign letters are green.
6. LPDC exit sign shall be for 120V or 277V operation.
7. Fixture LB1- lamp distribution shall be narrow flood.
8. Fixture LB2- lamp distribution shall be narrow flood.
9. Submit for fixture LC1 and LC2. Missing cutsheets from binders.
10. Architect to specify finish for LD1.
11. Fixtures on the specialty fixture schedule shall be reviewed by the lighting consultant for compliance with their specifications.
12. Fixtures LC1 and LC2 are 277V.
13. Fixtures AR1, PF1, PF2 are 120V.
14. Fixtures JM1, JM2, RF1, WF1, WF2, FD2, PM1, PM2, PM3 and SZ3 are 277V.
15. Fixture PP1 is 100W lamp.

Div 265600- Exterior Lighting- Furnish as Corrected

1. Architect to specify finish for fixture CC.
2. Exit signs are green.
3. XS-Pole shall be 48" high- finish by architect.
4. Fixtures on the specialty fixture schedule shall be reviewed by the lighting consultant for compliance with their specifications.
5. Fixtures BC1, BM1, BM3, GM1, SC1, SC2, SF8, WC3 are 277V.
6. Fixtures FD3, GM2, SZ7A and WC2 shall be for 120V operation.
7. Fixtures SC1 and SC2 are submitted as 120V operation. Electrical drawings indicate 277V. Is 277V available for fixtures?
8. Submit for obstruction light control relay and photocell- FAA approved.

Div 266000- Sustainability Public Interface- Revise and Resubmit

1. Provide product cut-sheets.
2. Provide shop drawings.
3. Indicate user interfaces for Total Electricity Use, Total Water Use, Hot Water Use, Natural Gas, Lighting Distribution, HVAC, LEED Checklist and Benchmark Comparisons. Refer to specifications section 266000-2.02.

Div 271100- Communications Equipment- Reviewed

Div 271300- Communications Backbone Cabling- Reviewed

Div 271500- Communications Horizontal Cabling- Reviewed

Emergency Services Radio Amplification System- Reviewed

1. Submit shop drawings.

City of Las Vegas Intersection Lights- Not Reviewed

1. Civil engineer shall review.

General

1. Submit samples as indicated in the specifications.
2. Submit for shunt trip stations.
3. Submit for power poles.
4. Submit for plug strips.
5. Submit for recessed table top connectivity box.
6. Submit for manual 3 phase contactor switches.
7. Submit for chiller room and boiler room breakglass stations.
8. Submit for lights in elevator pits.

If you should have any questions or concerns, please do not hesitate to call.

Very truly yours,

JBA CONSULTING ENGINEERS

Clint Gordon

Clint Gordon
Senior Project Manager- Electrical Engineering

CRG\kw
P:\2008 PROJECTS\08.0305 - 05\09-0305.0214 - CITY OF LAS VEGAS CITY HALL\Documents\Submittals\JMA Electrical Submittal Book.doc

jba
consulting
engineers

May 18, 2010

JMA Architecture Studios
10150 Covington Cross
Las Vegas, NV 89144

Attention: Mr. Robert Messiana

Subject: Las Vegas City Hall
Our Project No. 08.0214

Dear Michael:

We have completed our review of the electrical submittal books (telecommunications supplement) for the subject project. Our comments follow:

Div 271300- Communications Backbone Cabling- Revise and Resubmit

1. Hitachi not listed in specs.
2. Section 271323 C indicates optical fiber cable is terminated using fusion splice type duplex connectors as the system interface to network equipment.

We have returned the submittals under separate cover.

If you should have any questions or concerns, please do not hesitate to call.

Very truly yours,

JBA CONSULTING ENGINEERS

Clint Gordon
Senior Project Manager- Electrical Engineering

CRG\kw
[illegible]

Submittal Transmittal

Project Name : Las Vegas New City Hall
Project Number : 12600
Package Name: Electrical Submittals Book 4 of 4

WHITING-TURNER

JMA Architects
10150 Covington Cross Drive
Las Vegas, NV 89144
Tel: 702-731-2033
Fax: 702-731-2039
Attn: Robert Messiana
Delivered Via: Hand

Whiting-Turner Contracting Company
518 S 1st Street
Las Vegas, NV 89101
Tel: 702-851-4190
Fax: 702-851-4198
From: David Kortekaas
Tracking Number:

Spec Section	Submittal Number	Title	Type	Copies	Sent Date	Due Date	Action
264313	0781	Transient Voltage Suppression for Low Voltage Data Sheets	Product Data	5	04/15/2010	05/07/2010	Submitted
265100	0785	Interior Lighting	Product Data	5	04/15/2010	05/07/2010	Submitted
265600	0789	Exterior Lighting	Product Data	5	04/15/2010	05/07/2010	Submitted
271100	0793	Comm. Equipment Room Fittings	Product Data	5	04/15/2010	05/07/2010	Submitted
271300	0795	Comm. Backbone Cabling	Product Data	5	04/15/2010	05/07/2010	Submitted
271500	0797	Comm. Horizontal Cabling	Product Data	2	04/15/2010	05/07/2010	Submitted
265600	0790	Exterior Lighting	Shop Drawing	5	04/15/2010	05/07/2010	Submitted
265000	1061	Sustainability - Public Interface	LEED	5	04/15/2010	05/07/2010	Submitted
269100	1062	Interior Lighting	Warranty	5	04/15/2010	05/07/2010	Submitted

Subcontractor : Mojave Electric, Inc.

Contractor Comments:

Transmittal Remarks:

Package Reviewers					
To Company	To:	From	Date Rcv'd	Date Sent	Action Taken
JMA Architects	Robert Messiana	David Kortekaas		04/16/2010	

A/E Remarks
:

Copies To:

Myra Jordan

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APR 16 2010
JMA

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INFORMATION DRAWING SET

NEW CITY HALL

LAS VEGAS, NV

480/277V GENERATOR PARALLELING SWITCHGEAR

CASHMAN EQUIPMENT COMPANY
ISO PROJECT No. 36267

TABLE OF CONTENTS

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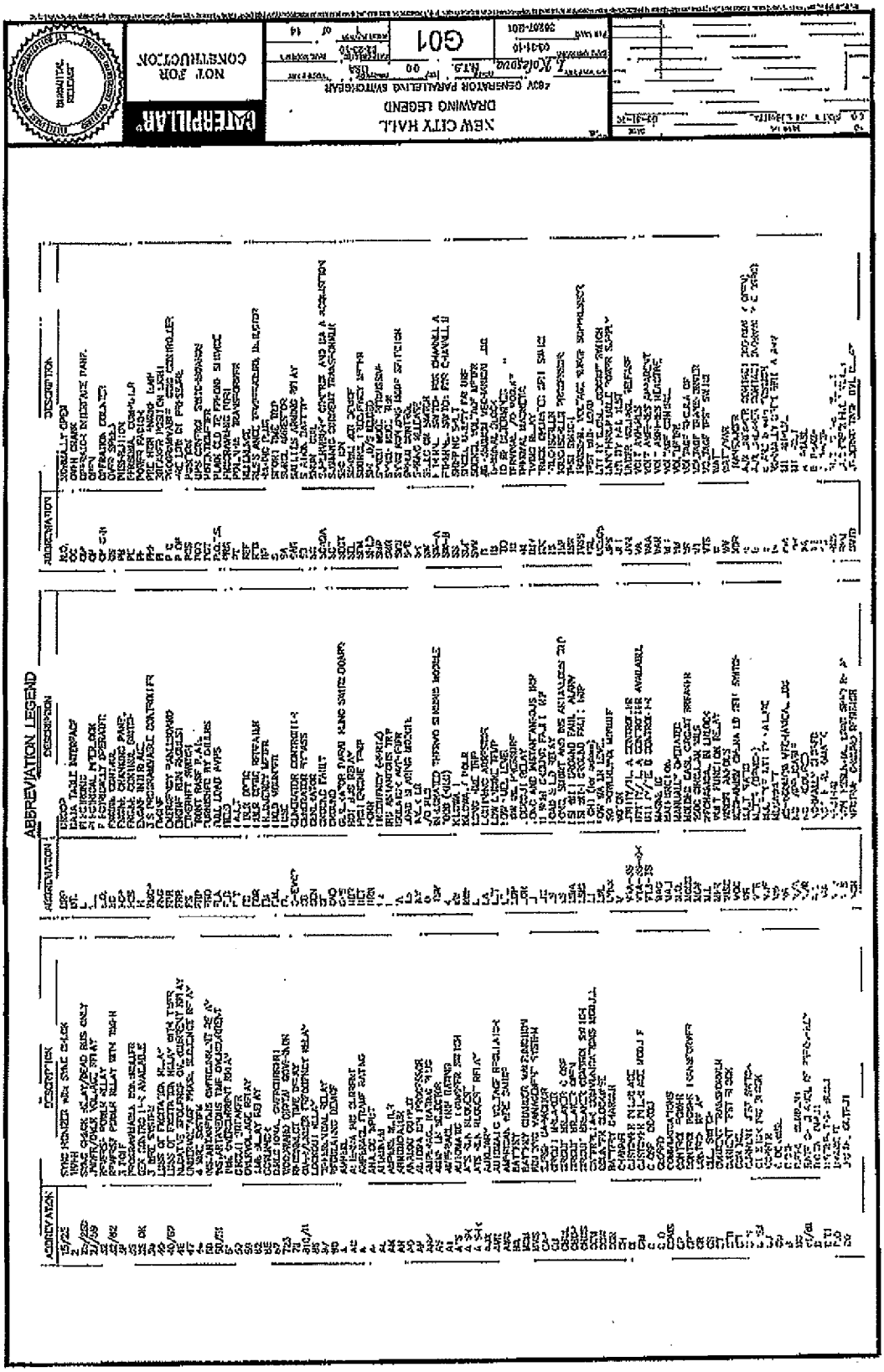
SUBMITTAL RELEASE

NEW CITY HALL
TITLE SHEET
480V GENERATOR PARALLELING SWITCHGEAR

TS



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JA 00003485

LV CIRCUIT BREAKER, LUGGING AND CONDUIT ENTRY SCHEDULE

DEVICE	LOCATION	MANUFACTURE TYPE / TRIP UNIT	FRAME (A)	TRIP SETTING (A)	RATING PLUG (A)	INTERRUPT CAPACITY (kA)	TRIP FUNCTIONS	OPERATION	MOUNTING	CHARGE	SHUNT CLOSE	SHUNT TRIP	ACCESSORIES: A/B CONTACTS	ACCESSORIES: BELL ALARM	ACCESSORIES: CELL SWITCH	ACCESSORIES: CLOSE COVER	ACCESSORIES: KIRK KEY	ACCESSORIES: OP CTR	ACCESSORIES: SHUTTERS	MECHANICAL LUGS: LUGS PER PHASE	MECHANICAL LUGS: NEUTRAL LUGS	MECHANICAL LUGS: GROUND LUGS	NAMEPLATE DESCRIPTION	CONDUIT ENTRY: TOP	CONDUIT ENTRY: BOTTOM
52G1	1D	CUTLER HAMMER MDS-816 / DT 520	1600	1600	1600	85	LSIA	E.O.	D.O.	120VAC	120VAC	24VDC	2	X	X	X				TBD	TBD	TBD	GENERATOR #1 MAIN 52G1	X	X
52D1	2A	CUTLER-HAMMER MDS-808/ DT 520	800	480	800	85	LSIA	E.O.	D.O.	120VAC	120VAC	24VDC	2	X	X					TBD	TBD	TBD	DISTRIBUTION 1 52D1	X	X
52D2	2B	CUTLER-HAMMER MDS-808/ DT-520	800	400	400	85	LSIA	E.O.	D.O.	120VAC	120VAC	24VDC	2	X	X					TBD	TBD	TBD	DISTRIBUTION 2 52D2 (SPARE)	X	X
52G2	2C	CUTLER-HAMMER MDS 816 / DT-520	1600	1600	1600	85	LSIA	E.O.	D.O.	120VAC	120VAC	24VDC	2	X	X	X				TBD	TBD	TBD	GENERATOR #2 MAIN 52G2	X	X
52D3	3B	CUTLER-HAMMER MDS 808 / DT-520	800	800	800	85	LSIA	E.O.	D.O.	120VAC	120VAC	24VDC	2	X	X					TBD	TBD	TBD	DISTRIBUTION 3 52D3	X	X
52D4	3C	CUTLER-HAMMER MDS 816 / DT-520	1600	1000	1000	85	LSIA	E.O.	D.O.	120VAC	120VAC	24VDC	2	X	X					TBD	TBD	TBD	DISTRIBUTION 4 52D4	X	X
52D5	3D	CUTLER-HAMMER MDS-816 / DT 520	1600	1200	1200	85	LSIA	E.O.	D.O.	120VAC	120VAC	24VDC	2	X	X					TBD	TBD	TBD	DISTRIBUTION 5 52D5	X	X

NOTE 1) CABLE SIZES AND QUANTITIES REQUIRED AT TIME OF ORDER, OR ONLY STANDARD NEMA 2 HOLE PATTERN WILL BE SUPPLIED.

NOTE 2) CONDUIT ENTRY TO BE DETERMINED AT TIME OF ORDER, OR ONLY BOTTOM ENTRY WILL BE SUPPLIED.

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NEW CITY HALL
CIRCUIT BREAKER SCHEDULE
480V GENERATOR PARALLELING SWITCHGEAR

J. Kolodziej · N.T.S. · 0.0 · DEA

03-01-10 · 03-17-10

36287-001

G02

2 of 4

J43-522

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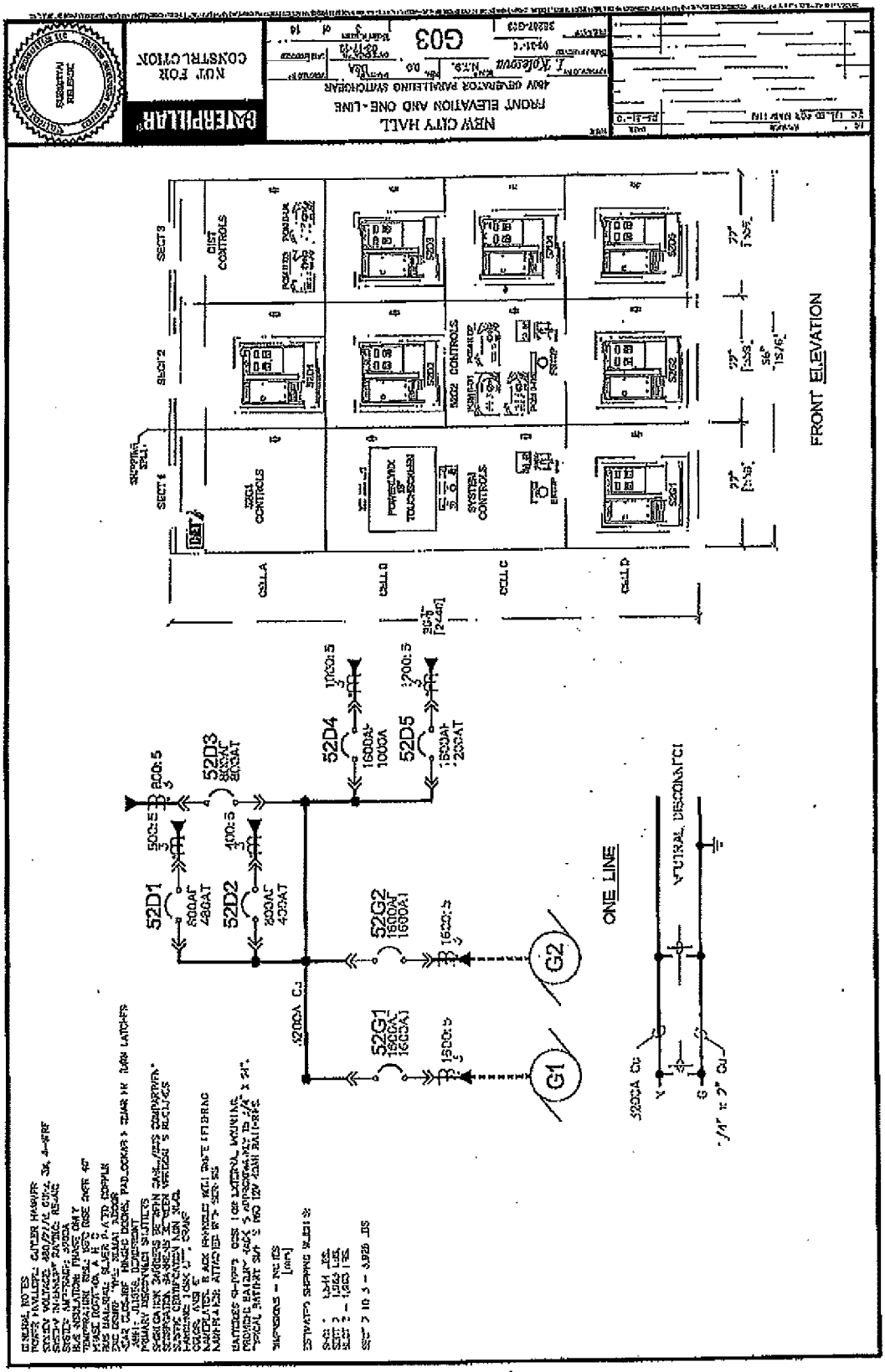
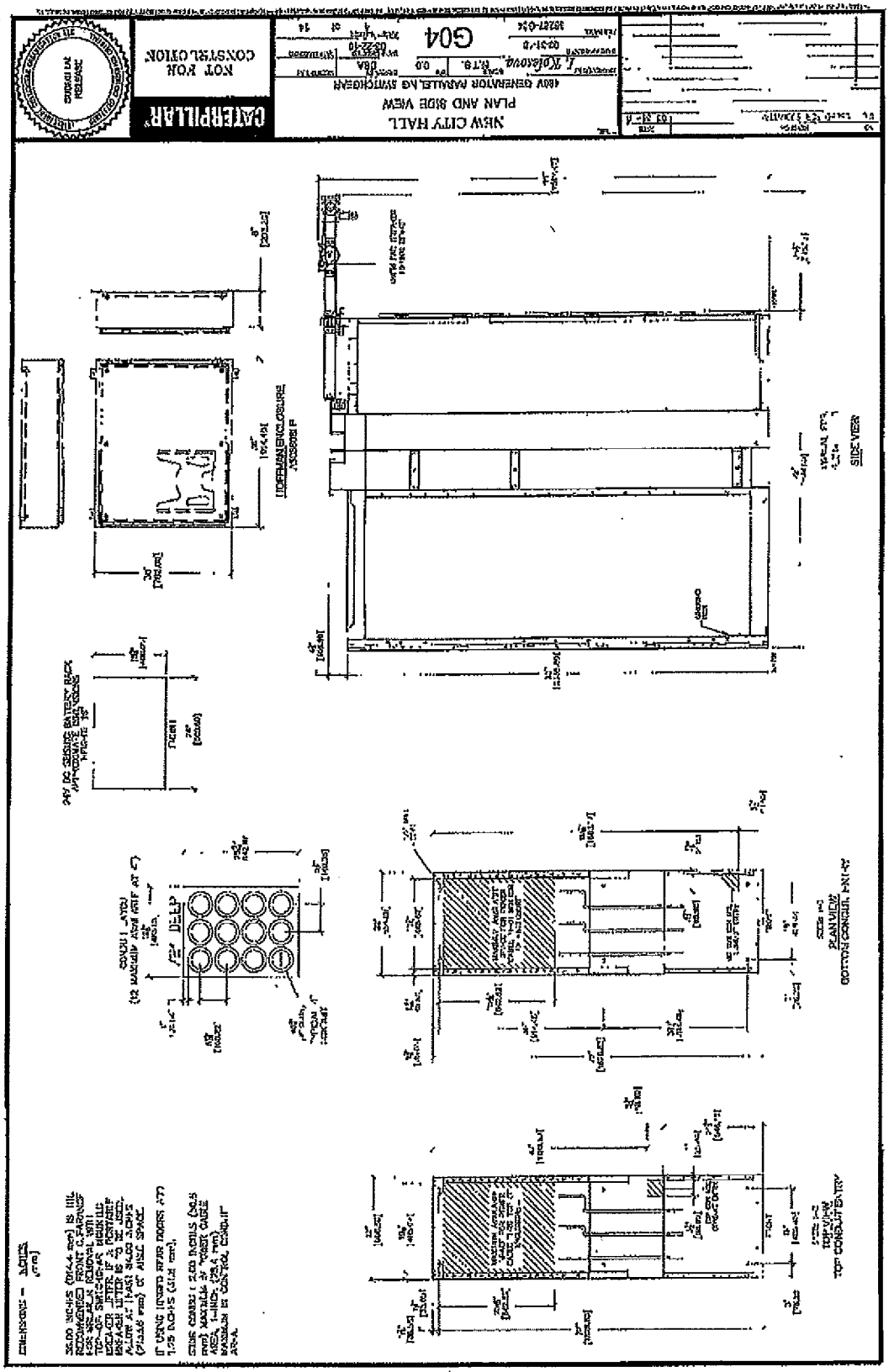
JA 00003486


NEW CITY HALL
FRONT ELEVATION AND ONE-LINE
CATERPILLAR
NOT FOR CONSTRUCTION
G03
FRONT ELEVATION
ONE LINE
52D1
52D2
52D3
52D4
52D5
52G1
52G2
G1
G2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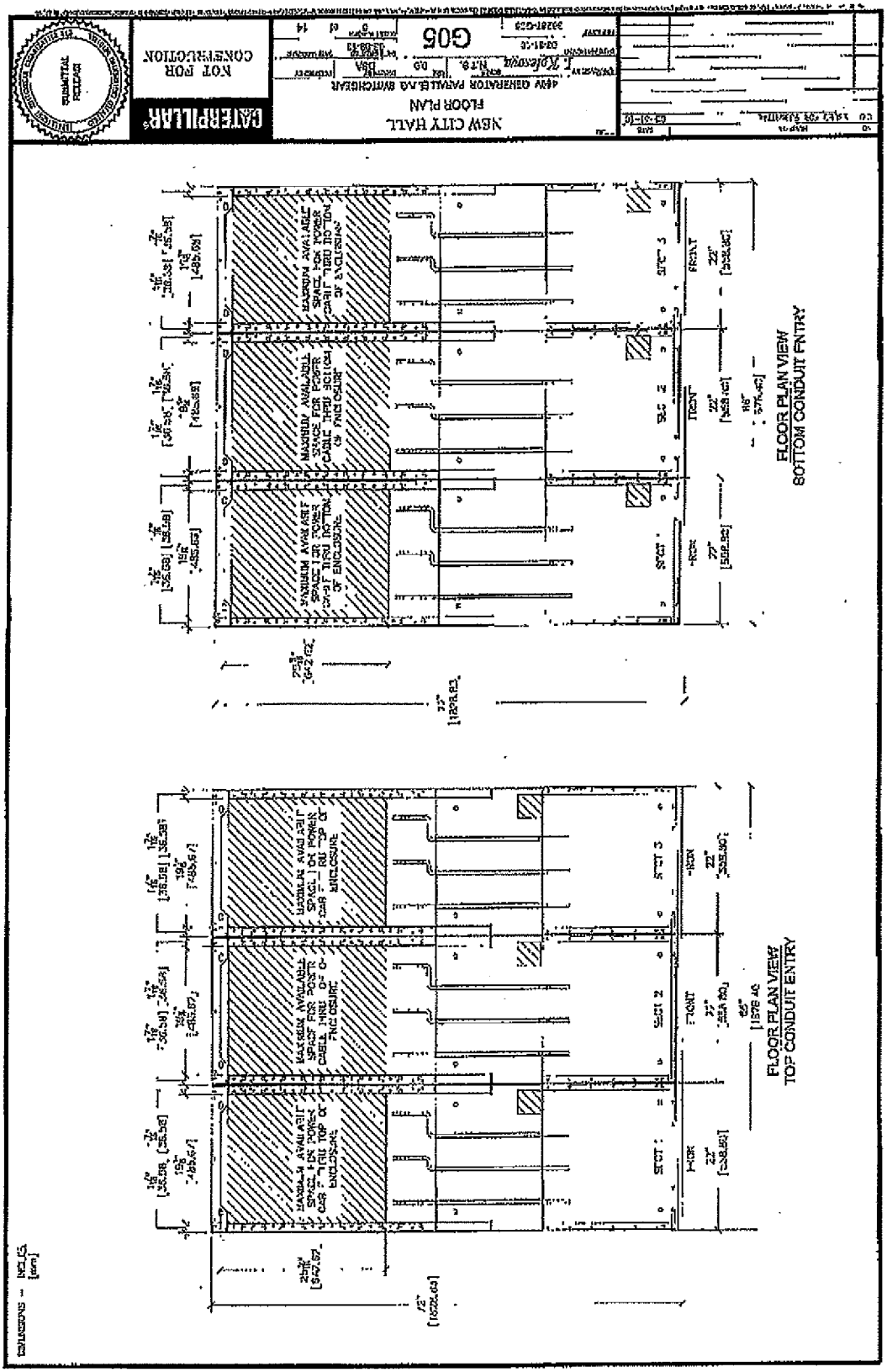
NEW CITY HALL
PLAN AND SIDE VIEW
G04
SIDE VIEW
TOP CONDUIT ENTRY



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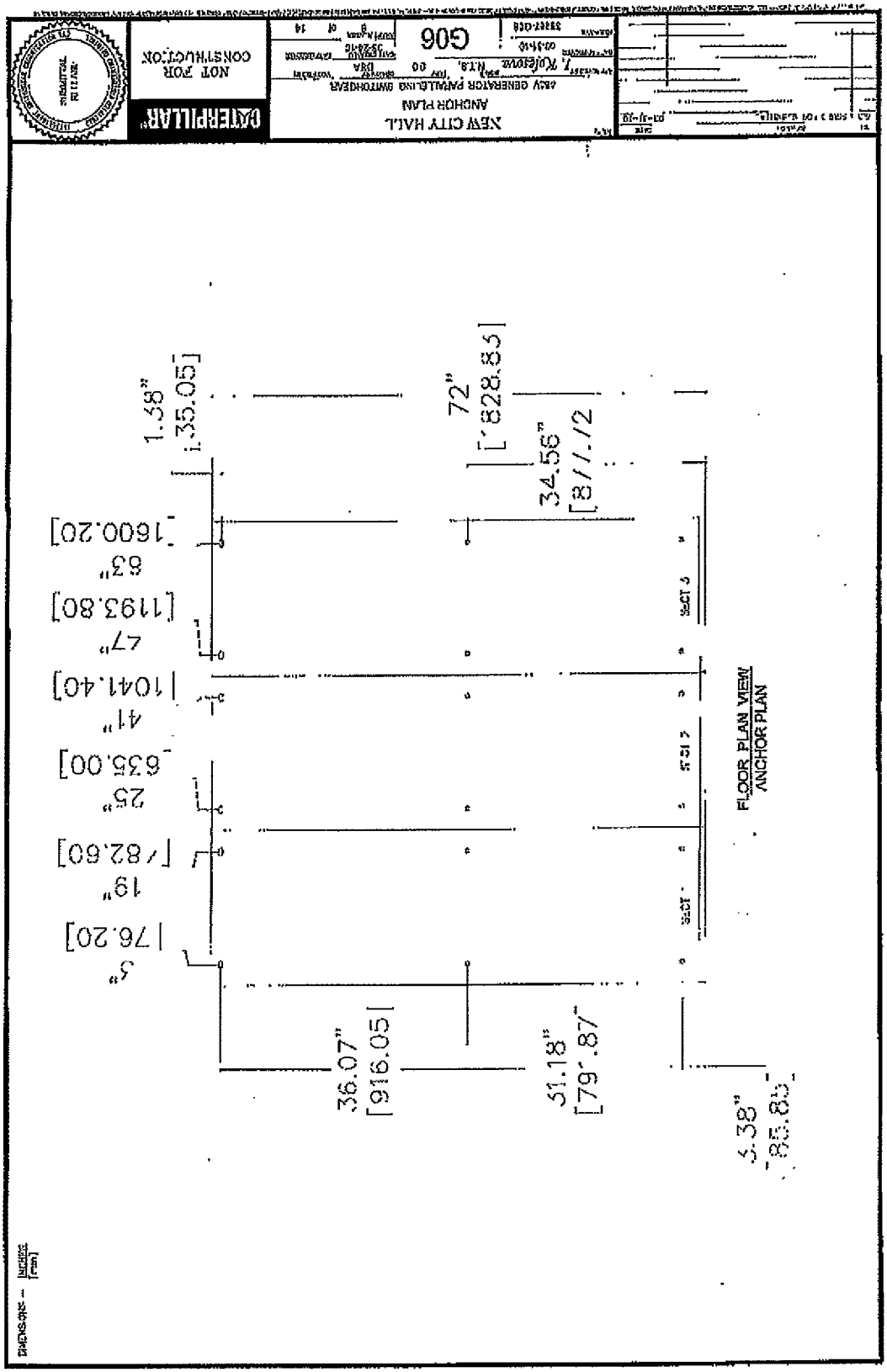
CATERPILLAR
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NEW CITY HALL
ANCHOR PLAN
FLOOR PLAN VIEW
ANCHOR PLAN
72" [1828.80]
34.56" [877.12]
1.38" [35.05]
63" [1600.20]
47" [1193.80]
41" [1041.40]
25" [635.00]
19" [482.60]
3" [76.20]
36.07" [916.05]
31.18" [791.87]
5.38" [136.65]

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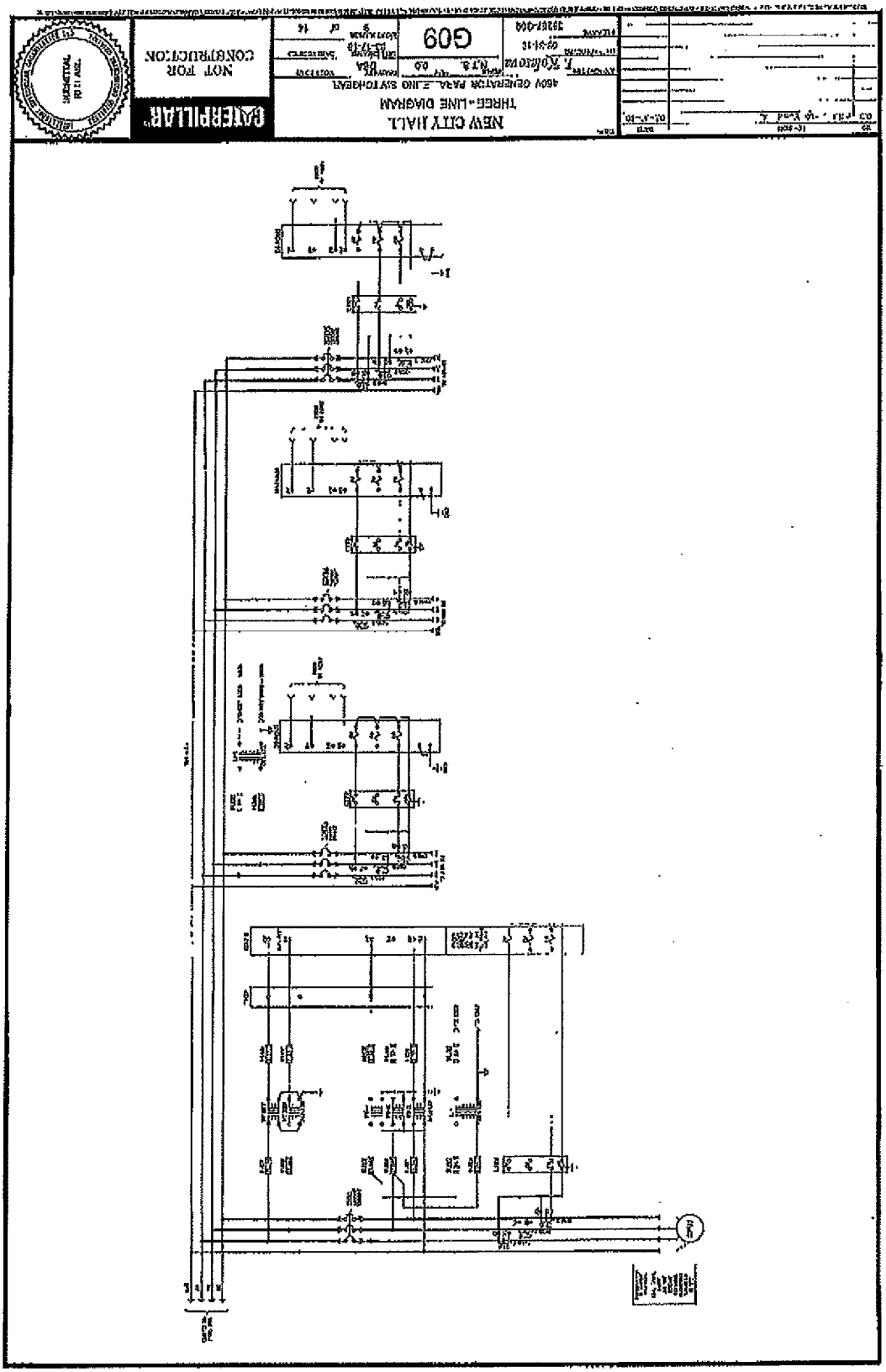
G08
NEW CITY HALL
THREE-LINE DIAGRAM
460V GENERATOR PARALLELING SWITCHGEAR


CATERPILLAR
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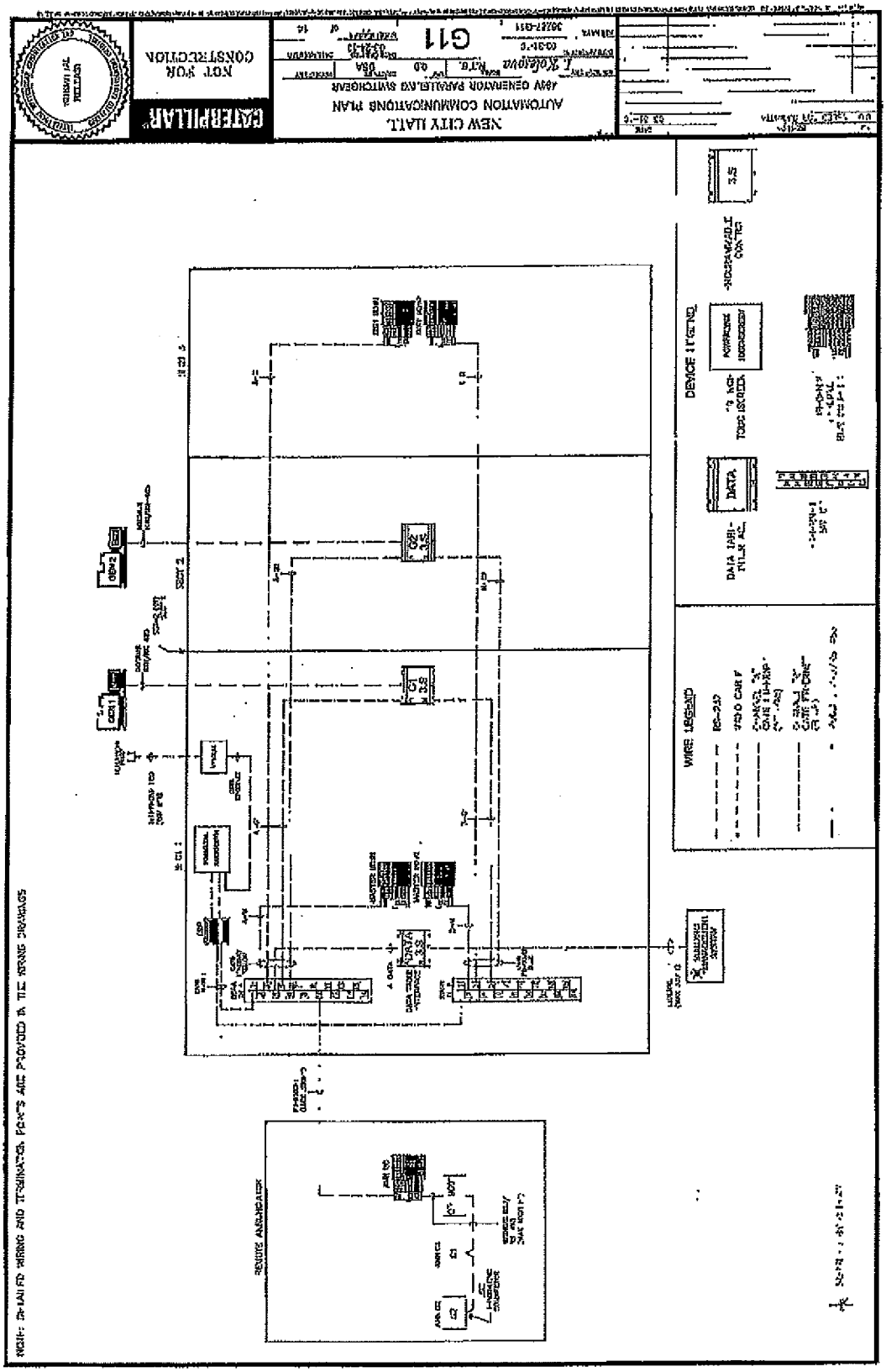
NEW CITY HALL
THREE-LINE DIAGRAM
G09



CONTROL CIRCUIT CONDUIT SCHEDULE (SEE NOTE 1)

NEW CITY HALL
CONTROL CONDUIT SCHEDULE
480V GENERATOR PARALLELING SWITCHGEAR

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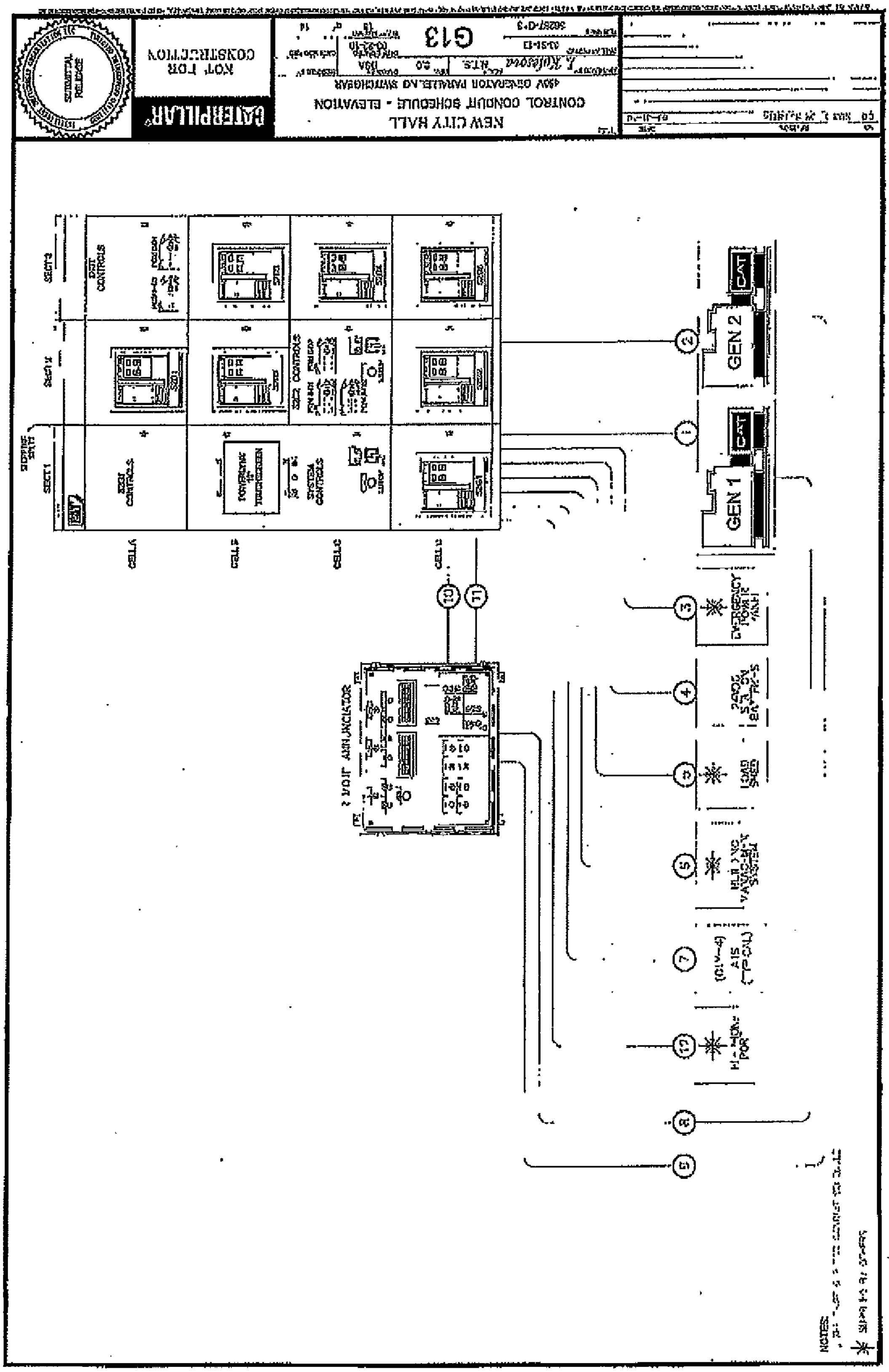
NOT FOR CONSTRUCTION

G12

CONDUIT TABLE

NOTES:


NEW CITY HALL
CONTROL CONDUIT SCHEDULE - ELEVATION
480V GENERATOR PARALLELING SWITCHGEAR
G13
CATERPILLAR
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GEN 1
GEN 2
NOTES

J43-533

Functional Sequence of Operations

Automatic/Standby Mode
1. The generator mains are open.
2. The automation is standing by to act in response to a run request from associated Automatic Transfer Switches.

Emergency Mode

Utility Failure
1. Automatic transfer switches send system a run request.
2. All available generators are started.
3. The first generator up to voltage and frequency is closed to the bus.
4. The remaining generators are synchronized and paralleled to the bus as they come up to voltage and frequency.
5. The system is now in Emergency Mode.

Utility Restoration and Exit from Emergency Mode
1. Automatic transfer switches sense the utility source is within acceptable operational tolerances for a time duration set at the automatic transfer switch.
2. As each automatic transfer switch transfers back to utility power, it removes its run request from the generator plant.
3. When the last automatic transfer switch has retransferred to the utility and all run requests have been removed from the generator plant, all generator main circuit breakers are opened.
4. The generators are allowed to run for their programmed cool-down period.
5. The system is now back in Automatic/Standby Mode.

No Load Test Mode

Entry
1. The No Load Test Switch is placed in the ON position.
2. All available generators are started
3. The first generator up to voltage and frequency is closed to the bus.
4. The remaining generators are synchronized and paralleled to the bus as they come up to voltage and frequency.
5. The system is now in No Load Test Mode.

Exit
1. The No Load Test Switch is placed in the OFF position.
2. All generator breakers are opened.
3. The generators are allowed to run for their programmed cool down period.
4. The system is now back in Automatic/Standby Mode.

Utility Fail Test Mode

Entry
1. The Utility Fail Test Switch is placed in the ON position.
2. A dry contact is sent to each ATS, which simulates a loss of utility within the ATS controls.
3. The system enters into Emergency Mode as described in the "Emergency Mode" sequence above.

Exit
1. The Utility Fail Test Switch is placed in the OFF position.
2. A dry contact is removed from each ATS, which simulates the return of utility within the ATS controls.
3. The system exits into Emergency Mode as described in the "Emergency Mode" sequence above.

Load Shed Control

The System Controls shall include a Load Shed Control function to control the loads served by the generator plant. The Load Shed Control shall have one Essential Load Shed Priority Level for each generator in the system plus one Non-Essential Load Shed Priority Level (which is always shed in the Emergency Mode of operation).

The Load Shed Control shall control each of the distribution circuit breakers within the switchgear. Each electrically operated distribution circuit breaker shall be field selectable to be assigned to any of the available Load Shed Priority Levels. Additionally, Load Shed Control shall provide a 4 pole, 10A, 120VAC rated, form C set of contacts for each Load Shed Priority Level to allow for control of loads external to the switchgear.

The following controls shall be provided for each level:
- a. Shed Delay Timer, adjustable from 0 to 1024 seconds
- b. Add Delay Timer adjustable from 0 to 1024 seconds
- c. Load Shed Override Selector (shed/auto/add)
- d. Status indicators to show whether the Priority Level is Added or Shed

The Load Shed Controls shall have:
- a. Load Shed Control Switch (On/Off)
- b. User-settable Load Shed % (as a function of on-line generator capacity)
- c. User-settable Load Add % (as a function of on-line generator capacity)
- d. User-settable Bus Under frequency Set point
- e. User-settable Bus Under frequency time delay
- f. Bus Under frequency Reset Pushbutton
- g. Bus Under frequency Indicator

Conditional Load Shed: Upon entrance into Emergency Mode of operation, the Load Shed Control shall shed all Essential and Non-Essential loads. As generators come to the bus, Essential Priority Level loads shall be added conditionally based on the number of generators on line. When the first generator comes to the bus, Priority Level 1 loads shall be added; Second generator, priority 2, etc. After a time delay that allows all operational generators to come to the bus, Load Shed Mode shall shift to Load Sensitive Mode.

Load Sensitive Load Shed - After all generators have been given sufficient time to come to the bus, load shed shall shift to "Load Sensitive" mode. The system shall compare current generator on-line capacity (in KW) to current load requirements. If surplus capacity is greater than the calculated Load Add setpoint, after the Load Add Time Delay the next Load Shed Priority will be added. This calculation will continue until all Sheddable Loads are added, or until surplus capacity is less than the calculated Load Add setpoint. If surplus capacity is less than the calculated Load Shed setpoint, after the Load Shed Time Delay the next Load Shed Priority will be shed. This calculation will continue until all Sheddable Loads are shed, or until surplus capacity is greater than the calculated Load Shed setpoint. The Load Shed Control, in its automatic shedding and adding of loads, shall not override any manual load shed/add operation.

Should the load bus frequency fall below the user selected bus underfrequency setpoint for a period longer than the bus underfrequency time delay, then all Priority Level loads shall be shed and load addition shall not resume until the operator has depressed the Bus Underfrequency Reset button. The bus underfrequency protection shall override any manual load add operation.

Generator Demand Priority Control

The System Controls shall include a Generator Demand Priority Control function to automatically match the on-line generator capacity to the loads to avoid unnecessary operation of all the generators when the loads are low.

The following controls shall be provided for each generator:
- a. User-settable Generator Priority Selector
- b. Status Indicator for the Generator Priority Selected
- c. Status Indicator for generator On-line or Off-line

The Generator Demand Priority Control shall have the following controls:
- a. Generator Demand Priority Control Switch (On/Off)
- b. User-settable Generator Remove % (as a function of a single generator capacity)
- c. User-settable Generator Remove Delay
- d. User settable Generator Add % (as a function of a single generator capacity)
- e. User settable Generator Add Delay

Upon entrance into Emergency or Load Management modes, all generators shall be started and paralleled to the bus. After the Remove Time Delay, generators shall be removed from the bus as a function of the generator percentage loading by the user selected Generator Remove time delay. Generators shall be removed from the bus in descending priority. Should the generator percentage loading increase to the user selected Generator Add limit for the user selected Add Delay, the next generator will be started, synchronized and paralleled to the bus. Generators shall be added to the bus in ascending priority order. Should the generator plant ever reach 95% loading, the next priority generator shall be started and added to the bus with no time delay.

	SUBMITTAL RELEASE
CATERPILLAR®	NOT FOR CONSTRUCTION
TITLE	NEW CITY HALL SEQUENCE OF OPERATIONS 480V GENERATOR PARALLELING SWITCHGEAR
DRAWN	J. Kalesnra
CHK'D	Y.T.A.
REV.	3.3
STATE	USA
SUBMITTED	03-31-10
APPROVED	03-22-10
DWG NO.	G14
JOB NO.	30287-G14
PAGE	12 of 14
DATE	05-11-10

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J43-534

WTUR0000703

JA 00003498

NEW CITY HALL
FRONT ELEVATION AND ONE-LINE
480V GENERATOR PARALLELING SWITCHGEAR
P01
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FRONT ELEVATION
ONE LINE
52D1
52D2
52D3
52D4
52D5
52G1
52G2
G1
G2
NEUTRAL DISCONNECT
3200A Cu
1/4" x 2" Cu

J43-536

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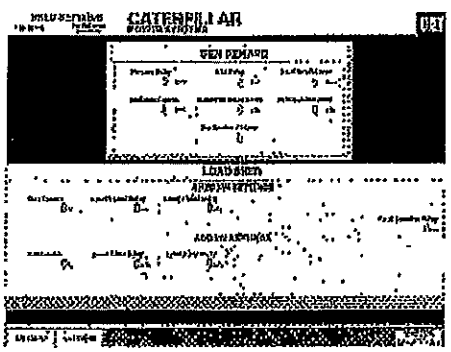
WTUR0000705

JA 00003500

15.5 Gen Demand Settings

Gen Demand & Load Shed Setting Screen



Screen Operations

Basic operations on the Gen Demand (and Load Shed) Setting Screen:

Gen Demand:

- *Remove time delay*
- *Add time delay*
- *Minimum Reserve KW*
- *Immediate Add Reserve*
- *Remove Differential*
- *Load Stabilization*
- *Min Number of Gens*

Operation

Generator Demand settings are set up as "View only". To change setpoint, the password must be entered.

Setting

Generator Demand Priority: Generator Demand Priority controls function to automatically match the on-line generator capacity to the loads in order to avoid unnecessary operation of all the generators when the plant loads are low. The removal and add condition of generators is based on the On-line reserve capacity.

ADD Condition:
Bus KW > Online Gen Capacity Min Reserve

REMOVE Condition:
Bus KW < Online Gen Capacity* Min Reserve - Remove Differential

* Remaining Online Gen Capacity after next generator has been removed.

Generator Demand Priority Settings:

Minimum Reserve: - This is the minimum reserve power the system should always have with the current online generators. In order to maintain the minimum reserve, additional generators can be brought to the bus.

Remove Differential: The value in KW sets the Remove Differential. Only when the bus KW drops under this value plus the Minimum Reserve a generator is removed from the bus.

Immediate Add Reserve: This setting is the KW setpoint to bypass the Add delay timer in case of a bus overload. If the load exceeds this setpoint any available generators offline will immediately be brought to the bus.

REMOVE DELAY: Time, in minutes, that the plant load must be in the **REMOVE** condition in order for the next lowest priority generator to be removed from the bus.

ADD DELAY: Time, in seconds, that plant load must be in the ADD condition in order for the next highest priority generator to be paralleled to the bus.

Load Stabilization: - This is the minimum time to allow all generators to come to the bus.

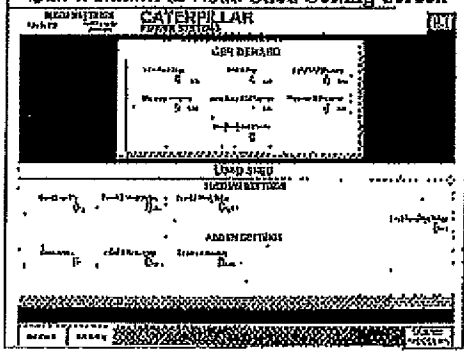
Min. Number of Gens: This number is the minimum Generators which will not be removed.

Generator Priority Requested/Actual: Each generator has a requested priority and an actual priority. Requested priorities are operator adjustable. Actual priorities are base on requested priority and generator availability.

PARAMETER	RANGE	DEFAULT VALUE
Minimum Reserve	1 - 32000	600
Remove Differential %	50 - 9999	2000
ADD TIME DELAY	1-900 sec.	30 sec.
REMOVE TIME DELAY	1-120 min.	10 min.
Immediate Add Reserve	1 - 32000	500
Min. Number of Gens	1 – 16	1
GENERATOR PRIORITY REQUEST	1-10	
1		1
2		2
3		3
4		4
5		5
6		6
7		7
8		8
9		9
10		10

15.6 Load Shed Settings

Gen Demand & Load Shed Setting Screen



Screen Operations

Basic operations on the (Gen Demand and) Load Shed Setting Screen:

Load Shed:

- *Shed level Percentage*
- *Shed time delay for each load shed level*
- *Add level Percentage*
- *Add time delay for each load shed level*
- *Under Frequency Trip*
- *Under Frequency Trip delay*

Operation

Load Shed settings are set up as "View only". To change setpoint, the password must be entered.

Load Shed Setting

SHED LEVEL %: Percentage of on-line generator capacity at which the next lowest Shed Level Priority will be disconnected from the bus.

LEVEL 'X' SHED DELAY: Time, in seconds, that the load must remain above the Shed Level % before that Shed Level Priority is removed from the bus.

ADD LEVEL %: Percentage of on-line generator capacity at which the next highest Shed Level Priority will be added to the bus.

LEVEL 'X' ADD DELAY: Time, in seconds, that the load must remain below the **ADD LEVEL %** before that Shed Level Priority is added to the bus.

Load Sensitive Delay: Time, in minutes, that is remained in Conditional Load Shed. When this timer expires the system enters Load Sensitive Load Shed.

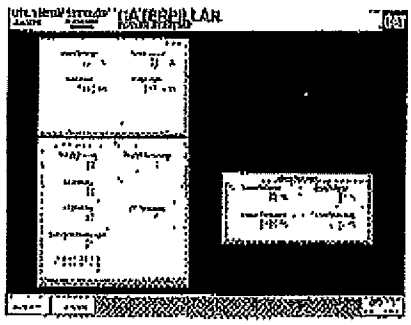
Under Frequency Trip: Frequency setpoint that will trigger a Bus under frequency alarm when in an overload condition.

Under Freq Trip Delay: Time, in seconds, that the system has to be in an overload condition before a system alarm is triggered.

PARAMETER	RANGE	DEFAULT VALUE
SHED LEVEL %	10 – 99%.	90%
ADD LEVEL %	10 – 99%	80%
SHED DELAY	1-999 sec	2 sec
ADD DELAY	1-999 sec	30 sec
Load Sensitive Delay	1 – 100 min	3 min
Under Frequency Trip	30.00 -60.00 Hz	55.00 Hz
Under Freq Trip Delay	1.0 – 20.0 sec	3.0 sec

16 Utility Setup Settings

16.1 Utility Setup

Utility Setting Screen	Screen Operations
	**Basic operations on the Utility Setting Screen:** • *Rated Voltage & Current* • *Rated kW & kVAR* • *Bus VT Primary* • *Bus VT Secondary* • *VT Primary* • *VT Secondary* • *Voltage Measure Type* • *Util Available Lower Voltage* • *Util Available Upper Voltage* • *Util Available Lower Frequency* • *Util Available Upper Frequency*

Operation

Utility settings are normally "View Only". To change setpoints, the password must be entered.

Setting Description

Rated Voltage: This is the Voltage rating of the utility. This variable is used for other setpoints which are entered in percent of this utility rated voltage.

Rated KW: This is the kW rating of the utility. This variable is used for protective setpoints which are entered in percent of this utility rated KW.

Rated kVAR: This is the kVAR rating of the utility. This variable is used for protective setpoints which are entered in percent of this utility rated kVAR

Bus VT Primary: This is the busbar primary Voltage transformer setting.

Bus VT Secondary: This is the busbar secondary Voltage transformer setting.

CT Primary: This is the utility primary current transformer setting.

VT Primary: This is the busbar primary Voltage transformer setting.

VT Secondary: This is the busbar secondary Voltage transformer setting.

Voltage Measure Type: This is sets the voltage measurement type. Following types are supported: 0 = 3phase4wire, 1 = 3phase3wire, 2 = 1phase2wire and 3 = 1phase3wire.

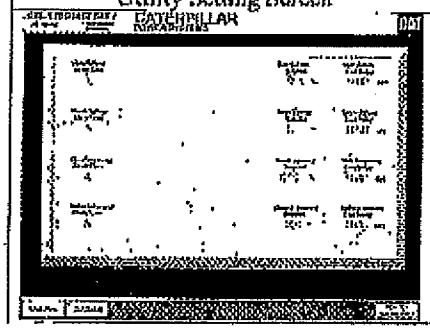
Lower Voltage (Utility Available): This setting is the lower variable setpoint where the utility voltage is considered to be in range. The value is entered in percentage of the utility rated voltage.

Upper Voltage (Utility Available): This setting is the upper variable setpoint where the utility voltage is considered to be out of range. The value is entered in percentage of the utility rated voltage.

Lower Frequency (Utility Available): This setting is the lower variable setpoint where the utility frequency is considered to be in range. The value is entered in percentage of the utility rated frequency.

Upper Frequency (Utility Available): This setting is the lower variable setpoint where the utility frequency is considered to be out of range. The value is entered in percentage of the utility rated frequency.

16.2 Utility Protective Settings

Utility Setting Screen	Screen Operations
	**Basic operations on the Utility Setting Screen:** • *Over/Under Voltage Setpoint* • *Over/Under Voltage Alarm Class* • *Over/Under Voltage Time delay* • *Over/Under Frequency Setpoint* • *Over/Under Frequency Alarm Class* • *Over/Under Frequency Time delay*

Operation

Utility settings are normally "View Only". To change setpoints, the password must be entered.

Setting Description

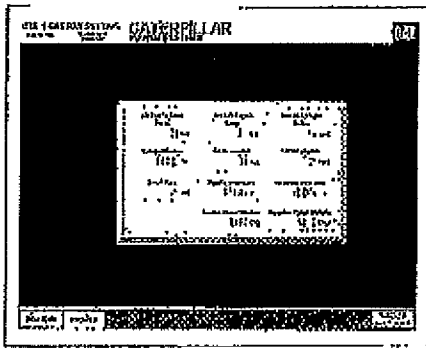
Under/Over Voltage & Time Delay: This is a protective function that is monitored within PowerLynx, which senses the utility voltage. When the utility voltage is below/above the setpoint for the allotted time delay (Under/Over Voltage Delay) will activate the trip function within PowerLynx, open the breaker.

Over Voltage & Under Voltage Alarm Class: This setting is the alarm class and the taken action when the Over/Under voltage alarm is triggered. The alarm classes A-F are supported. Please refer. APPENDIX D: Alarm Classes and Actions for details.

Under/Over Frequency & Time Delay: This is a protective function that is monitored within PowerLynx, which senses the utility frequency. When the utility frequency is below/above the setpoint for the allotted time delay (Under/Over Frequency Delay) will activate the trip function within PowerLynx, open the breake.

Over/Under Frequency Alarm Class: This setting is the alarm class and the taken action when the Over/Under frequency alarm is triggered. The alarm classes A-F are supported. Please refer. APPENDIX D: Alarm Classes and Actions for details.

16.3 Utility Circuit Breaker Settings



Basic operations on the Gen Circuit Breaker Settings screen:

- *CB Fail to Close /Open Delay*
- *CB Fail to Sync Delay*
- *Voltage Window*
- *CB On/Off Impulse*
- *Phase Angle Dwell Time*
- *Negative / Positive Slew Rate*
- *Positive / Negative Phase Window*

Operation

System settings are normally "View Only". To change setpoint, the password must be entered.

Setting Description

CB Fail to Open/Close Delay: This setting is the number of milliseconds allotted to open/close the utility breaker after an open/close command was issued. When this time is expired, then a fail to open/close alarm will be generated for the appropriate generator.

Fail to Synchronize Delay: This setting is the number of milliseconds that a synchronizing attempt will be made. When this time is expired, then a fail to synchronize alarm will be generated for the utility.

Voltage Window: This setting is the voltage dead band around the targeted bus voltage (+/- Bus Voltage) that the generator voltage must be within prior to issuing a command to close the utility breaker. It is entered in percent of the utility rated voltage.

CB On/Off Impulse: This setting is the number of milliseconds allotted to the pulse On/Off timings on a generator breaker open or close command. The On pulse sets the time that an open/close command goes true. The Off impulse sets the time the signal stays false before going true again.

Dwell Time: This setting is the number of milliseconds that the phase angle must remain in the in the synchronizing window (Positive and Negative Phase Window) prior to issuing a command to close the breaker.

Positive Phase Window: This setting is the number of degrees seen from the top of the Synchroscope meter (12:00) to left hand side (slow side) where the synchronizing window starts and initiates the dwell time.

Negative Phase Window: This setting is the number of degrees seen from the top of the Synchroscope meter (12:00) to right hand side (fast side) where the synchronizing window starts and initiates the dwell time.

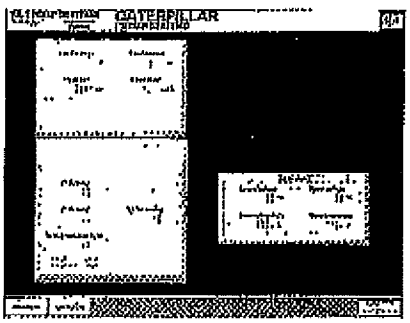
Positive Slew Rate: This setting is the positive setpoint of the frequency dead band around the target bus frequency that the generator frequency must be within prior to issuing a command to close the breaker.

Negative Slew Rate: This setting is the negative setpoint of the frequency dead band around the target bus frequency that the generator frequency must be within prior to issuing a command to close the breaker.

Disconnect kW: This setting is utilized when the system performs soft unloading across the breaker. When the kW across the breaker is unloaded below the setpoint, the breaker will open.

17 Tie Setup Settings

17.1 Tie Setup

Tie Setting Screen	Screen Operations
	Basic operations on the Utility Setting Screen: • *Rated Voltage & Current* • *Rated kW & kVAR* • *CT Primary* • *VT Primary* • *VT Secondary* • *Voltage Measure Type* • *Tie Available Lower Voltage* • *Tie Available Upper Voltage* • *Tie Available Lower Frequency* • *Tie Available Upper Frequency* •

Operation

Utility settings are normally "View Only". To change setpoints, the password must be entered.

Setting Description

Rated Voltage: This is the Voltage rating of the busbar. This variable is used for other setpoints which are entered in percent of this busbar rated voltage.

Rated KW: This is the kW rating of the utility. This variable is used for protective setpoints which are entered in percent of this utility rated KW.

Rated kVAR: This is the KVAR rating of the busbar. This variable is used for protective setpoints which are entered in percent of this busbar rated KVAR

CT Primary: This is the bus bar primary current transformer setting.

VT Primary: This is the bus bar primary Voltage transformer setting.

VT Secondary: This is the bus bar secondary Voltage transformer setting.

Voltage Measure Type: This is sets the voltage measurement type. Following types are supported: 0 = 3phase 4wire, 1 = 3phase 3wire, 2 = 1phase 2wire and 3 = 1phase 3wire.

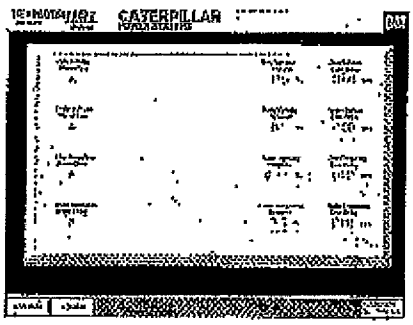
Lower Voltage (Bus bar Available): This setting is the lower variable setpoint where the busbar voltage is considered to be in range. The value is entered in percentage of the utility rated voltage.

Upper Voltage (Bus bar Available): This setting is the upper variable setpoint where the busbar voltage is considered to be out of range. The value is entered in percentage of the busbar rated voltage.

Lower Frequency (Bus bar Available): This setting is the lower variable setpoint where the busbar frequency is considered to be in range. The value is entered in percentage of the busbar rated frequency.

Upper Frequency (Bus bar Available): This setting the lower variable setpoint where the busbar frequency is considered to be out of range. The value is entered in percentage of the busbar rated frequency.

17.2 Tie Protective Settings

Tie Protective Setting Screen	Screen Operations
	Basic operations on the Tie Setting Screen: • *Over Voltage Alarm Class* • *Under Voltage Alarm Class* • *Over Frequency Alarm Class* • *Under Frequency Alarm Class* • *Over Voltage Setpoint* • *Over Voltage Time delay* • *Under Voltage Setpoint* • *Under Voltage Time delay* • *Over Frequency setpoint* • *Over Frequency Time Delay* • *Under Frequency setpoint* • *Under Frequency Time Delay*

Operation

Utility settings are normally "View Only". To change setpoints, the password must be entered.

Setting Description

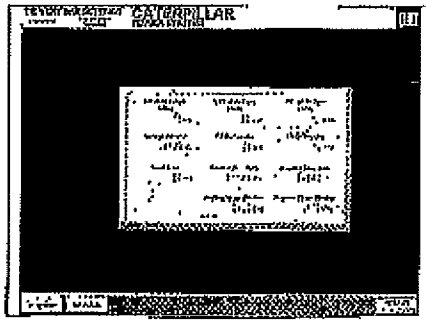
Under/Over Voltage & Time Delay: This is a protective function that is monitored within PowerLynx, which senses the tie voltage. When the tie voltage is below/above the setpoint for the allotted time delay (Under/Over Voltage Delay) will activate the trip function within PowerLynx, open the breaker.

Over Voltage & Under Voltage Alarm Class: This setting is the alarm class and the taken action when the Over/Under voltage alarm is triggered. The alarm classes A-F are supported. Please refer, APPENDIX D: Alarm Classes and Actions for details.

Under/Over Frequency & Time Delay: This is a protective function that is monitored within PowerLynx, which senses the tie frequency. When the tie frequency is below/above the setpoint for the allotted time delay (Under/Over Frequency Delay) will activate the trip function within PowerLynx, open the breaker.

Over/Under Frequency Alarm Class: This setting is the alarm class and the taken action when the Over/Under frequency alarm is triggered. The alarm classes A-F are supported. Please refer, APPENDIX D: Alarm Classes and Actions for details.

17.3 Tie Circuit Breaker Settings



Basic operations on the Tie Breaker Settings screen:

- *CB Fail to Close /Open Delay*
- *CB Fail to Sync Delay*
- *Voltage Window*
- *CB On/Off Impulse*
- *Phase Angle Dwell Time*
- *Negative / Positive Slew Rate*
- *Positive / Negative Phase Window*

Operation

System settings are normally "View Only". To change setpoint, the password must be entered.

Setting Description

CB Fail to Open/Close Delay: This setting is the number of milliseconds allotted to open/close the tie breaker after an open/close command was issued. When this time is expired, then a fail to open/close alarm will be tie breaker.

Fail to Synchronize Delay: This setting is the number of milliseconds that a synchronizing attempt will be made. When this time is expired, then a fail to synchronize alarm will be generated for the tie breaker.

Voltage Window: This setting is the voltage dead band around the targeted bus voltage (+/- Bus Voltage) that the busbar voltage must be within prior to issuing a command to close the tie breaker. It is entered in percent of the busbar rated voltage.

CB On/Off Impulse: This setting is the number of milliseconds allotted to the pulse On/Off timings on a tie breaker open or close command. The On pulse sets the time that an open/close command goes true. The Off impulse sets the time the signal stays false before going true again.

Dwell Time: This setting is the number of milliseconds that the phase angle must remain in the in the synchronizing window (Positive and Negative Phase Window) prior to issuing a command to close the breaker.

Positive Phase Window: This setting is the number of degrees seen from the top of the Synchroscope meter (12:00) to left hand side (slower side) where the synchronizing window starts and initiates the dwell time.

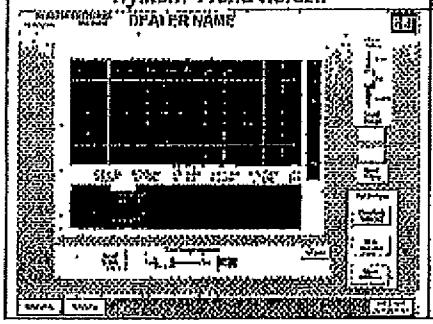
Negative Phase Window: This setting is the number of degrees seen from the top of the Synchroscope meter (12:00) to right hand side (fast side) where the synchronizing window starts and initiates the dwell time.

Positive Slew Rate: This setting is the positive setpoint of the frequency dead band around the target bus frequency that the generator frequency must be within prior to issuing a command to close the tie breaker.

Negative Slew Rate: This setting is the positive setpoint of the frequency dead band around the target bus frequency that the generator frequency must be within prior to issuing a command to close the tie breaker.

18 Trending

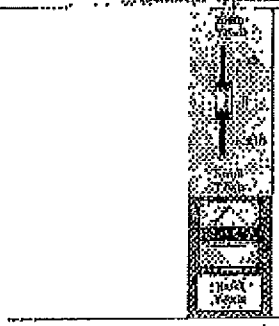
18.1 System Real Time Trend Screen

System Trend Screen	Screen Operations
	**Basic operations on the System Trend Screen:** • *System kW* • *Each individual Generators kW*

Operation and buttons

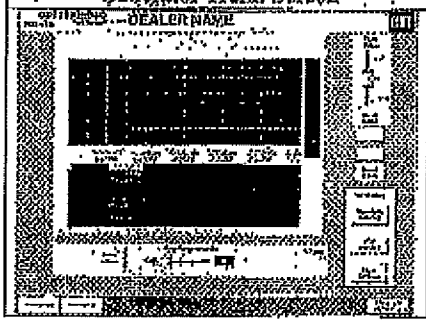
Time Range

Time Ranges: • Touch and move the slider to expand or condense the amount of time that is viewed • Pressing the Reset X-Axis button will return the time to the original state • Pressing the Pause button will pause time and also change states and will display Play • Pressing Play will display current time

Engine Historical Trend Screen	Screen Operations
	

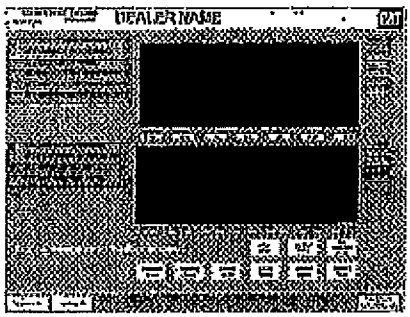
Pen Masking: • By pressing 1 of these 3 buttons you have the option of showing only 1 pen, all pens or hiding the pens that are selected.	**Y-Axis:** • Touch and move the slider to expand or condense the scale that is viewed • Pressing the Reset Y-Axis button will return the scale to the original state

18.2 Generator Real Time Trend Screen

Generator Trend Screen	Screen Operations
	**Basic operations on the Generator Trend Screen:** • *Current* • *Real power (kW)* • *Reactive power (kVAR)* • *Voltage*

18.3 Engine Historical Trend

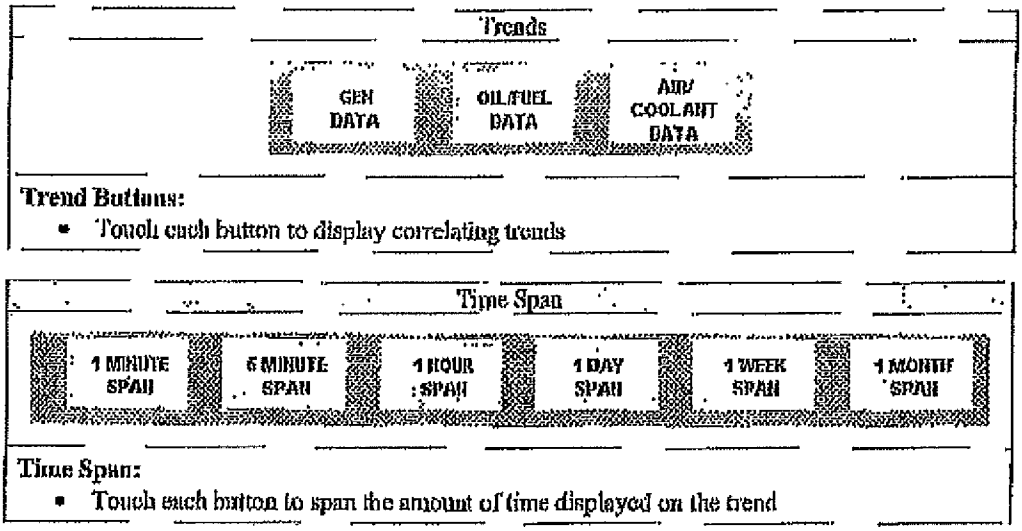
Engine Historical Trend Screen	Screen Operations



Basic operations on the Engine Historical Trend Screen:

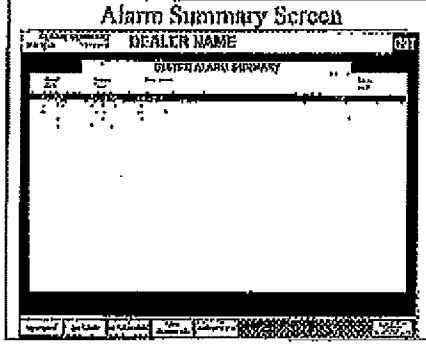
- *Average Current*
- *Average Voltage*
- *Fuel Consumption Rate*
- *Air Filter Restriction*
- *Atmospheric Pressure*
- *Boost Pressure*
- *Left Air Filter*
- *Right Air Filter*
- *Left Turbo Inlet Pressure*
- *Right Turbo Inlet Pressure*
- *After Coolant Temperature*
- *Filtered Oil Pressure*
- *Left Exhaust Temp*
- *Right Exhaust Temp*
- *Engine speed*
- *Oil pressure*
- *Water temperature*
- *Battery Voltage*

Operation and buttons

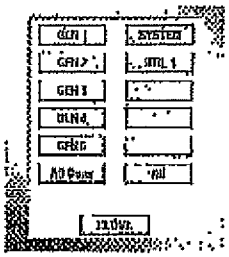


19 Alarm Summary

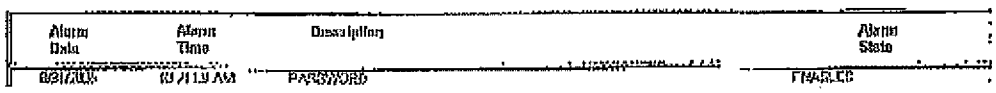
19.1 Purpose

Alarm Summary Screen	Screen Operations
	**Basic operations on the Alarm Summary Screen:** • The Alarm Summary is used to record of all events in the PowerLynx system.

19.2 Filter

Alarm Filter Popup	Operations
	**Basic operations on the Alarm Filter Popup:** • Each individual component with an annunciation system can be filtered to view only the alarm information pertaining to that component. • To filter: Touch filter alarm button and then select component to view filtered data.

19.3 Indication of Alarm

Date/Time/Description	Operations
	**Alarm Indication will show:** • Date of the Event • Time of the Event • Description of the Event • State of the Event

19.4 Indication of Cleared Condition

Alarm State	Operations
Alarm State ENABLED DISABLED	**Basic operations of the Alarm State:** • When Events are cleared the summary will indicate a state change.

19.5 Printing of Alarm Summary

Print Screen Button	Operations
PRINT SCREEN	**Basic operations of the Print Screen Button:** • Alarm summary may be printed, via an optional report printer, by pressing this button. • This button is located on the Alarm Summary Screen and Reports Screens only if you have a printer connected (and option purchased).

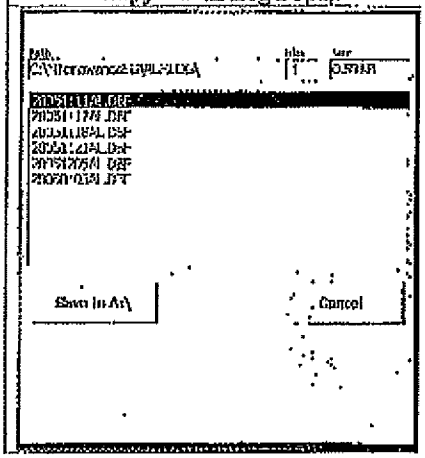
19.6 Copy Alarm Log

Copy Alarm Log Button

Copy Alarm Log Button	Operations
COPY ALARM LOG	**Basic operations of the Copy Alarm Log Button:** • Touch this button to invoke the Copy Alarm Log Popup Screen.

Copy Alarm Log Popup

Copy Alarm Log Popup



Operations

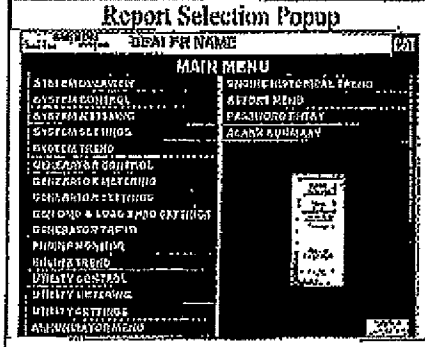
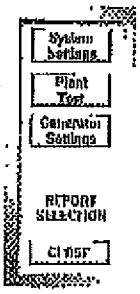
Basic operations of the Copy Alarm Log Popup Button:

- On this Popup Screen, you can save the Alarm Parameters to your floppy drive.

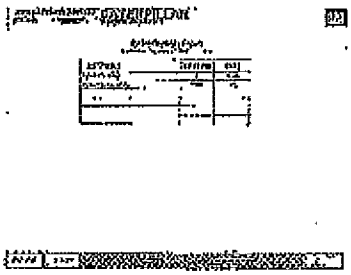
20 Report Menu

20.1 Report Selection Popup

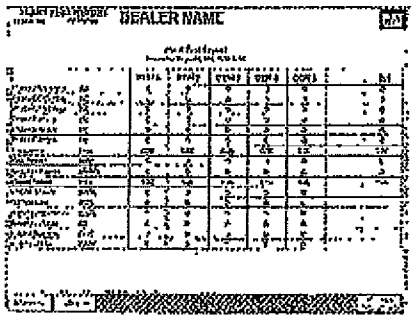
*Note: All reports can be accessed via the Main Menu Screen

Report Selection Popup	Operations
 	**Basic operations on the Report Selection Popup:** ▪ The popup can be invoked by pressing the Report Menu Button on the Main Menu Available reports/information • System Settings Report • Plant Test Report • Generator Settings Report

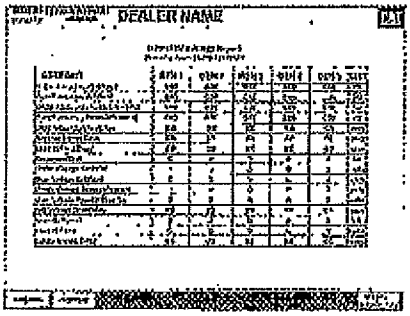
20.2 System Settings Report

System Settings Report Screen	Screen Operations
	**Basic operations on the System Settings Report Screen:** • *Voltage* • *Frequency*

20.3 Plant Test Report

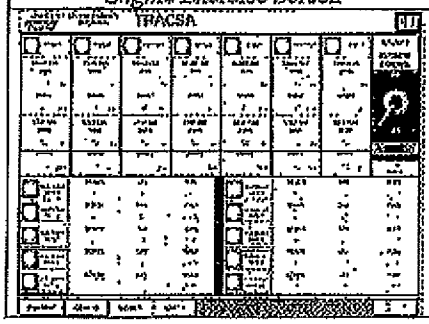
Plant Test Report Screen	Screen Operations
	**Basic operations of the Plant Test Report Screen:** • *Voltage* • *Current* • *Frequency* • *Real power output* • *Reactive power output* • *PF* • *Engine speed* • *Oil Pressure* • *Water Temperature* • *Battery Voltage* • *Run Hours* • *Engine Starts*

20.4 Generator Settings Report

Generator Settings Report Screen	Screen Operations
	**Basic operations of the Generator Settings Report Screen:** • *Under Frequency setpoint* • *Over Frequency setpoint* • *Under Frequency reset differential* • *Over Frequency reset differential* • *U/O Frequency time delay* • *Reverse Power time delay* • *Loss of Field time delay* • *Disconnect kW* • *Under Voltage setpoint* • *Over Voltage setpoint* • *Under Voltage reset differential* • *Over Voltage reset differential* • *Reverse Power setpoint* • *Loss of Field setpoint* • *Safety Arming Delay*

21 Options

21.1 Engine Exercise Timer

Engine Exercise Screen	Screen Operations
	**Basic operations on the Engine Exercise Screen:** **Purpose** • The Engine Exercise Timer is set up and designed to allow periodic running of the engines under either "No Load" or "With Load" test conditions.

21.2 Optional Languages

- Currently, only English is offered. There are more languages to come..

22 Factory Default Settings

22.1 System Settings Factory Default

System Voltage:	Volt	480
System Frequency:	Hz	60
System KW Ramp Rate:	kW	25

22.2 Generator Factory Default Setup Settings

Rated Voltage	Volt	480
Rated KW:	kW	1000
Rated kVAR:	kVAR	1000
Cooldown:	Min	5
Engine Safety Alarm	Sec	15
Bus VT Primary:	Volt	480
Bus VT Secondary:	Volt	480
CT Primary	[1]	1500
NGR CT Primary	[1]	20
Voltage Measure Type:	[1]	0 = 3 Phase 4 Wire
Speed Droop Setpoint:	Hz	60
Lower Voltage (Gen available):	% (of rated Voltage)	90
Upper Voltage (Gen available)	% (of rated Voltage)	110
Lower Frequency (Gen available):	% (of rated Frequency)	90
Upper Lower Frequency (Gen available):	% (of rated Frequency)	110

22.3 Generator Protective Settings

Reverse kW Alarm Class	[1]	F
Reverse kW Setpoint	% (of rated kW)	-5
Reverse kW Time Delay	Sec	3
Over Excitation Alarm Class:	[1]	5 = F
Under/Over Excitation Setpoint	% (of rated Frequency)	20
Over Excitation Time Delay:	sec	10
Under Excitation Time Delay:	sec	10
Over Voltage Alarm	[1]	5 = F

Class:		
Over Voltage Setpoint	% (of rated Voltage)	112
Over Voltage Time Delay:	sec	3
Under Voltage Alarm Class:	[1]	F
Under Voltage Setpoint	% (of rated Voltage)	88
Over Frequency Alarm Class:	[1]	5 = F
Over Frequency Setpoint	% (of rated Frequency)	115
Over Frequency Time Delay:	sec	3
Under Frequency Alarm Class:	[1]	5 = F
Under Frequency Setpoint	% (of rated Frequency)	85
Under Frequency Time Delay:	sec	3

22.4 Gen Circuit Breaker Settings

CB Fail to Open Delay	ms	500
CB Fail to Close Delay	ms	500
CB Fail to Synchronize Delay	sec	90
Voltage Window:	% (of rated Voltage)	3
CB On Impulse:	ms	250
CB On Impulse:	ms	250
Dwell Time:	ms	250
Positive Phase Window:	Hz	0.04
Negative Phase Window:	Hz	-0.04
Positive Slew Rate:	deg	7
Negative Slew Rate:	deg	-7

22.5 Load Shed/Gen Demand Settings

REMOVE DELAY	min	10
ADD DELAY:	sec	30
Load Stabilization	min	10
Minimum Reserve	kW	2000

Immediate Add Reserve	kW	500
Remove Differential	kW	2000
Min. Number of Gens:	[1]	1
Shed Level %:	%	90
Level 'X' Shed Delay	sec	10
Add Delay %:	%	60
Level 'X' Add Delay:	min	5
Load Sensitive Delay	min	3
Under Frequency Trip	Hz	55.00
Under Frequency Trip Delay	sec	30

22.6 Utility Setup Settings

Rated Voltage:	Volt	480
Rated Current	Amp	1000
Rated KW	kW	2000
Rated kVAR	kW	2000
Rated Bus Voltage:	Volt	480
Bus VT Primary:	[1]	480
Bus VT Secondary	[1]	480
CT Primary:	[1]	1500
VT Primary:	[1]	20
VT Secondary:	[1]	480
Voltage Measure Type:	[1]	0 = 3 Phase 4 Wire
Lower Voltage (Utility Available):	% (of rated Voltage)	90
Upper Voltage (Utility Available):	% (of rated Voltage)	110
Lower Frequency (Utility Available	% (of rated Frequency)	90
Upper Frequency (Utility Available):	% (of rated Frequency)	110

22.7 Utility Protective Settings

Under Voltage Alarm Class	[1]	F
Under Voltage Setpoint	% (of rated Voltage)	90
Under Voltage Time Delay:	sec	0.6

Over Voltage Alarm Class	[1]	F
Over Voltage Setpoint	% (of rated Voltage)	110
Over Voltage Time Delay:	sec	0.6
Under Frequency Alarm Class	[1]	5 = F
Under Frequency Setpoint	% (of rated Frequency)	90
Under Frequency Time Delay:	sec	0.6
Over Frequency Alarm Class	[1]	5 = F
Over Frequency Setpoint	% (of rated Frequency)	110
Over Frequency Time Delay:	sec	0.6

22.8 Utility Circuit Breaker Settings

CB Fail to Open Delay	ms	1000
CB Fail to Close Delay	ms	1000
Fail to Synchronize Delay	sec	90
Voltage Window:	% (of rated Voltage)	300
CB On Impulse	ms	250
CB Off Impulse	ms	250
Dwell Time	ms	250
Positive Slew Rate	Hz	0.04
Negative Slew Rate	Hz	-0.04
Positive Phase Window:	Deg	7
Negative Phase Window:	Deg	-7

22.9 Tie Setup Settings

Rated Voltage:	Volt	480
Rated KW	kW	1000
Rated kVAR:	kVAR	1000
CT Primary:	Amp	300
VT Primary:	Volt	480
VT Secondary:	Volt	480
Voltage Measure Type:	[1]	0 = 3 Phase 4 Wire

Lower Voltage (Busbar Available):	% (of rated Voltage)	90
Upper Voltage (Busbar Available):	% (of rated Voltage)	110
Lower Frequency (Busbar Available):	% (of rated Frequency)	90
Upper Frequency (Busbar Available):	% (of rated Frequency)	110

22.10 Tie Protective Settings

Under/Over Voltage & Time Delay	sec	3
Over Voltage & Under Voltage Alarm Class	[1]	5 = F
Under/Over Frequency & Time Delay:	sec	3
Over/Under Frequency Alarm Class	[1]	5 = F

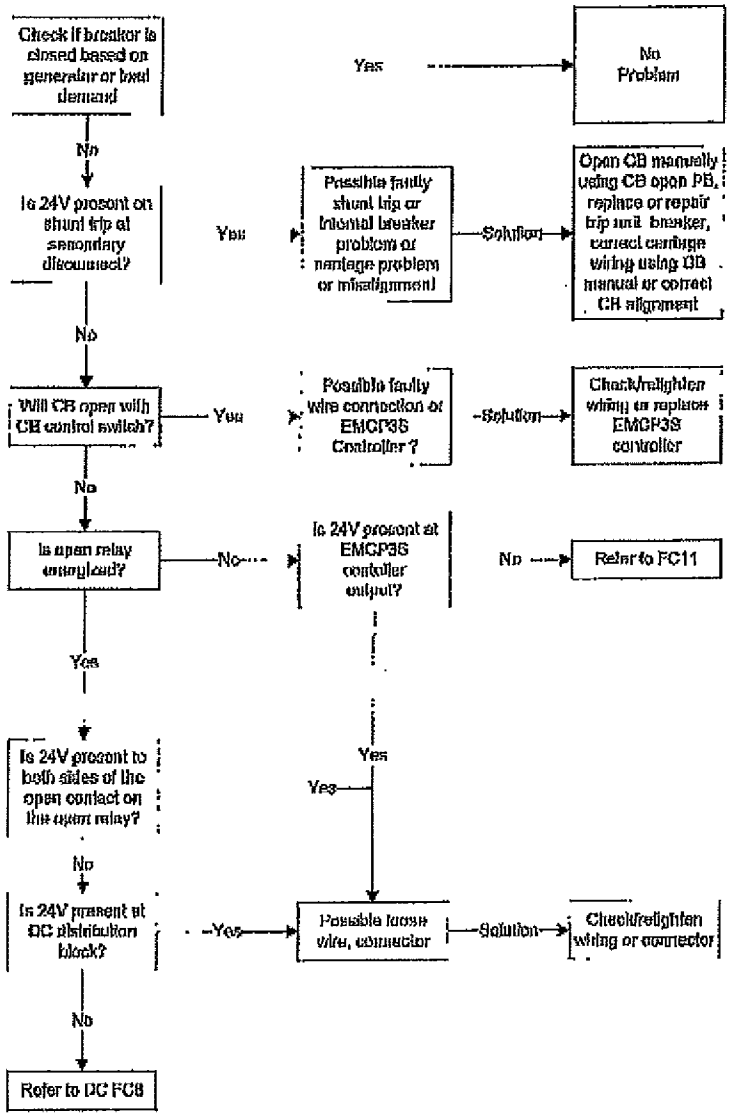
22.11 Tie Circuit Breaker Settings

CB Fail to Open/Close Delay:	ms	1000
Fail to Synchronize Delay:	sec	90
Voltage Window:	%	1
CB On/Off Impulse	ms	250
Dwell Time	sec	30
Positive Phase Window:	Deg	7
Negative Phase Window	Deg	-7
Positive Slew Rate:	Hz	0.18
Negative Slew Rate	Hz	-0.1

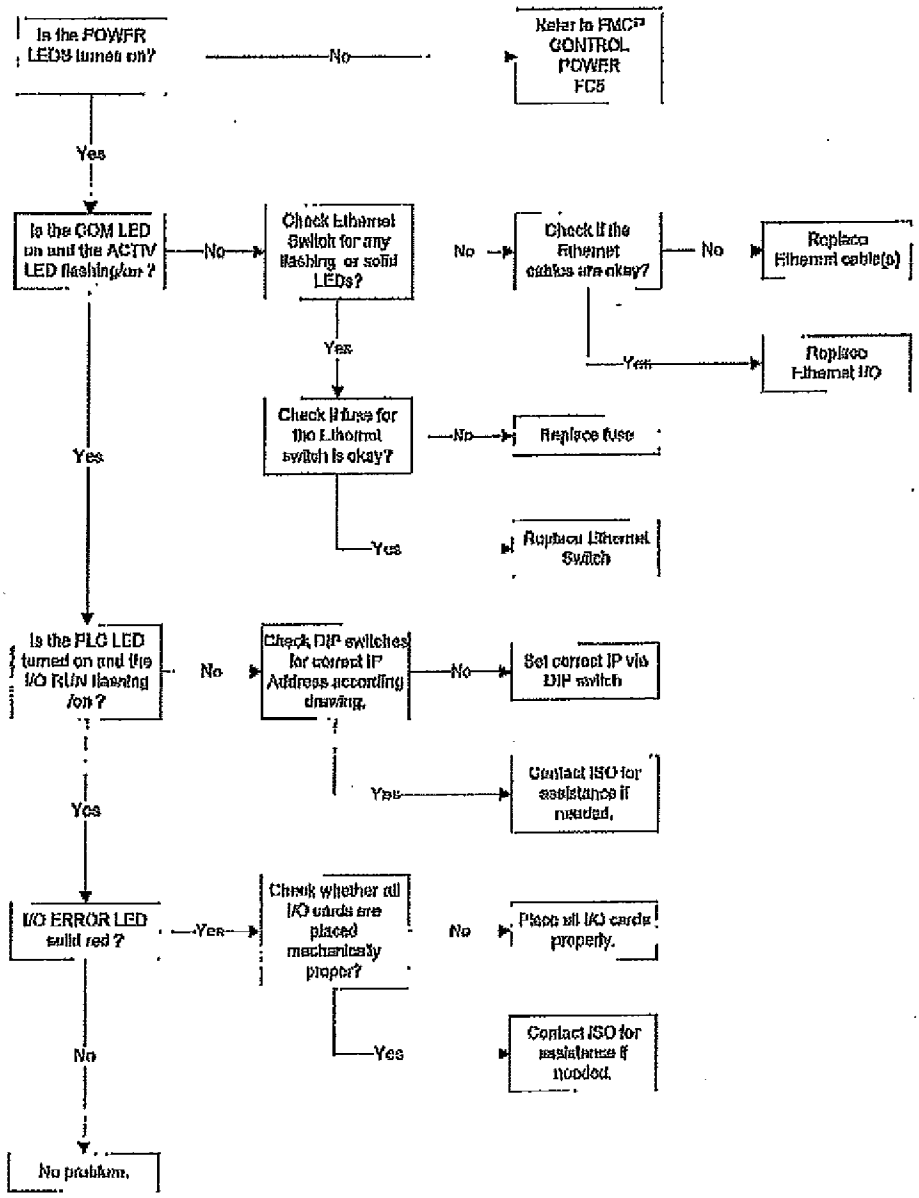
23 Trouble Shooting Guide

23.1 Troubleshooting Flowcharts

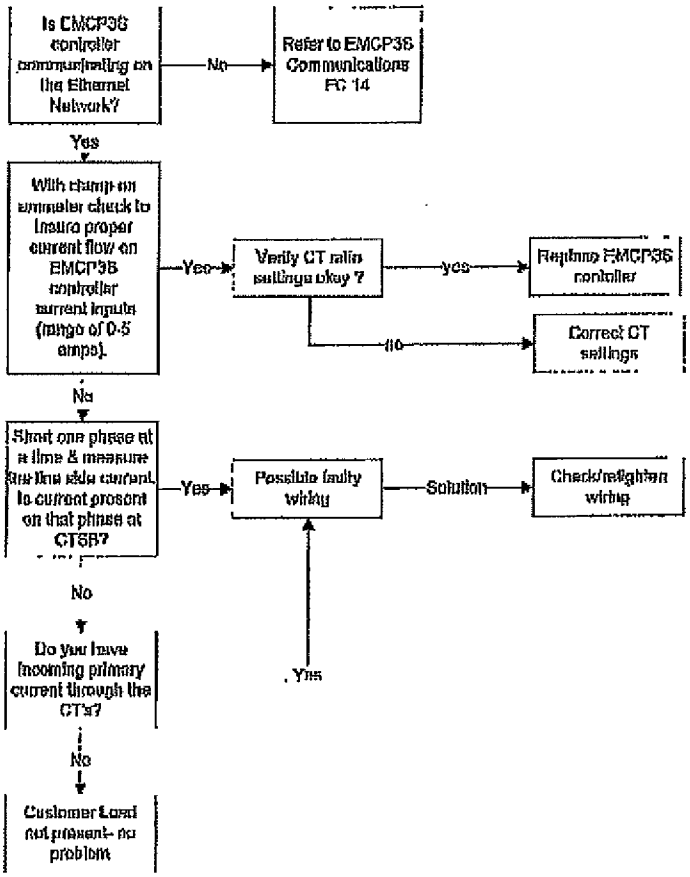
23.1.1 FC1 - Circuit Breaker Will Not Open



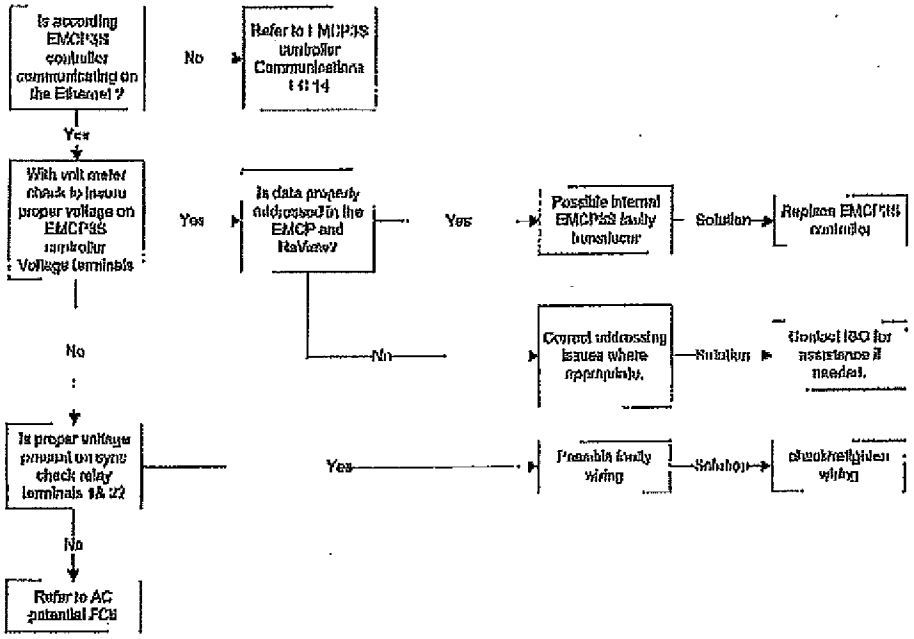
23.1.2 FC2 - Circuit Breaker Will Not Close



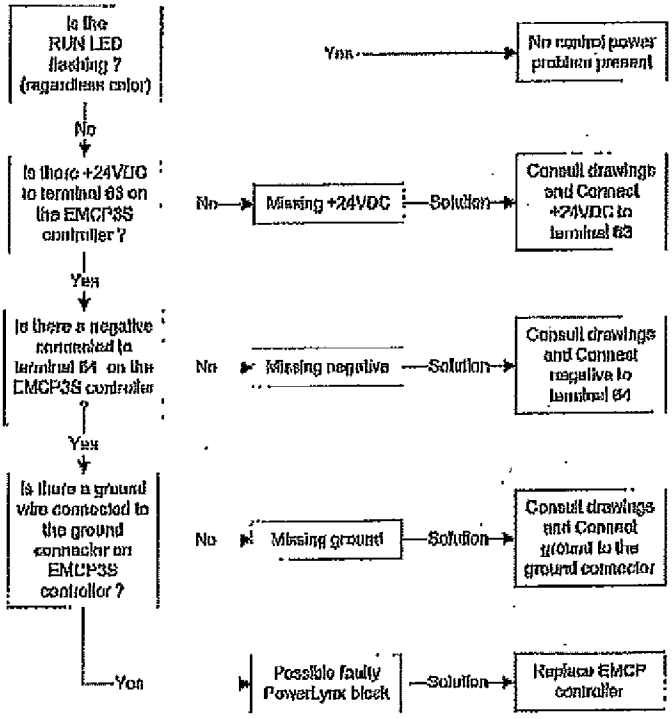
23.1.3 FC3 – No Current on Metering Screen / EMCP3S CT Inputs



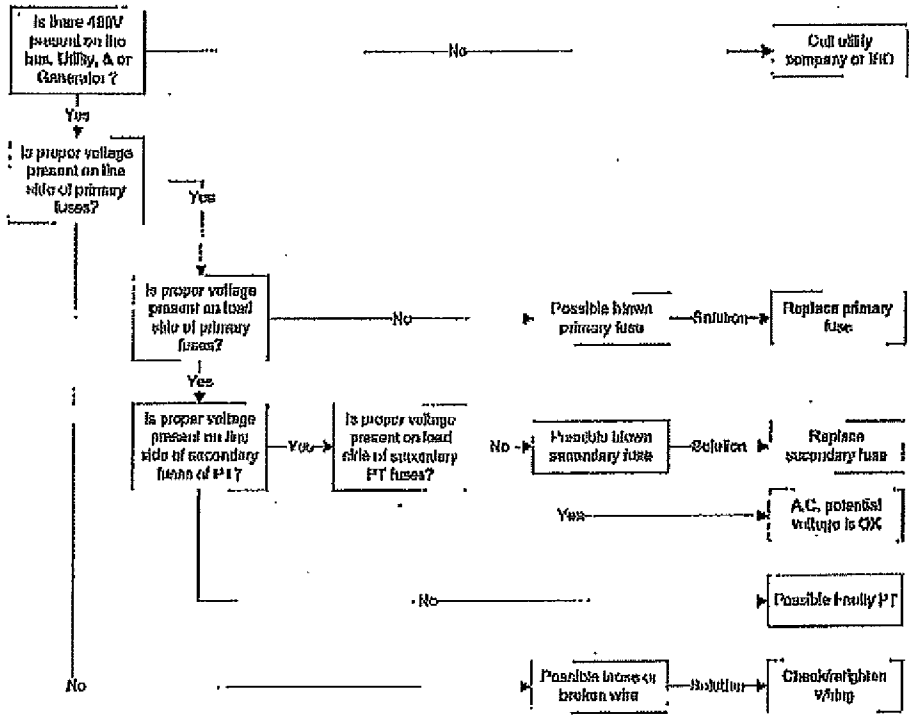
23.1.4 FC4 - NO AC Voltage on Metering Screen/ EMCP3S PT Inputs



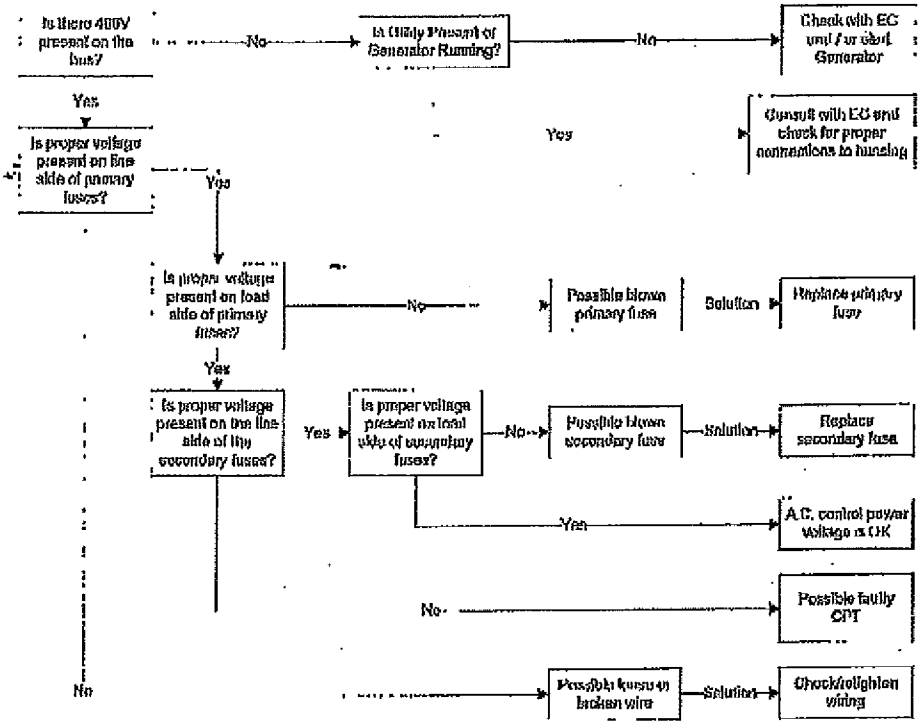
23.1.5 FC5 - EMCP3S Control Power



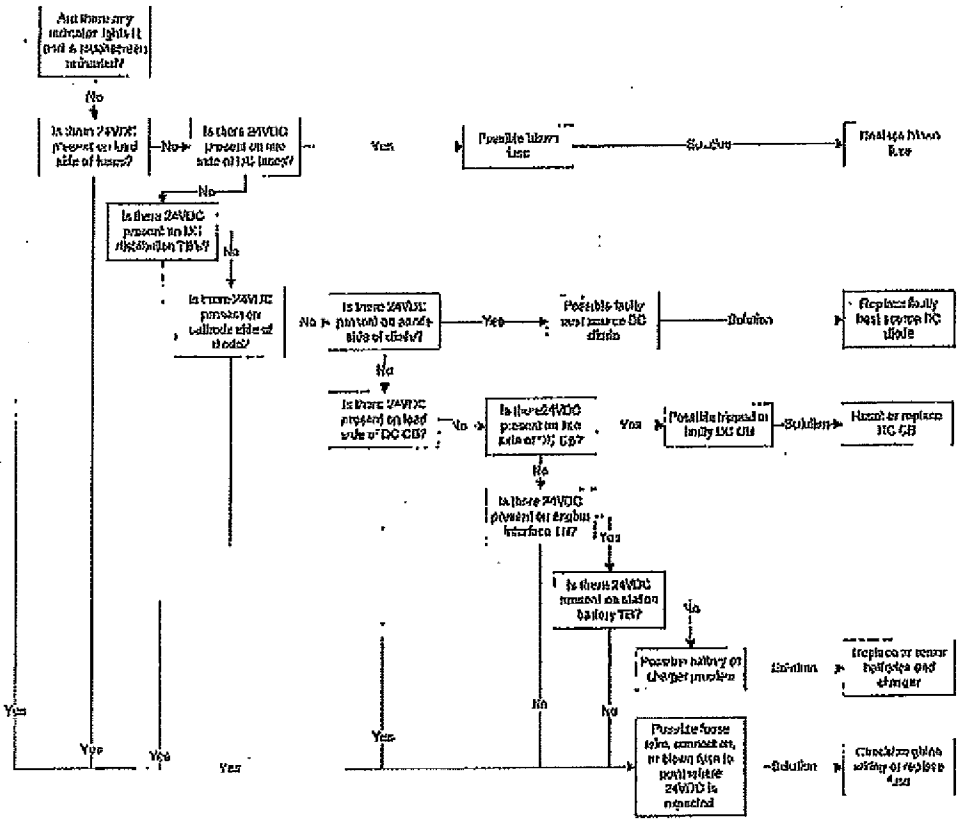
23.1.6 FC6 - A.C. Potential Voltage



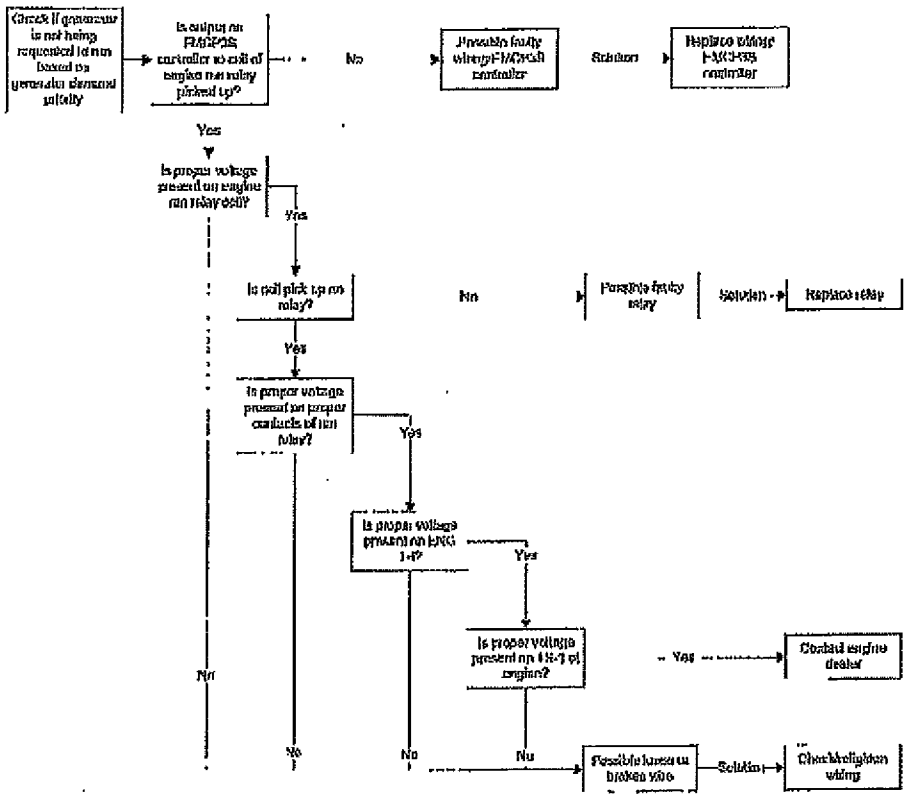
23.1.7 FC7 - A.C. Control Power Voltage



23.1.8 FC8 - D.C. Voltage

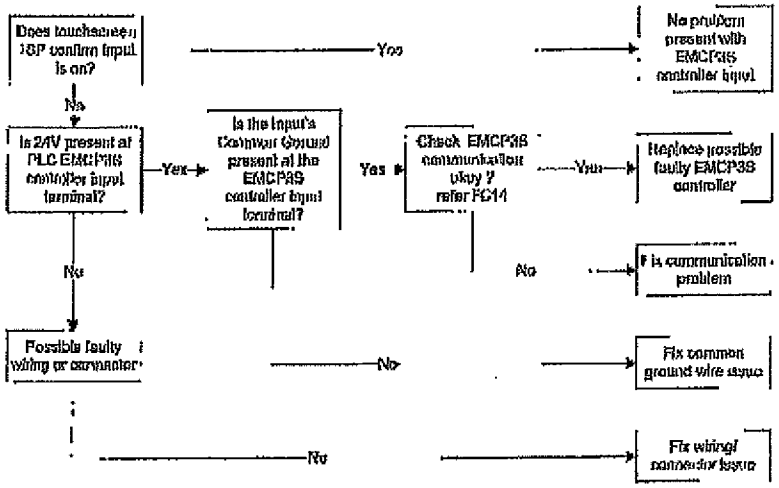


23.1.9 FC9 - Engine Run Relay

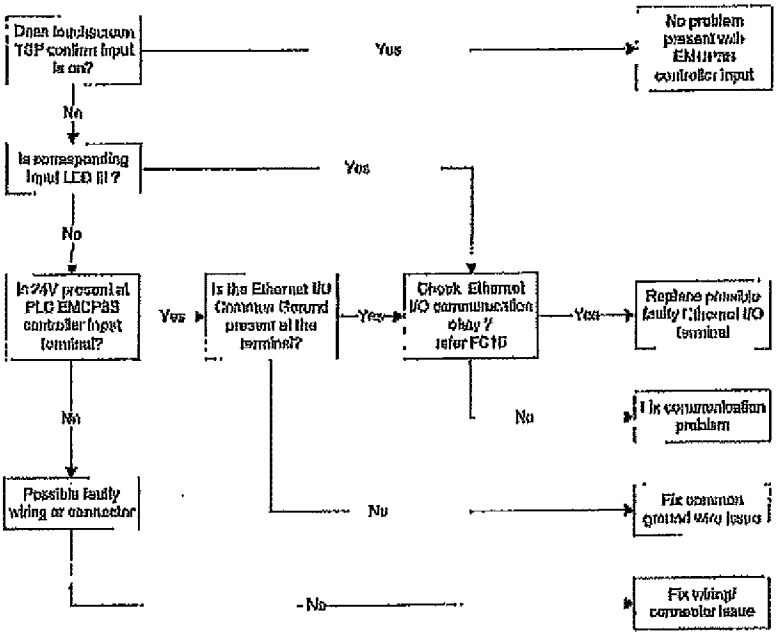


23.1.10 FC10- Discrete Inputs

EMCP3S CONTROLLER INPUTS

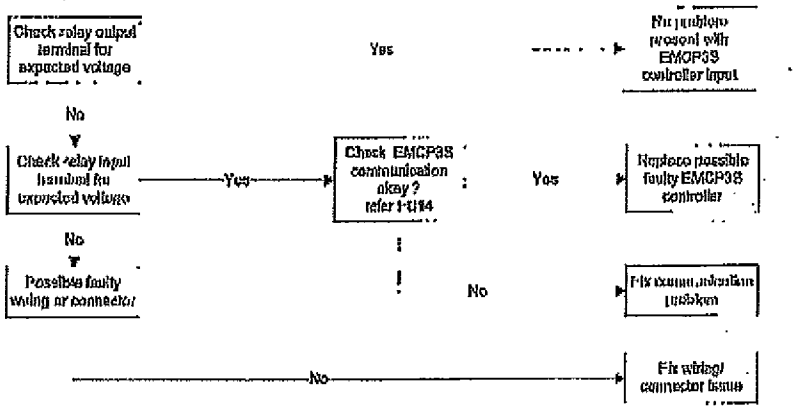


ETHERNET I/O INPUTS

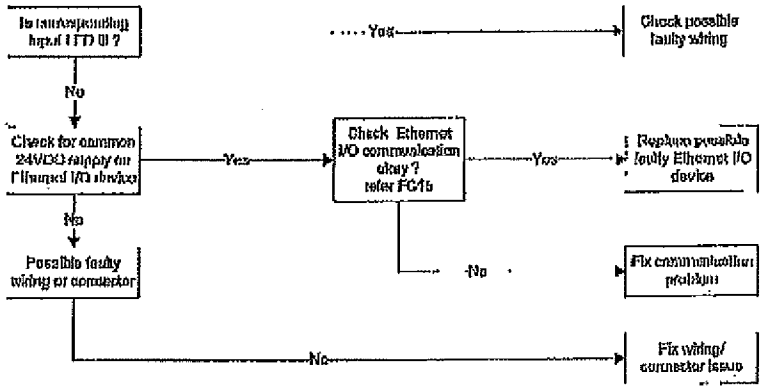


23.1.11 FC11- Discrete Outputs

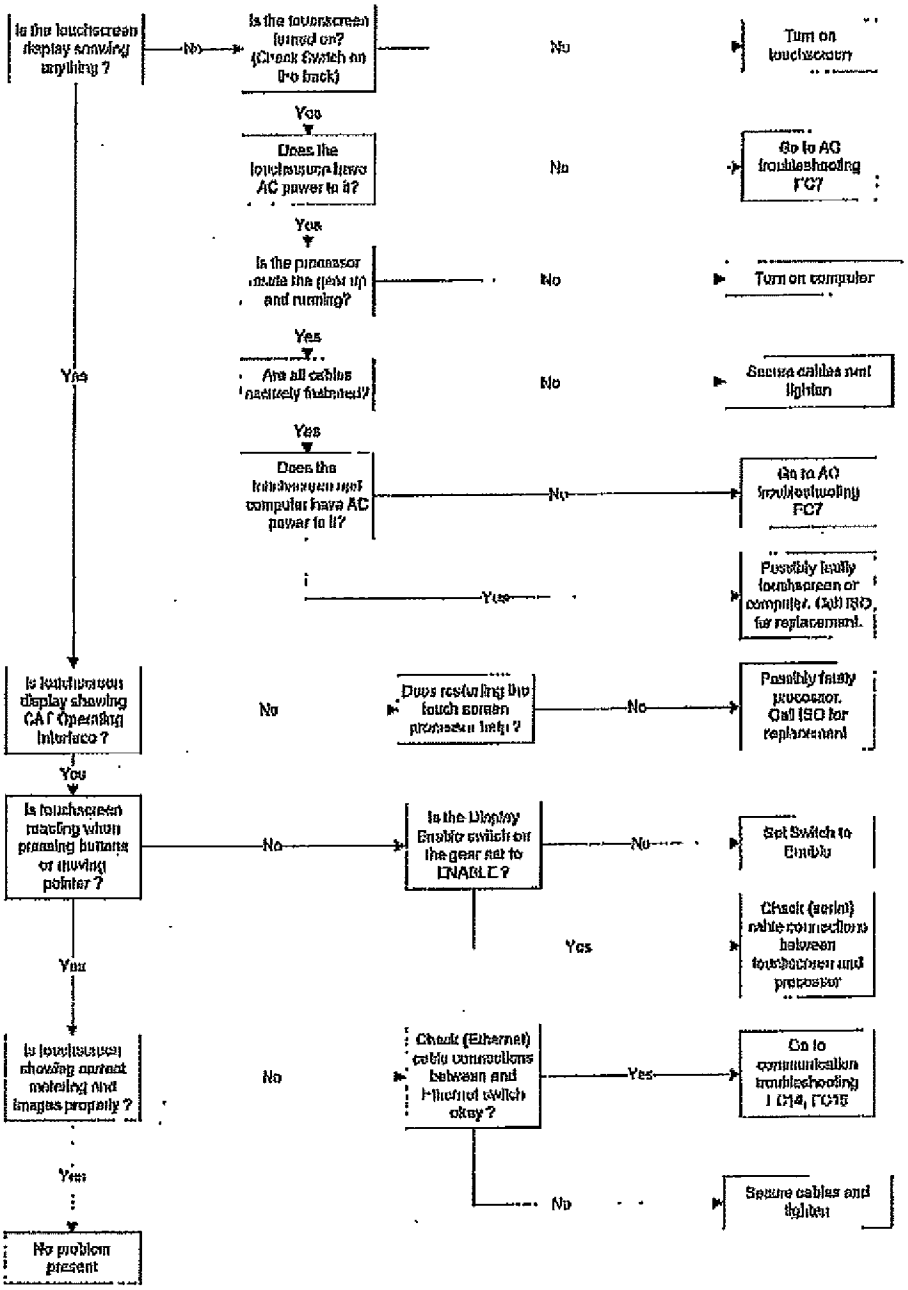
EMCP3S CONTROLLER RELAY OUTPUTS



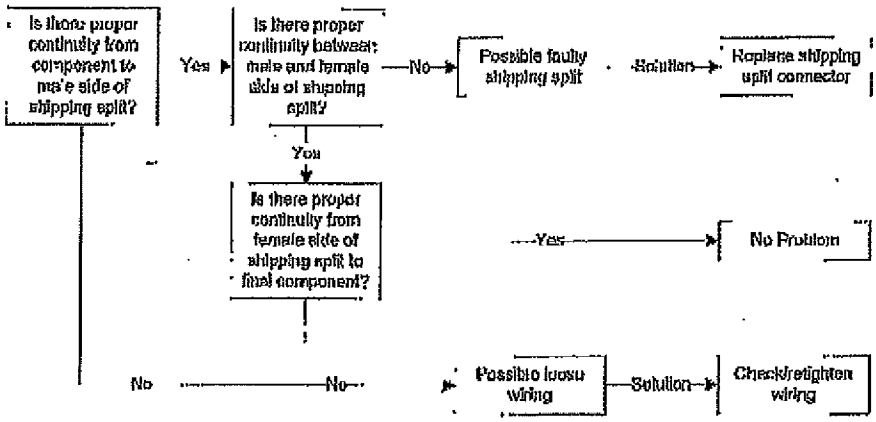
ETHERNET I/O OUTPUTS



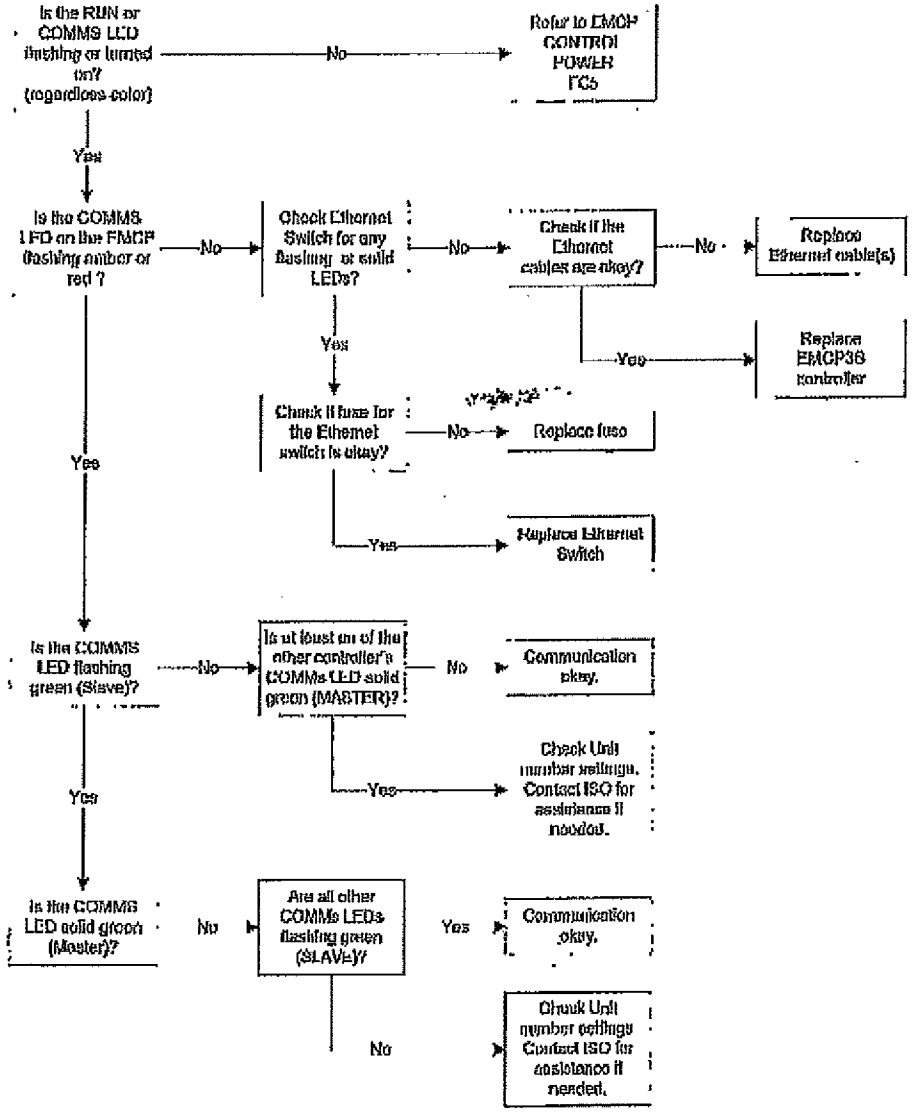
23.1.12 FC12- HMI Touch Screen Processor


Is the touchscreen display showing anything ?
No
Is the touchscreen turned on? (Check switch on the back)
No
Turn on touchscreen
Yes
Does the touchscreen have AC power to it?
No
Go to AC troubleshooting FC7
Yes
Is the processor inside the case up and running?
No
Turn on computer
Yes
Are all cables properly fastened?
No
Secure cables and tighten
Yes
Does the touchscreen not computer have AC power to it?
No
Go to AC troubleshooting FC7
Yes
Possibly faulty touchscreen or computer. Call ISO for replacement.
Yes
Is touchscreen display showing CAT Operating Interface ?
No
Does restarting the touch screen processor help ?
No
Possibly faulty processor. Call ISO for replacement
Yes
Is touchscreen reacting when pressing buttons or moving pointer ?
No
Is the Display Enable switch on the gear set to ENABLE ?
No
Set Switch to Enable
Yes
Check (serial) cable connections between touchscreen and processor
Yes
Is touchscreen showing current metering and images properly ?
No
Check (Ethernet) cable connections between and Ethernet switch okay ?
Yes
Go to communication troubleshooting 1 CM4, FC15
No
Secure cables and tighten
Yes
No problem present

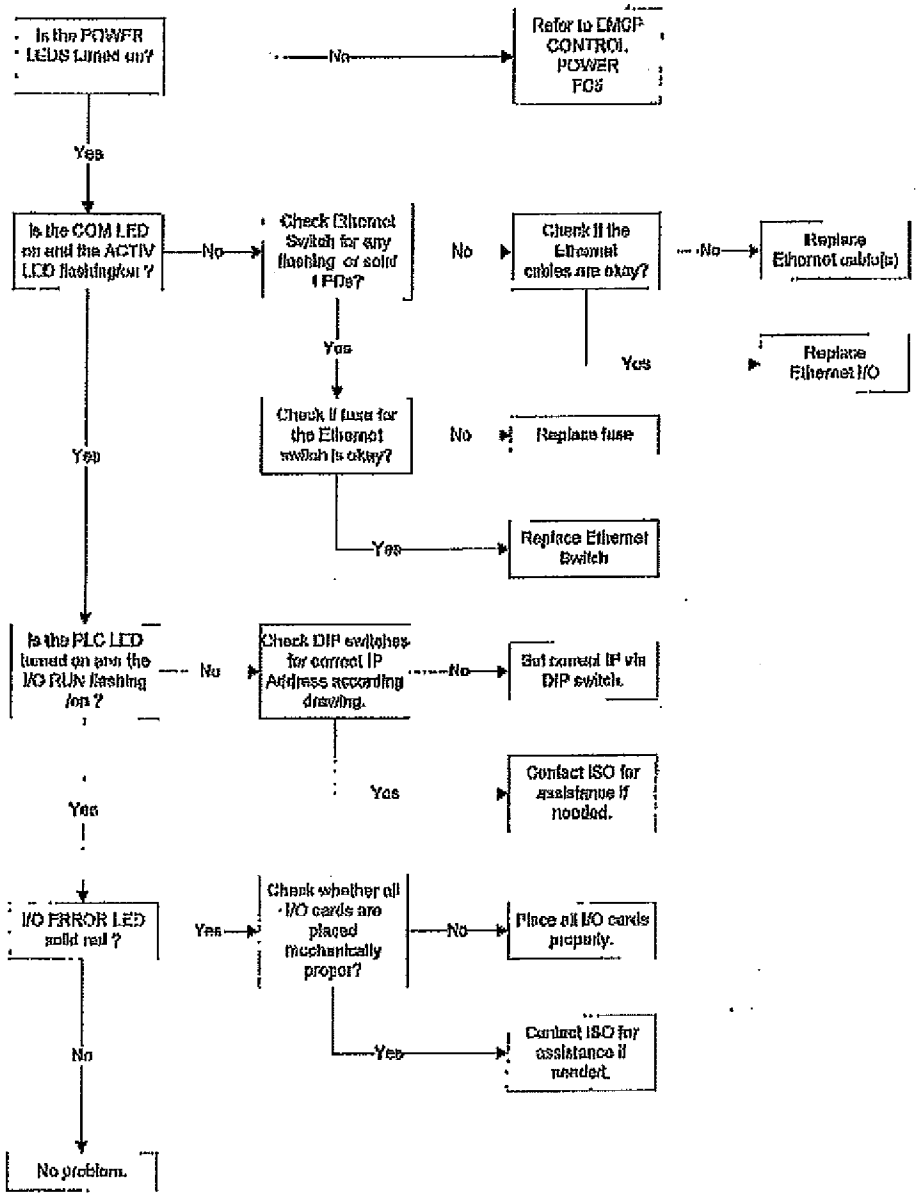
23.1.13 FC13- Shipping Splits



23.1.14 FC14- EMCP3S Controller Communication



23.1.15 FC15- Ethernet I/O Communication



24 Appendix

24.1 APPENDIX A: Generator Demand Control Example

24.1.1.1 Generator Demand Control

A Generator is removed from the bus when the bus kW drops below the remove setpoint that is the online Generator capacity minus the Minimum Reserve capacity (user adjustable) and a Remove Differential (user adjustable) of a single Genset.

A Generator is added to the bus when the bus kW rises above the add setpoint that is the online Generator capacity minus the Minimum Reserve capacity (user adjustable) of a single Genset.

System and Generator Demand Settings:

Total Generator plant capacity:	2 x 750kw= 1500kw.
Min. Reserve kW:	1025 kW
Remove Differential:	100 kW
Remove delay Time:	10 minutes
Add delay Time:	10 seconds
Immediate Add Reserve:	925 kW

Example : Removing Priority #2

Bus kW: 300 kW

Remove Condition:

Bus kW < Gensize Min. Reserve kW – Remove Differential
300kW < 1500 kW – 1025 kW – 100 kW
300kW < 375 kW

So, if the bus kW drops and stays beneath 375kw for more than 10 minutes, the priority #2 Genset would be removed from the bus and go into Cooldown.

Example: Adding Priority #2

Bus kW: 600kW

Add Condition:

Bus kW > Gensize Min. Reserve kW
300kW > 1500 kW – 1025kW
300kW > 475 kW

Immediate Add Condition:

Bus kW > Gensize – Immediate Add Reserve:
300kW > 1500 925 kW
300kW > 575 kW

If the bus kW slowly rises above 475kW for more than 10 seconds, the next priority Generator will be added. In case the bus kW changes fast and exceeds the Immediate Add Reserve 575kW the next priority Generator is added to the bus with no time delay.

24.2 APPENDIX B: Engine Data Table

24.2.1.1 GSC

DESCRIPTION	PID
HCS Position	F08F
Alarm Word	F460
Shutdown Word	F461
RPM	0040
Filtered Oil Pressure	0054
Coolant Temp	0044
Battery Voltage	F013
Hour Meter	005E
Spare Alarms	F462
Spare Shutdowns	F463

24.2.1.2 ADEM II

DESCRIPTION	PID
Alarm Word (LSW)	FC07
Alarm Word (MSW)	FC07
Shutdown Word (LSW)	FC08
Shutdown Word (MSW)	FC08
Atmospheric Pressure	0053
Boost Pressure	0055
Air Filter Restriction	0058
Left Turbo Inlet Pressure	005C
Right Turbo Inlet Pressure	005F
Total Fuel Burned (LSW)	00C8
Total Fuel Burned (MSW)	00C8
Percent Engine Load	F118
Oil Pressure Differential	F40B
Fuel Pressure Differential	F41C
After coolant Temp	F420
Right Exhaust Temp	F440
Left Exhaust Temp	F441
Crankcase Pressure	F509
Filtered Fuel Pressure	F50F
Right Air Filter Restriction	F51F

24.2.1.3 ADEM III Gas

Device	DESCRIPTION	PID
ADEM III (Master)	GAS FLOW	F58E
ADEM III (Master)	TOTAL HOURS (LSW)	FC2D
ADEM III (Master)	TOTAL HOURS (MSW)	FC2D
ADEM III (Master)	OIL DIFFERENTIAL PRESSURE	F40B
ADEM III (Master)	UNFILTERED OIL PRESS	F4EA
ADEM III (Master)	OIL TEMP	F53E
ADEM III (Master)	COOLANT PRESS	F48D
ADEM III (Master)	FUEL TEMP	F51D
ADEM III (Master)	AIR FUEL RATIO	F512
ADEM III (Master)	INLET AIR PRESSURE	F5BA
ADEM III (Master)	INLET AIR TEMP	F511
ADEM III (Master)	INLET AIR FLOW	F51E
ADEM III (Slave)	Cylinder Ignition Timing #1	D00040
ADEM III (Master)	Cylinder Ignition Timing #2	D00041
ADEM III (Slave)	Cylinder Ignition Timing #3	D00042
ADEM III (Master)	Cylinder Ignition Timing #4	D00043
ADEM III (Slave)	Cylinder Ignition Timing #5	D00044
ADEM III (Master)	Cylinder Ignition Timing #6	D00045
ADEM III (Slave)	Cylinder Ignition Timing #7	D00046
ADEM III (Master)	Cylinder Ignition Timing #8	D00047
ADEM III (Slave)	Cylinder Ignition Timing #9	D00048
ADEM III (Master)	Cylinder Ignition Timing #10	D00049
ADEM III (Slave)	Cylinder Ignition Timing #11	D0004A
ADEM III (Master)	Cylinder Ignition Timing #12	D0004B
ADEM III (Slave)	Cylinder Ignition Timing #13	D0004C
ADEM III (Master)	Cylinder Ignition Timing #14	D0004D
ADEM III (Slave)	Cylinder Ignition Timing #15	D0004E
ADEM III (Master)	Cylinder Ignition Timing #16	D0004F
ADEM III (Slave)	Cylinder Ignition Timing #17	D00050
ADEM III (Master)	Cylinder Ignition Timing #18	D00051
ADEM III (Slave)	Cylinder Ignition Timing #19	D00052
ADEM III (Master)	Cylinder Ignition Timing #20	D00053
ADEM III (Slave)	Cylinder Secondary Volts #1	D000EB
ADEM III (Master)	Cylinder Secondary Volts #2	D000EC
ADEM III (Slave)	Cylinder Secondary Volts #3	D000ED
ADEM III (Master)	Cylinder Secondary Volts #4	D000EE
ADEM III (Slave)	Cylinder Secondary Volts #5	D000EF

ADEM III (Master)	Cylinder Secondary Volts #6	D000F0
ADEM III (Slave)	Cylinder Secondary Volts #7	D000F1
ADEM III (Master)	Cylinder Secondary Volts #8	D000F2
ADEM III (Slave)	Cylinder Secondary Volts #9	D000F3
ADEM III (Master)	Cylinder Secondary Volts #10	D000F4
ADEM III (Slave)	Cylinder Secondary Volts #11	D000F5
ADEM III (Master)	Cylinder Secondary Volts #12	D000F6
ADEM III (Slave)	Cylinder Secondary Volts #13	D000F7
ADEM III (Master)	Cylinder Secondary Volts #14	D000F8
ADEM III (Slave)	Cylinder Secondary Volts #15	D000F9
ADEM III (Master)	Cylinder Secondary Volts #16	D000FA
ADEM III (Slave)	Cylinder Secondary Volts #17	D000FB
ADEM III (Master)	Cylinder Secondary Volts #18	D000FC
ADEM III (Slave)	Cylinder Secondary Volts #19	D000FD
ADEM III (Master)	Cylinder Secondary Volts #20	D000FE
ITSM (Master)	Cylinder Temp #1	F430
ITSM (Master)	Cylinder Temp #2	F431
ITSM (Master)	Cylinder Temp #3	F432
ITSM (Master)	Cylinder Temp #4	F433
ITSM (Master)	Cylinder Temp #5	F434
ITSM (Master)	Cylinder Temp #6	F435
ITSM (Master)	Cylinder Temp #7	F436
ITSM (Master)	Cylinder Temp #8	F437
ITSM (Master)	Cylinder Temp #9	F438
ITSM (Master)	Cylinder Temp #10	F439
ITSM (Master)	Cylinder Temp #11	F43A
ITSM (Master)	Cylinder Temp #12	F43B
ITSM (Master)	Cylinder Temp #13	F43C
ITSM (Master)	Cylinder Temp #14	F43D
ITSM (Master)	Cylinder Temp #15	F43E
ITSM (Master)	Cylinder Temp #16	F43F
ITSM (Master)	Cylinder Temp #17	F598
ITSM (Master)	Cylinder Temp #18	F599
ITSM (Master)	Cylinder Temp #19	F59A
ITSM (Master)	Cylinder Temp #20	F59B

24.2.1.4 ADEM III Diesel

DESCRIPTION	PID
Alarm Word (LSW)	FC07
Alarm Word (MSW)	FC07
Shutdown Word (LSW)	FC08
Shutdown Word (MSW)	FC08
Atmospheric Pressure	0053
Boost Pressure	0055
Air Filter Restriction	0058
Left Turbo Inlet Pressure	005C
Right Turbo Inlet Pressure	005F
Total Fuel Burned (LSW)	00C8
Total Fuel Burned (MSW)	00C8
Percent Engine Load	F118
Oil Pressure Differential	F40R
Fuel Pressure Differential	F41C
After coolant Temp	F420
Right Exhaust Temp	F440
Left Exhaust Temp	F441
Crankcase Pressure	F509
Filtered Fuel Pressure	F50F
Right Air Filter Restriction	F51F
Left Air Filter Restriction	F520
Fuel Consumption Rate	F525

24.3 APPENDIX C: Typical PLC I/O Table

24.3.1.1 Generator PLC I/O

*Note: Refer to drawing 3 for actual inputs and outputs

DISCRETE INPUTS			DISCRETE OUTPUTS			
IN	TERMINAL	DESCRIPTION	OUT	TERMINAL	DESCRIPTION	
IN1	67	Gen CB AUX	CR1	41-42	PLC ok	
IN2	68	Gen CB tripped	CR2a	46-43	Open CB	
IN3	69	H/W Emergency start	CR2b	44		
IN4	70	Engine Shutdown Fault	CR2c	45		
IN5	71	Crank Terminate	CR3	47-48	ENG RUN	
I:6	72	Battery Charger fault	CR4	49-50	Close CB	
I:7	73	Gen mounted Brkr AUX	CR5	51-52	Close CB	
I:8	74	Spare	CR6	53-54	Spare	
I:9	75	Gen CB Pull to lock out	CR7	55-56	Spare	
I:10	76	Low Fuel	CR8a	60-57	Spare	
I:11	77	High Fuel	CR8b	58	Spare	
I:12	78	Fuel tank malfunction	CR8c	59	N/A	
I:13	141	Ground fault	CR9	121-122	N/A	
I:14	142	Gen Brkr connected	CR10	123-124	N/A	
I:15	143	Local ESTOP	CR11	125-126	N/A	
I:16	144		CR12	127-128	N/A	
I:17	145		CR13	129-130	N/A	
I:18		N/A	CR14	131-132	N/A	
I:19		N/A	CR15	133-134	N/A	
I:20		N/A	CR16	135-136	N/A	
I:21		N/A	CR17	137-138	N/A	
I:22		N/A	CR18	139-140	N/A	
I:23		N/A				

24.3.1.2 Generator PLC I/O

ANALOG INPUTS			ANALOG OUTPUTS			
IN	TERMINAL	DESCRIPTION	OUT	TERMINAL	DESCRIPTION	
IN1	67	Spare	CR1	15,16,17	Voltage Control	
IN2	68	Spare	CR2a	18,19,20	Speed Control	

24.3.1.3 Utility/Tie PLC I/O

*Note: Refer to drawings for actual inputs and outputs.

DISCRETE INPUTS				DISCRETE OUTPUTS		
I/O	terminal	DESCRIPTION	I/O	terminal	DESCRIPTION	
I:1	67	Utility CB Aux	CR1	41-42	PLC ok	
I:2	68	Utility CB tripped	CR2a	46-43	Utility CB Open	
I:3	69	(86) -32 lockout	CR2b	44		
I:4	70	Utility Relay 27/81U	CR2c	45		
I:5	71	Utility Relay 32	CR3	47-48	Utility Fail Test	
I:6	72	Utility Relay fault	CR4	49-50	Utility CB Close	
I:7	73	Utility CLsLockout	CR5	51-52	Utility CB Close	
I:8	74	Spare	CR6	53-54	Rev. Power Inhibit	
I:9	75	Utility Ground Fault	CR7	55-56	Spare	
I:10	76	Utility Relay GF Trip	CR8a	60-57	Tie CB Open	
I:11	77	Utility CB Not connected	CR8b	58	Spare	
I:12	78	Utility CB locked out	CR8c	59	Spare	
I:13	141	Tie CB Aux	CR9	121-122	Tie CB Close	
I:14	142	Tie CB Tripped	CR10	123-124	Tie CB Close	
I:15	143	Tie CB locked out	CR11	125-126	N/A	
I:16	144		CR12	127-128	N/A	
I:17	145	Tie Relay fault	CR13	129-130	N/A	
I:18	146	Tie CB Not connected	CR14	131-132	N/A	
I:19	147	Tie CB Ground Fault	CR15	133-134	N/A	
I:20	148	N/A.	CR16	135-136	N/A	
I:21	149	N/A	CR17	137-138	N/A	
I:22	150	N/A	CR18	139-140	N/A	

1:23	151	N/A				

24.3.1.4 Master I/O

*[illegible] to map tags for [illegible] inputs and [illegible]

DISCRETE INPUTS				DISCRETE OUTPUTS	
I/O	terminal	DESCRIPTION	I/O	terminal	DESCRIPTION
		Slot 1			Slot 3
		Input Power	O:1	1	Horn
			O:2	5	Master I/O ok
		Slot 2	O:3	2	Test with load relay
I:1	1	Horn silence	O:4	6	Non-Essential Load Shed
I:2	2	Instant Auto Switch	O:5	3	Level 1 Load Shed
I:3	5	Load Shed Switch	O:6	7	Level 2 Load Shed
I:4	6	24V Battery Charger fail	O:7	4	Level 3 Load Shed
I:5	3	Engine Run Request	O:8	8	Level 4 Load Shed
I:6	7	Hot bus			
I:7	4	Spare			Slot 4
I:8	8	Spare	O:1	1	Spare
			O:2	5	Spare
			O:3	2	Spare
			O:4	6	Spare
			O:5	3	Spare
			O:6	7	Spare
			O:7	4	Spare
			O:8	8	Spare

24.3.1.5 Distribution I/O

[illegible] the discrete inputs and outputs

DISCRETE INPUTS			DISCRETE OUTPUTS		
I/O	terminal	DESCRIPTION	I/O	terminal	DESCRIPTION
		Slot 1			Slot 4
		Input Power	O:1	1	52D1 open
			O:2	5	52D1 close
			O:3	2	52D2 open
I:1	1	52D1 closed	O:4	6	52D2 close
I:2	2	52D1 Bell/Tripped	O:5	3	52D3 open
I:3	5	52D2 closed	O:6	7	52D3 close
I:4	6	52D2 Bell/Tripped	O:7	4	52D4 open
I:5	3	52D3 closed	O:8	8	52D4 close
I:6	7	52D3 Bell/Tripped			
I:7	4	52D4 closed			Slot 5
I:8	8	52D4 Bell/Tripped	O:1	1	52D5 open
			O:2	5	52D5 close
		Slot 3	O:3	2	52D6 open
I:1		52D5 closed	O:4	6	52D6 close
I:2		52D5 Bell/Tripped	O:5	3	52D7 open
I:3		52D6 closed	O:6	7	52D7 close
I:4		52D6 Bell/Tripped	O:7	4	52D8 open
I:5		52D7 closed	O:8	8	52D8 close
I:6		52D7 Bell/Tripped			
I:7		Engine Run Request			
I:8		Hot Bus			

24.4 APPENDIX D: Alarm Classes and Actions

24.4.1.1 Alarm class overview table

ALARM CLASS	ALARM TYPE	ACTIONS	
A	Pre-alarm	annunciated	
B	Pre-alarm	annunciated + horn	
C	Shutdown	Annunciated + horn + soft unloading + cooldown	
D	Shutdown	annunciated + horn + cooldown	
E	Shutdown	annunciated + horn + soft unloading	
F	Shutdown	Shutdown: annunciated + horn	

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Cutler-Hammer

IB019010001E

INSTRUCTIONS FOR MAGNUM DS METAL-ENCLOSED LOW-VOLTAGE SWITCHGEAR ASSEMBLIES WITH MAGNUM DS BREAKERS

Read and understand these instructions before attempting to unpack, assemble, operate or maintain this type equipment.

All possible contingencies which may arise during installation, operation or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance of particular equipment, contact the local Cutler-Hammer representative.

DANGER

METAL-ENCLOSED LOW-VOLTAGE SWITCHGEAR ASSEMBLIES COVERED BY THESE INSTRUCTIONS ARE DESIGNED AND TESTED TO OPERATE WITHIN THEIR NAMEPLATE RATINGS. OPERATION OUTSIDE OF THESE RATINGS MAY CAUSE THE EQUIPMENT TO FAIL RESULTING IN DEATH, SERIOUS INJURY AND/OR PROPERTY DAMAGE. ALL RESPONSIBLE PERSONNEL SHOULD LOCATE THE EQUIPMENT NAMEPLATE AND BE FAMILIAR WITH THE INFORMATION PROVIDED ON THE NAMEPLATE. THE MAGNUM DS NAMEPLATE IS SHOWN IN FIGURE 1.

PURPOSE

This instruction manual is expressly intended to cover the installation, operation and maintenance of Magnum DS Metal-Enclosed Low-Voltage Switchgear used with Magnum DS Power Circuit Breakers.

For application information consult applicable descriptive bulletins, application publications and/or the applicable industry standards.

For installation, operation and maintenance of Low-Voltage Power Circuit Breakers see separate instruction books.

SAFETY

All safety codes, safety standards and/or regulations must be strictly observed in the installation, operation and maintenance of this equipment.

DANGER

THE DANGER, WARNING AND CAUTION MESSAGES INCLUDED AS PART OF THE PROCEDURAL STEPS IN THIS MANUAL ARE FOR PERSONNEL SAFETY AND PROTECTION OF EQUIPMENT FROM DAMAGE. AN EXAMPLE OF A TYPICAL WARNING LABEL HEADING IS SHOWN ABOVE THIS PARAGRAPH TO FAMILIARIZE PERSONNEL WITH THE TYPE OF PRESENTATION. THIS WILL HELP TO ASSURE THAT PERSONNEL ARE ALERT TO THESE MESSAGES. IN addition, THESE MESSAGES ARE ALL UPPER CASE AND BOLDFACE.

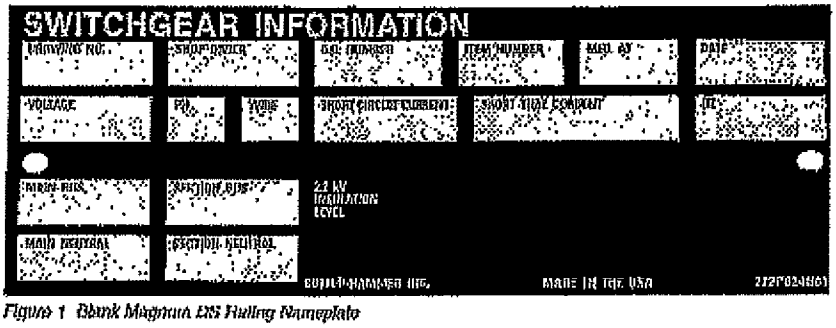

Figure 1 Blank Magnum DS Rating Nameplate

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SECTION 1: INTRODUCTION

1.1 GENERAL INFORMATION

Magnum DS Switchgear assemblies with Magnum DS Low-Voltage ac Power Circuit Breakers control and protect power circuits through 600 volts ac and interrupting capacities through 100 kA at 600 volts. The switchgear assembly is composed of vertical sections that are arranged to suit the customer's requirements. Magnum DS switchgear utilizes a four high structure design consisting of various combinations of Magnum DS Low-Voltage ac Power Circuit Breakers and auxiliary compartments (Figure 1-1). Rear accessible bus and cable compartments provide space for connections, maintenance and inspection.

This instruction manual contains important procedures and information pertinent to the receiving, handling, storage, installation, operation and maintenance of Magnum DS Low-Voltage Switchgear. Information provided in this instruction manual and by other supplied documentation and/or drawings should be read and understood by all personnel responsible for supervision, operation or maintenance. Familiarization should always include the characteristics of each piece of equipment contained in or mounted on the switchgear assembly.

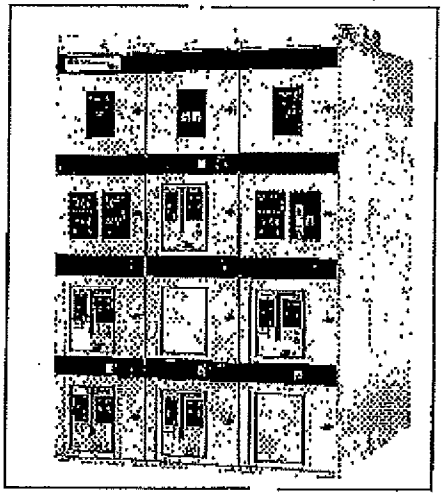


Figure 1-1 Type Magnum DS Low-Voltage Indoor Switchgear (Front View)

Proper installation, operation and maintenance are essential to insure continued satisfactory service from the equipment. It should not be installed in places where it will be required to operate at voltage, currents or fault capacities greater than those for which it was designed, or where the environmental conditions are dirty, corrosive, humid or otherwise harsh or unsuitable. (Ref. ANSI C37.20.1 for abnormal operation conditions).

The information given in this manual applies to both draw-out and fixed Magnum DS switchgear assemblies unless otherwise noted.

1.2 SAFETY FEATURES

Each Magnum DS Assembly is manufactured with built-in interlocks and safety related features. They are provided to reduce hazards to operating personnel and provide proper operating sequences.

DANGER

METAL-ENCLOSED LOW-VOLTAGE SWITCHGEAR ASSEMBLIES ARE PROVIDED WITH MANY SAFETY FEATURES. NEVERTHELESS, THEY CONTAIN POWER CIRCUITS WITH HIGH FAULT CAPACITY. THE VOLTAGES AND POWER LEVELS AVAILABLE IN THIS EQUIPMENT MAKE CONTACT WITH BARE CONDUCTORS OR TERMINALS EXTREMELY DANGEROUS, AND IS LIKELY TO BE FATAL. ALL POWER SHOULD BE TURNED OFF OR ADEQUATE PROTECTIVE EQUIPMENT USED WHEN WORKING INSIDE SUCH EQUIPMENT. IN ADDITION TO THE HAZARDS INHERENT TO THE SWITCHGEAR ASSEMBLY ITSELF, OPERATION BY UNQUALIFIED PERSONS MAY CAUSE DAMAGE TO CONNECTED EQUIPMENT AND INJURY TO OPERATORS OF CONNECTED EQUIPMENT.

UNDER NO CIRCUMSTANCE SHOULD THE INTERLOCKS OR OTHER SAFETY FEATURES BE MADE INOPERATIVE, AS THIS MAY RESULT IN DEATH, BODILY INJURY OR PROPERTY DAMAGE.

TO PROTECT PERSONNEL DURING THE INSTALLATION, OPERATION AND MAINTENANCE OF THIS EQUIPMENT, THE FOLLOWING PRACTICES MUST BE FOLLOWED:

1.3 SAFETY PRACTICES

Type Magnum DS Low-Voltage Switchgear is complex high current electrical equipment. It is designed to operate within the voltage and current limitations shown on the nameplate (Figure 1). Do not apply this equipment to systems with voltages and/or currents in excess of those limits.

1. Only qualified electrical personnel familiar with the construction and operation of this equipment and the associated hazards should be permitted to work on such equipment. Additionally, only qualified personnel should be permitted to install or operate such equipment.
2. Always be certain that the primary and secondary circuits are de-energized before attempting any maintenance.
3. For maximum safety, only insert a completely assembled breaker into an energized cell. Front covers and inter-pole barriers are safety features and must be in place when energized.
4. Always ensure that drawout circuit breakers are in one of four designed positions: "Connect", "Test", "Disconnect" or "Withdrawn". A circuit breaker permitted to remain in an intermediate position could result in control circuits being improperly connected causing other equipment to malfunction.
5. Do not remove access covers unless the circuits to be exposed are de-energized.
6. Use calibrated test equipment of known reliability to confirm that all circuits are de-energized before servicing.
7. After maintenance, be certain every current transformer secondary circuit is completely connected or shorted.

DANGER

IF THE SECONDARY CIRCUIT OF ANY CURRENT TRANSFORMER IS LEFT OPEN WITHOUT LOAD, AND ITS PRIMARY CIRCUIT IS ENERGIZED, A DANGEROUSLY HIGH VOLTAGE IS DEVELOPED ACROSS TRANSFORMER SECONDARY TERMINALS. TO PREVENT DEATH, BODILY INJURY OR ELECTRICAL SHOCK, EITHER DE-ENERGIZE THE CIRCUIT BY OPENING THE BREAKER, OR SHORT CIRCUIT CURRENT TRANSFORMER SECONDARY TERMINALS, BEFORE PROCEEDING WITH MAINTENANCE.

8. Always be certain that all assembly hardware is in place and bolted tightly before inserting a drawout circuit breaker into its compartment.

WARNING

FAILURE TO FOLLOW THESE DIRECTIONS COULD RESULT IN DEATH, SERIOUS BODILY INJURY OR PROPERTY DAMAGE.

1.4 QUALIFIED PERSONNEL

For the purpose of operating switchgear assemblies, a person who has been thoroughly trained in the operation of the circuit breakers and any included instrumentation and who has complete knowledge of the loads connected to the assembly may be considered to be a qualified person.

For the purpose of installing, inspecting and maintaining switchgear assemblies, a qualified person must ALSO be thoroughly trained in regard to the hazards inherent to working with electricity and in the proper way to perform such work. The individual should be able to de-energize, clear and tag circuits in accordance with established safety practices. In addition, the individual should be equipped with, and trained in the use of, protective equipment (rubber gloves, flash clothes, etc.) for those occasions when it is not possible to de-energize all circuits before doing maintenance work in the area.

1.5 PRECAUTIONS

1. If relays are included, remove all blocking. Check control circuits (except voltage and current transformer circuits) for grounds and short circuits before applying control power.
2. Connect the assembly to the station ground before applying any power.
3. In case of fire, do not use liquid fire extinguisher until all circuits have been disconnected.
4. If an indoor assembly is to be stored prior to installation, it must be protected from the weather and kept free of condensation.
5. If an outdoor assembly is to be stored prior to installation, provisions must be made for energizing the space heaters to prevent condensation of moisture inside the assembly.

1.6 OTHER PUBLICATIONS AND DOCUMENTATION

In addition to this instruction manual, other printed information and documentation is supplied with each assembly. This additional information will include, but not necessarily be limited to, a Magnum DS Low-Voltage Power Circuit Breaker instruction manual, arrangement drawings, and connection diagrams.

SECTION 2: RECEIVING, HANDLING AND STORAGE

2.1 GENERAL INFORMATION

Magnum DS Metal-Enclosed Low-Voltage Switchgear assemblies are shipped in one or more shipping groups, depending on the number of vertical sections, or the limitations of handling facilities at the installation site. This would usually be up to five vertical sections for an indoor assembly, or up to three or four sections for an outdoor assembly.

Indoor shipping groups are secured by lag bolts to wooden skids that extend beyond all sides of the switchgear. All shipping sections are shipped so as to be protected from the weather during shipment but are not suitable for storage outdoors as shipped. Outdoor assemblies are not weatherproof until completely assembled. Treat them the same as indoor equipment until fully assembled.

2.2 RECEIVING

When a switchgear assembly reaches its destination, the purchaser should check the material received against the shipping list to be certain that all items have arrived. Note accurately any discrepancies. Each shipping group is plainly marked with or accompanied by an identifying shop order number, general order number and shipping weight. Each shipment includes a contents list which is a part of the overall package of shipping papers. To avoid the loss of any parts, the contents of each container should be carefully checked against the packing list. Do not discard any packing material until it is certain that every item has been received in the proper condition and that certain packing material will not be required later for equipment storage. Larger items, such as indoor traveling lifters, are shipped in separate cartons. Other loose and unmounted items may be packed in the same box as the lifter (Figure 2-1). These items, such as shipping split hardware, should be logged in and set aside in a safe location until the assembly has been set in its final position.

Equipment shipped from the factory is carefully packed and inspected prior to its departure. On occasion, however, equipment damage is incurred during transportation. If any damage is found, file a damage claim immediately with the transportation carrier and notify a Cutler-Hammer representative. All claims should be filed as soon as possible and include applicable part numbers, shop order numbers and/or general order numbers.

2.3 PRECAUTIONS

It is preferable to use an overhead crane when moving the assembly. Circumstances at the installation location

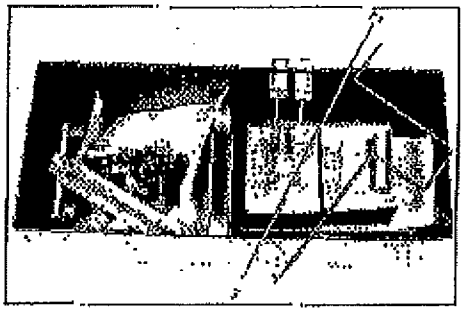


Figure 2-1 Carton Containing Indoor Lifter Assembly

may prevent the use of an overhead crane for all movement. In such instances, the careful use of rollers can be employed. Although the methods for moving indoor and outdoor assemblies are similar, the techniques vary slightly. The differences are highlighted in this section.

2.3.1 OVERHEAD LIFTING

DANGER

FAILURE TO FOLLOW LIFTING INSTRUCTIONS COULD RESULT IN DEATH OR SERIOUS BODILY INJURY. READ INSTRUCTIONS FOR LIFTING SWITCHGEAR PRIOR TO ATTACHING CABLES, CHAINS OR SPREADER BARS.

Indoor Assemblies: For ease of handling by crane, each indoor shipping group is equipped with a lifting plate that extends the length of the shipping group. The lifting plate is designed and placed such that a spreader bar is not required between the lifting cables (Figure 2-2). Spreader bars can, however, be used if the overhead space is limited for crane use. In addition to the built in lifting angle, bolt on lift plates are attached to the front of each Switchgear shipping section to provide stability while lifting. These lift plates are not provided as the primary lifting means and should only be utilized as a means of providing stability. The primary lifting means should be achieved by use of the built in lifting angles located over the bus compartment. After installation, the bolt on lift plates can be removed and discarded.

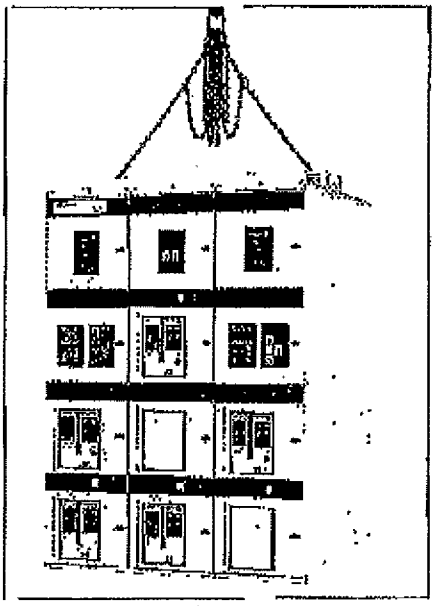


Figure 2-2 Indoor Assembly Lifting Method

Outdoor Assembly: Lifting plates are attached along the assembly base at the *front and rear* for crane cable attachment. The methods used for lifting an outdoor assembly are similar to those used with an indoor assembly, except that spreader bars, not provided, must be placed between lift cables to prevent equipment damage (Figure 2-3). If it appears that the cables will touch the assembly during the lifting process, place appropriately sized *lumber* along the sides where contact could be made between the cable and the equipment. This will prevent damage caused by the lifting cables.

2.3.2 ROLLING

If during the moving and positioning process it is not feasible to use an overhead crane, the equipment can be moved on construction rollers. The shipping skids on indoor assemblies or the heavy steel base on outdoor assemblies are used directly when rolling. If conditions

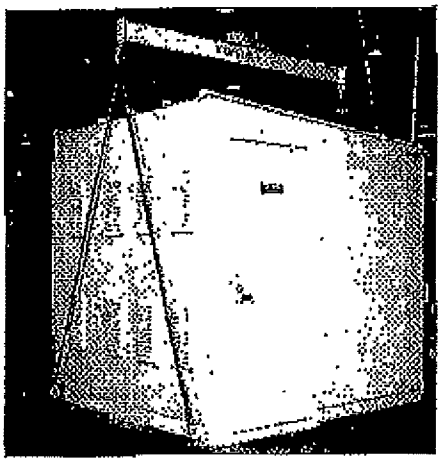


Figure 2-3 Outdoor Assembly Lifting Method

are such that the indoor assemblies cannot be rolled into position with the shipping skids in place, they may be removed before rolling the assemblies. For best results, however, the shipping skids should be used. Use no less than four evenly spaced rollers for assembly movement. Since equipment length can vary, each 1.5 to 2.0 feet (457 to 610 mm) of equipment length requires a roller. As the equipment is carefully moved, the rollers that become free at the end opposite the movement direction should once again be placed at the front for continued movement (Figure 2-4).

2.3.3 SHIPPING SKID AND LIFTING PLATE REMOVAL

The wooden shipping skid bolted to the bottom of an indoor assembly should be removed once the indoor assembly is in its permanent location. Lag bolts attach the shipping skids to the assembly from the inside. The holes that remain after the skids and lag bolts are removed are used in securing the indoor assembly permanently in position (Figure 2-5).

Once an outdoor assembly is in its permanent location remove the lifting eyes from the angles (Figure 2-6). Rotate the angles 180 degrees and reinstall. Use the angles to bolt the assembly to the foundation.

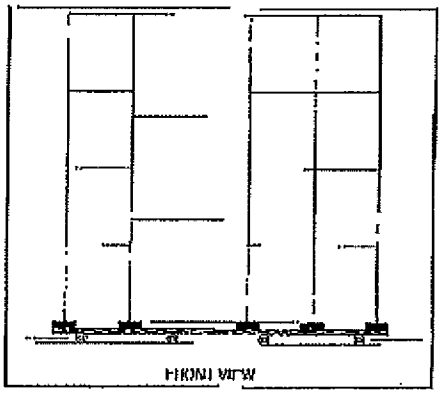


Figure 2-4 Assembly Rolling Procedure

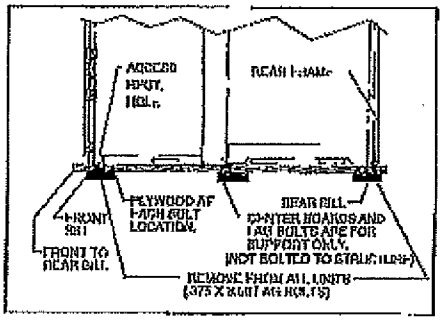


Figure 2-5 Shipping Skid

2.4 STORAGE

An indoor switchgear assembly which cannot be installed and put into service immediately should be stored in a dry and clean place, preferably indoors in a heated building. Conditions such as dampness, changes in temperature, dirty or corrosive atmospheres should be carefully avoided. Special precautions are required if the indoor assembly is to be stored outdoors. The assembly must be kept clean, well ventilated, and warm enough to prevent condensation. It will be necessary to cover the assembly and install temporary heating equipment. Approximately 250 watts per vertical section are required for average conditions. Outdoor storage of indoor equipment, even for a brief period, is not

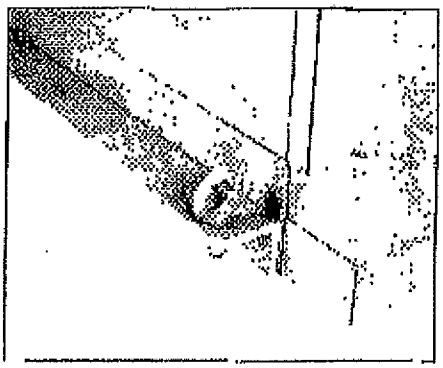


Figure 2-6 Lifting Angle in Place on Outdoor Assembly

recommended and should be avoided. The covering provided during shipment for indoor assemblies is NOT adequate for outdoor storage. Covering must be adequate to protect the assembly from dust and falling debris, but loose enough to permit adequate ventilation. Place blocking on the roof of the equipment to keep covering material from restricting the air flow.

A fully assembled outdoor assembly requires a minimum of care during outdoor storage. The area should be reasonably free of dirt and corrosive gases. The space heaters, which are standard with weatherproof assemblies, must be energized to prevent condensation.

Outdoor assemblies which are not fully assembled must be treated in the same manner as indoor equipment.

CAUTION

CARE MUST BE TAKEN THAT INTEGRAL CONTROL POWER TRANSFORMERS ARE NOT BACK-FED. DISCONNECT PRIMARY AND SECONDARY FUSES.

During storage , all assemblies, whether indoor or outdoor, should be placed on a firm, level surface. This will prevent any unnecessary strain or possible distortion.

Store all other separately packaged accessory equipment in a clean, dry location. It is recommended that a waterproof cover be placed over circuit breaker cartons and the cartons kept in an indoor storage location when the circuit breakers are stored separately from the assembly.

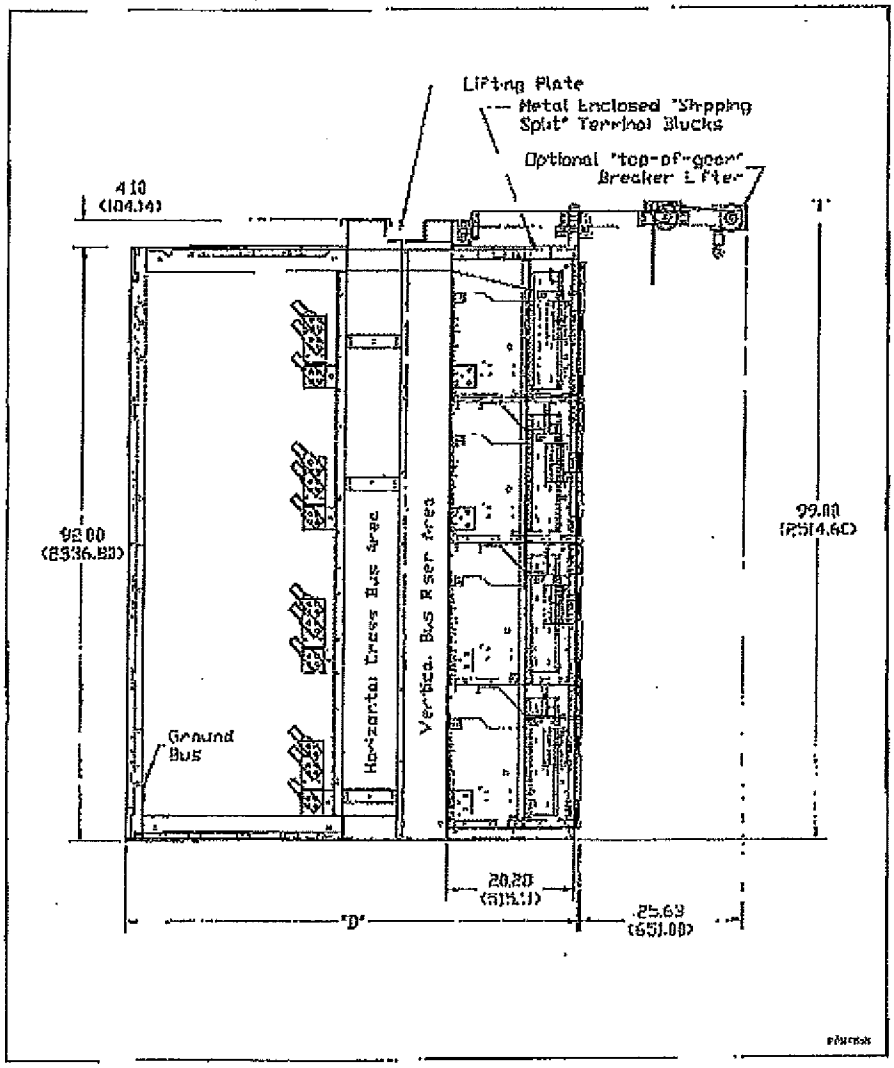


Figure B-1 Four High Vertical Section (Side View)

SECTION 3: EQUIPMENT DESCRIPTION

3.1 GENERAL DESCRIPTION

The following descriptions apply to standard metal-enclosed construction and wiring. Special features and control schemes are often incorporated. These special features are evident on the drawings and diagrams for the specific switchgear assembly. Instructions on standard apparatus such as relays, instruments, control switches and circuit breakers are included elsewhere in separate instruction books or sheets.

Each low-voltage (600 volts and below) indoor and outdoor metal-enclosed switchgear assembly is factory assembled and tested. It is designed to require a minimum amount of labor for installation.

The switchgear assembly consists of a stationary structure that includes one or more free-standing vertical sections mechanically and electrically joined to make a single coordinated installation. Each vertical section consists of three major parts: front compartment, bus compartment, and cable compartment (Figure 3-1).

Type Magnum DS metal-enclosed switchgear assemblies are available for both indoor (NEMA Type 1) and outdoor (NEMA Type 3R) applications. The circuit breakers and design features are similar whether the installation be indoor or outdoor. An outdoor metal-enclosed switchgear assembly is constructed by assembling an outdoor enclosure around a standard indoor switchgear assembly.

Modifications can be made to the NEMA 1 enclosure for use in dirt resistant or sprinkler resistant environments. When this is the case, these parts are shipped separately to reduce the risk of damage during shipping and handling. Installation instructions are given in drawings included in the information packet attached to the side of the switchgear assembly. Should additional copies of this drawing be needed, contact your nearest Cutler-Hammer sales office. Refer to Section 4.3.1.1 for further information.

3.2 FRONT COMPARTMENT

The front compartment is a bolted steel structure. This structure may be an auxiliary unit used to house instruments, relays, switches and their associated auxiliary equipment or it may be divided into a maximum of four individual cells used to house circuit breakers (Figure 3-2). These individual cells may also be used as instrument cells by omitting the circuit breaker and its associated stationary parts. The hinged door then becomes available for mounting instruments, relays, etc. Either draw-out or fixed breakers can be mounted in this compartment.

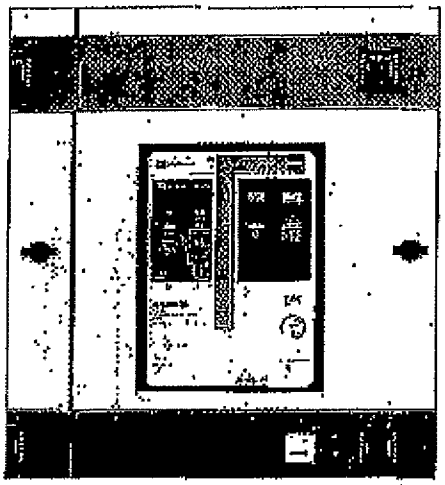


Figure 3-2 Magnum DS Breaker in Connected Position

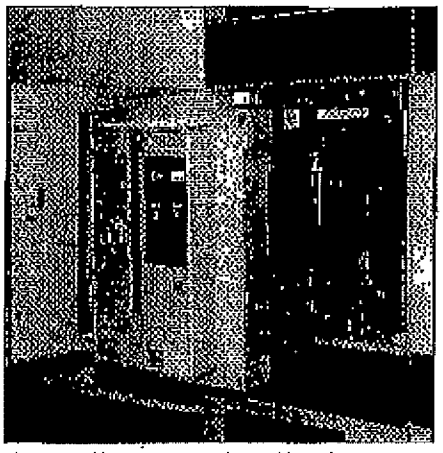


Figure 3-3 Magnum DS Breaker on Extension Rails

Above each breaker cell exists a compartment that contains terminal blocks and control wiring for connections to circuit breaker's secondary terminals and other devices. Breaker control devices and instrumentation may be mounted on the door defining this compartment.

3.2.1 BREAKER CELLS (DRAW-OUT)

DANGER

FAILURE TO HAVE THE BREAKER COMPLETELY IN THE DISCONNECT POSITION BEFORE LEVERING CAN CAUSE SERIOUS EQUIPMENT DAMAGE. ENSURE THAT THE BREAKER REACHES A POSITIVE STOP WHEN INSERTING INTO THE CELL PRIOR TO LEVERING.

In draw-out cells equipped for circuit breakers, a bolted-in cassette with extension rails supports the breaker (Figure 3-3). The cassette provides the mounting for the stationary secondary control disconnecting contacts and is located in the top/front region of the breaker cell (Figure 3-4). These provide the control circuit interface to the circuit breaker. In addition, the cassette provides the stationary ground contact for the circuit breaker, the truck operated switch (cell switch), and shorting terminal blocks for cell mounted instrument current transformers.

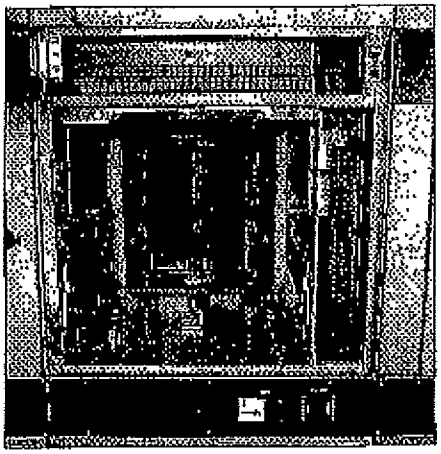


Figure 3-4 Magnum DS Breaker Cell

A molded glass polyester plate at the rear of the breaker cell provides mounting for the instrument class current transformers.

The breaker cell provides three positions for the circuit breaker identified as "connect", "test" and "disconnect". Each specific position is indicated by the position indicator on the circuit breaker as it moves into and out of the cell. The "withdrawn" position is attained when the circuit breaker is removed from the cell with the extension rails fully extended.

In the "connect" position, both the primary and secondary contacts are engaged and the circuit breaker is ready for operation. In the "test" position, only the secondary control contacts are engaged and the circuit breaker can be operated electrically without energizing the power circuit. In the "disconnect" position, both the primary and secondary control contacts are disengaged and the entire circuit breaker is isolated. Unlike the "connect" and "test" positions, the circuit breaker is not held captive in the cell in the "disconnect" position.

The door can be closed with the breaker located in the "connect", "test" and "disconnect" positions.

When the levering device, located on the circuit breaker, is moved to the "disconnect" position, the circuit breaker can then be freely withdrawn out of the cell.

3.2.1.1 BREAKER CELLS (FIXED)

In fixed mounted breaker applications, the breaker is rigidly supported via side plates anchored securely to the front and rear of the cell. Many similarities exist between draw-out and fixed mounted cells. These similarities are detailed in applicable sections of 3.2.

For removal of a fixed mounted breaker located in the A, B or C cell position proceed as follows.

Step 1: Remove the ground wire by disconnecting the ground screw from the front post as shown in Figure 3-5.1.

Step 2. To remove the left hand breaker stop, remove the screw as shown in Figure 3-5.2L and pull the metal plate forward. Then remove the two screws as shown in Figure 3-5.2R and pull the metal plate to the left and forward.

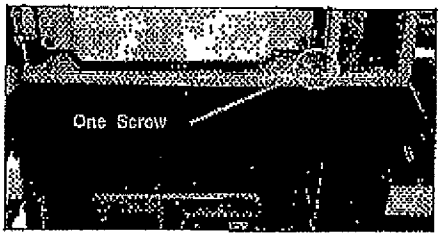


Figure 3-5.1

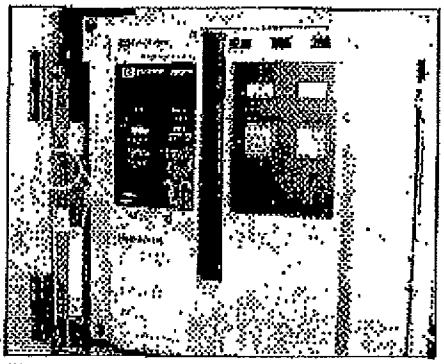


Figure 3-5.2L

Figure 3-5.2R

Step 3. Remove the secondary terminal block mounting bracket above the breaker by removing the three screws as shown in Figure 3-5.3. The bracket can then be lifted and removed from the cell.

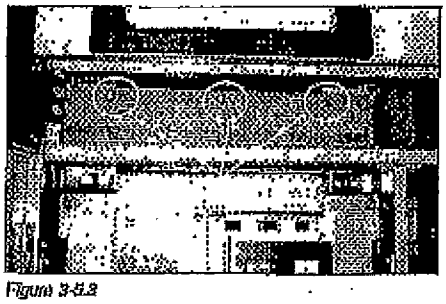


Figure 3-5.3

Step 4. Remove arc barrier above the breaker by removing the four screws as shown in Figure 3-5.4 that attach the arc barrier to the cell divider pan. Slide the arc barrier forward and remove it from the cell.

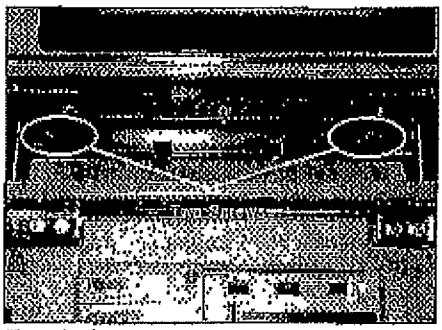


Figure 3-5.4

Step 5. Remove the main bracket assembly by compressing the spring-loaded terminal mounting channel by turning the screws shown in Figure 3-5.5B to the right until the breaker secondary terminals are completely disconnected. Then remove the four screws at the top of the breaker as shown in Figures 3-5.5L and 3-5.5R.

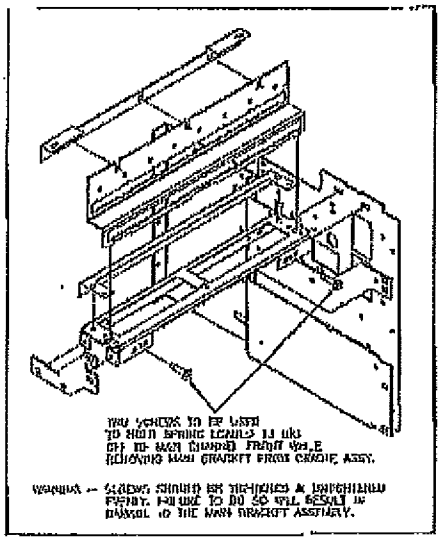


Figure 3-5.5B

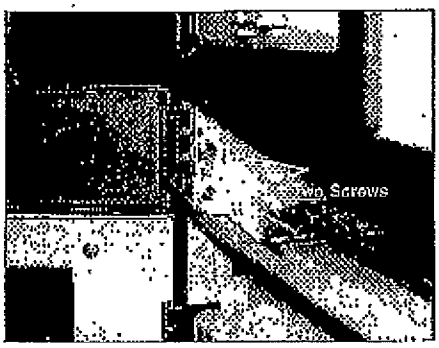


Figure 3-5.5L

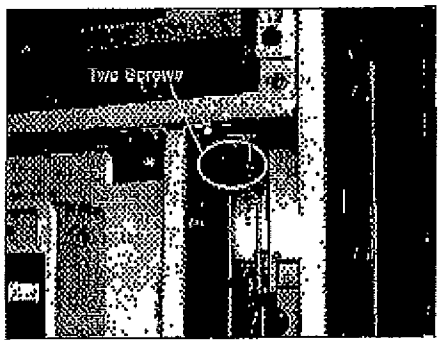


Figure 3-5.5R

Step 6. The line side barrier is removed by disconnecting the two screws from the rear cell back pan (Figure 3-5.6). Then slide the line side barrier forward.

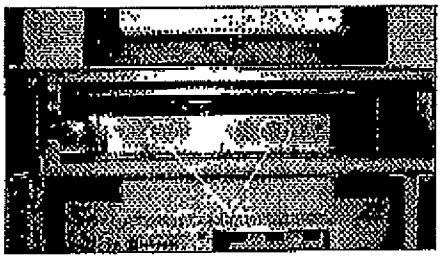


Figure 3-5.6

Step 7. Remove the bottom half of the cell divider frame located above the breaker. This is accomplished by first removing the remaining screw on the left side of the cell (Figure 3-5.7L), then removing the three screws on the right side of the cell (Figure 3-5.7R) and removing the two screws attaching the cell divider frame to the pan (Figure 3-5.7B).

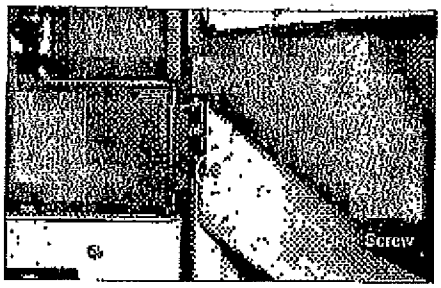


Figure 3-5.7I.

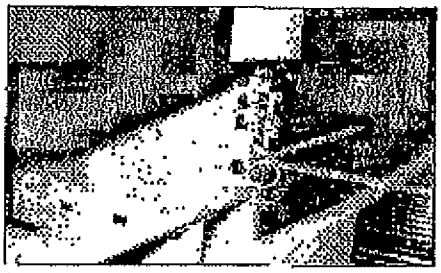


Figure 3-5.7H

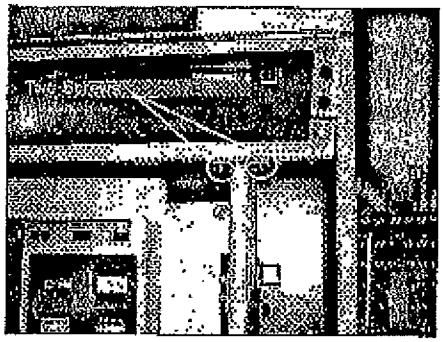


Figure 3-5.7B

Step 8. Remove the bolts from each phase of the line side connections (Figure 3-5.8).

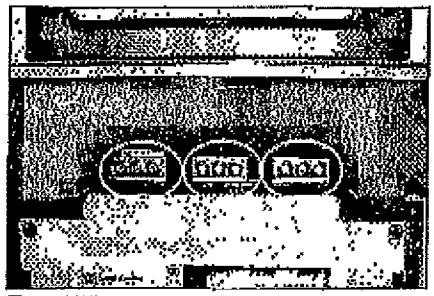


Figure 3-5.8

Step 9. Repeat steps 3 and 4 for the cell located below the breaker being removed.

Step 10. Remove the top half of the divider frame located below the breaker cell by removing the two remaining screws holding the left side of the top divider frame (Figure 3-5.10L). Then remove the two screws holding the right side (Figure 3-5.10R). Remove the three screws holding the lower door hinge and the two screws attaching the frame to the bottom of the post (Figure 3-5.10T). Remove the seven screws holding the post (Figure 3-5.10P). Then the divider pan can be slid out of the cell giving access to the load side connections (Figure 3-5.10).

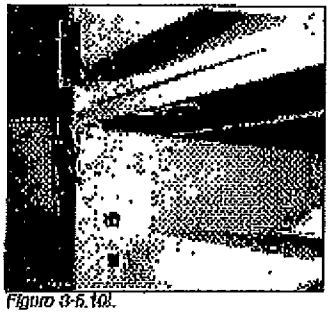


Figure 3-5.10L

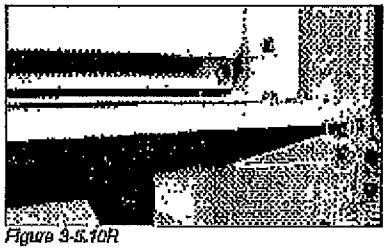


Figure 3-5.10R

Figure 3-5.10T

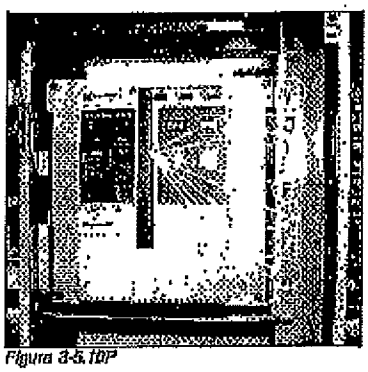


Figure 3-5.10P

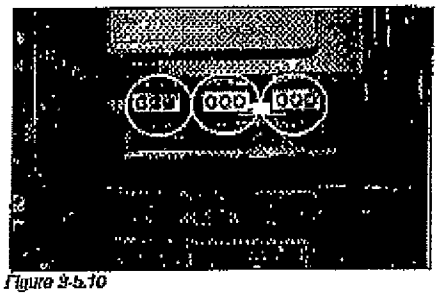


Figure 3-5.10

⚠ CAUTION

CARE SHOULD BE TAKEN WHEN THE BREAKER IS REMOVED FROM THE CELL. FAILURE TO TAKE PROPER PRECAUTIONS IN HANDLING THE BREAKER CAN RESULT IN PERSONNEL INJURY.

Step 11. At this point the entire breaker weight is being carried by the side plates. Care should be taken when the breaker is slid out of the cell. It is recommended that there be a platform equal to the height at the bottom of the breaker to be removed that will hold the weight of the breaker. Slide the breaker out onto this platform.

Step 12. With the breaker out of the cell, access is gained to the cell connectors (Figure 3-5.11) and breaker connectors (Figure 3-5.12).

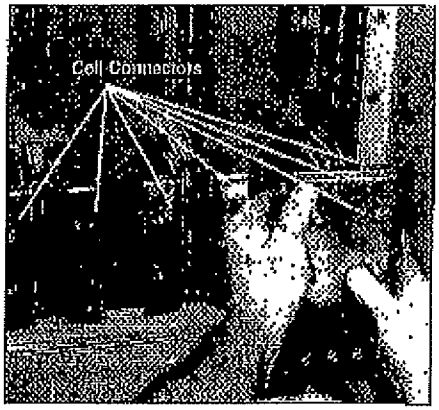


Figure 3-5.11

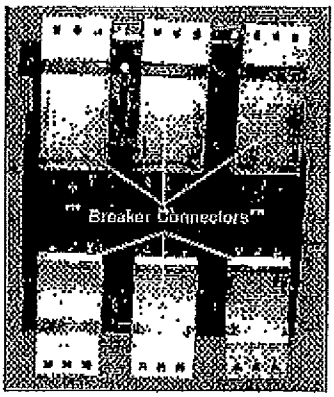


Figure 3-5.12

For removal of a fixed mounted breaker located in the D cell position follow the above steps 1 through 8. Then from the bus compartment disconnect the load side mechanic as shown in Figure 3-5.13. With those connections removed, the breaker can be slid out of its cell.

Note that most of the loadside copper runbacks will still be attached to the breaker and will be withdrawn as the breaker is removed from the cell (Figure 3-5.14).

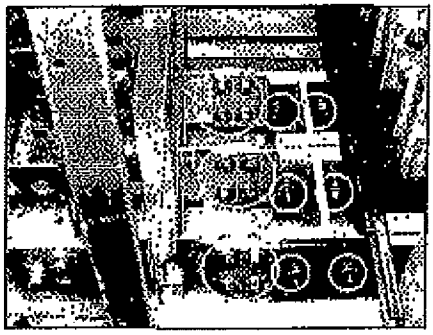


Figure 3-5.13

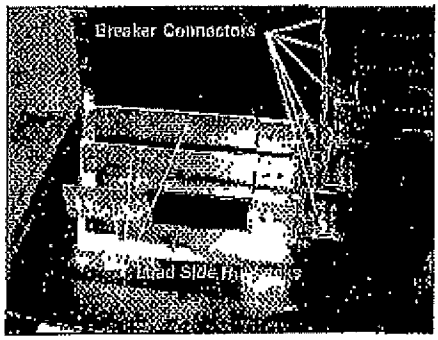


Figure 3-5.14

3.2.1.2 BREAKER CASSETTE (DRAW-OUT)

The breaker cassette supports the breaker in the cell and on the movable extension rails as the breaker is placed into the cell.

3.2.1.2.1 EXTENSION RAILS (DRAW-OUT)

The extension rails are withdrawn from the breaker cassette by pulling the black handles located on the end of the extension rails. Once extended, the breaker is placed onto the draw-out rails by aligning the hook features located on each side of the circuit breaker

BREAKERS WHICH WILL FIT CELL IN EMERGENCIES	
BREAKER CELL	EMERGENCY SITUATION
MDS-408	MDS-608, MDS-616, MDS-620, MDS-808, MDS-816, MDS-820, MDS-C08, MDS-C16, MDS-C20
MDS-608 MDS-616 MDS-620	MDS-808, MDS-816, MDS-820, MDS-808, MDS-816, MDS-820, MDS-C08, MDS-C16, MDS-C20
MDS-808 MDS-816 MDS-820	MDS-808, MDS-816, MDS-820, MDS-C08, MDS-C16, MDS-C20
MDS-C08 MDS-C16 MDS-C20	MDS-C08, MDS-C16, MDS-C20
MDS-632	MDS-832, MDS-C32
MDS-832	MDS-C32
MDS-C32	NONE
MDS-840	MDS-C40
MDS-C40	NONE
MDS-850	MDS-C50, MDS-863, MDS-C60
MDS-C50	MDS-C60
MDS-860	MDS-C60
MDS-C60	NONE

CAUTION

IN EMERGENCY SITUATIONS THE BREAKER LISTED ON THE RIGHT WILL FIT THE CELL LISTED ON THE LEFT. HOWEVER, DO SO ONLY IF TRIP UNIT CAN BE ADJUSTED TO PROTECT THE COMPLETE CIRCUIT.

Table 3-1 Emergency Usage of Breakers

housing with the slotted features in the draw-out rails. The breaker is then pushed into the cell until it reaches a positive stop.

3.2.1.2.2 BREAKER INTERFERENCE INTERLOCKS (DRAW-OUT)

800, 1600, 2000 and 3200 Ampere circuit breakers have the same dimensions. Additionally, 4000 and 5000 Ampere breakers have the same dimensions. To prevent insertion of circuit breakers with mismatching features, insufficient interrupting ratings, or incorrect frame sizes into cells, interference interlocks are provided.

DANGER

DO NOT DISABLE AN INTERFERENCE INTERLOCK. IF A FAULT OCCURS THE USE OF A LOWER CAPACITY BREAKER COULD RESULT IN DEATH, BODILY INJURY AND SEVERE EQUIPMENT DAMAGE.

These interference interlocks are steel pins located on the floor of the breaker cassette. As the breaker is pushed into the cell, the mating pins on the breaker bottom moves past a set of corresponding pins on the breaker cassette. If the breaker is not matched correctly for the cell, the pins will not clear each other and the breaker will not travel to the disconnect position. See Table 3-1 for emergency use of breakers.

3.2.1.3 KEY INTERLOCKS

Key interlocks are supplied when it is necessary to ensure the proper sequence of operation between two or more circuit breakers or between a circuit breaker, fuse truck or transformer high voltage disconnect switch. The interlock mechanism provided in a circuit breaker cell functions by keeping the breaker cell trip-free. The key interlock mechanism is located on the wire way side of the circuit breaker. The breaker can be removed, inserted, or a different breaker installed and the cell will remain trip-free. The key interlock operates by pulling the slide forward, rotating the key, and removing it from the lock. The slide mechanism activates a lever located on the circuit breaker, which prevents the breaker from being closed. The key can then be used in another location. The cell will remain trip-free until the key is put back into the lock, rotated, and the slide retracted.

CAUTION

TO FACILITATE MANUFACTURE AND INSTALLATION PROCEDURES, A KEY IS SUPPLIED WITH EACH LOCK. BEFORE PLACING A SWITCHGEAR ASSEMBLY WITH KEY INTERLOCKS IN OPERATION, THE KEY SCHEME MUST BE CAREFULLY CHECKED, AND ONLY THE PROPER KEYS LEFT IN THE LOCKS. ALL EXTRA KEYS MUST BE REMOVED AND DESTROYED OR STORED WHERE NOT AVAILABLE TO OPERATING PERSONNEL. THIS PROCEDURE IS NECESSARY SINCE THE IMPROPER USE OF SPARE KEYS WILL DEFEAT THE INTERLOCKING SCHEME.

3.2.1.4 METERING CURRENT TRANSFORMERS

When required for metering, current transformers are normally positioned around the stationary main contacts (Figure 3-4) for draw-out breakers and around the breaker conductors for fixed mounted breakers. Holes are provided in the main contact support insulation for mounting front accessible current transformers. See Table 3-2 for metering accuracies.

Short circuiting terminal blocks are provided as standard for each set of current transformers.

3.2.1.5 CELL SWITCH (DRAW-OUT)

An optional cell switch is operated by movement of the circuit breaker between the "connect" and "test" positions. It is mounted on the side of the cassette at the rear of the wireway. A plunger connected to the switch is actuated by the frame of the breaker as it moves into or out of the "connect" position. As a result, the cell switch can be used to electrically indicate whether or not the breaker is in the "CONNECT" position.

Its most common uses are for disconnecting remote control circuits to electrically operated breakers, and for bypassing "b" interlocking auxiliary contacts when a breaker is withdrawn from the connected position.

For applications with four (4) Form C contacts, the cell switch contacts are wired to C1-C12 (stationary secondary terminal blocks). When the second module of four (4) Form C contacts are required, they are connected with a mate and lock type plug located in the vertical wireway.

3.2.1.6 SPACE HEATERS

Space heaters are furnished as standard equipment in outdoor switchgear assemblies to reduce condensation. Heaters are placed at the rear of the "D" position breaker cell, the bottom of bus compartment and the bottom of the cable compartment. As an option, space heaters can be installed in indoor equipment.

3.2.1.7 SHUTTERS (DRAW-OUT)

DANGER

Shutters covering the primary contacts are supplied on an optional basis. The shutter is operated as a circuit breaker is moved into and out of the cell. These are provided to prevent accidental contact with live bus.

DO NOT ATTEMPT TO ACTIVATE SHUTTERS MANUALLY! SHUTTERS ARE ONLY INTENDED TO BE OPERATED BY THE CIRCUIT BREAKER. ALL POWER SHOULD BE TURNED OFF PRIOR TO INSPECTING SHUTTERS. FAILURE TO DO SO COULD RESULT IN DEATH, SERIOUS BODILY INJURY OR PROPERTY DAMAGE.

3.2.2 SECONDARY TERMINAL COMPARTMENT

Above each breaker cell is a narrow door (Figure 3-6). Control wiring entering or leaving the cell is connected to terminal blocks in the area behind this door. This area provides mounting for up to 72 termination points. Factory connections are made on the rear side of these terminal blocks. Field connections are made along the front surface of these terminal blocks by hinging the terminal block cover down. A screw type terminal landing is provided. See Figure 3-7 for secondary disconnect terminal arrangement.

3.2.3 CONTROL WIRING

The standard wire used in Switchgear Assemblies is Type SIS stranded copper, No.14 AWG. For communication wire, No.18 AWG shielded with 600 volt insulation is used.

Field installed control wiring is to enter the enclosure in the area above the bus compartment for top entry and in the breaker compartment base for bottom entry as shown in Figure 3-6. The right side of the front compartment has been reserved for field wiring to run from top to bottom. For top entry field control wiring, an enclosed wiring trough is provided to run wiring forward. When the wiring exits the wiring trough it can then be transitioned vertically to the appropriate breaker cell by tying to the vertical plane provided. Lances punched into this plane provide placement of wire ties for securing wire bundles.

The control conduit cover plates for top (Figure 3-6) and bottom entry are removable. Once removed, these plates can then be punched for the appropriate conduit size.

⚠ DANGER

IF THE SECONDARY CIRCUIT OF ANY CURRENT TRANSFORMER IS LEFT OPEN WITHOUT LOAD, AND ITS PRIMARY CIRCUIT IS ENERGIZED, A DANGEROUSLY HIGH VOLTAGE IS DEVELOPED ACROSS TRANSFORMER SECONDARY TERMINALS. TO PREVENT DEATH, BODILY INJURY OR ELECTRICAL SHOCK, EITHER DE-ENERGIZE THE CIRCUIT BY OPENING THE BREAKER, OR SHORT CIRCUIT CURRENT TRANSFORMER SECONDARY TERMINALS, BEFORE PROCEEDING WITH MAINTENANCE.

Current Transformer Metering Accuracy
Metering Type Current Transformers for
Mounting in Circuit Breaker Cells

Breaker Frame Rating	Ratio	Ratio	B-0.1	B-0.2	B-0.5	B 0.9	B-1.8
800, 1000, 2000	100/5	100/1	2.4	—	—	—	
	150/5	150/1	1.2	2.4		—	—
	200/5	200/1	1.2	2.4	2.4	—	—
	250/5	250/1	0.6	1.2	2.4	—	
	300/5	300/1	0.6	0.6	1.2	2.4	—
	400/5	400/1	0.3	0.6	1.2	1.2	—
	500/5	500/1	0.3	0.3	0.6	1.2	2.4
	600/5	600/1	0.3	0.3	0.6	1.2	1.2
	750/5	750/1	0.3	0.3	0.3	0.6	1.2
	800/5	800/1	0.3	0.3	0.3	0.6	1.2
	1000/5	1000/1	0.3	0.3	0.3	0.6	0.6
	1200/5	1200/1	0.3	0.3	0.3	0.6	0.6
	1500/5	1500/1	0.3	0.3	0.3	0.6	0.6
	1600/5	1600/1	0.3	0.3	0.3	0.6	0.6
	2000/5	2000/1	0.3	0.3	0.3	0.6	0.3
3200	1600/5	1600/1	0.3	0.3	0.6	0.6	1.2
	2000/5	2000/1	0.3	0.3	0.3	0.6	0.6
	2400/5	2400/1	0.3	0.3	0.3	0.3	0.6
	2500/5	2500/1	0.3	0.3	0.3	0.3	0.6
	3000/5	3000/1	0.3	0.3	0.3	0.3	0.3
	3200/5	3200/1	0.3	0.3	0.3	0.3	0.3
	4000/5	4000/1	0.3	0.3	0.3	0.3	0.3
4000	4000/5	4000/1	0.3	0.3	0.3	0.3	0.3
5000	5000/5	5000/1	0.3	0.3	0.3	0.3	0.3
6000	6000/5	6000/1	0.3	0.3	0.3	0.3	0.3

Table 3-2 Current Transformer Metering Accuracy

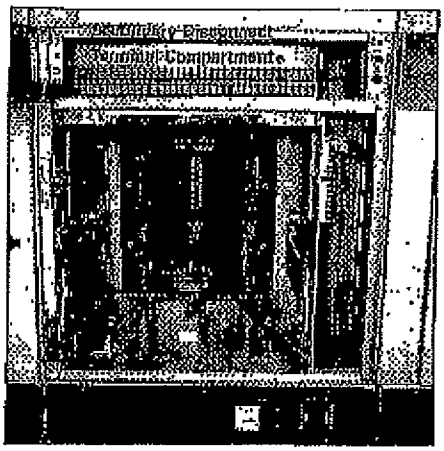


Figure 3-6 Secondary Disconnect Terminal Compartment

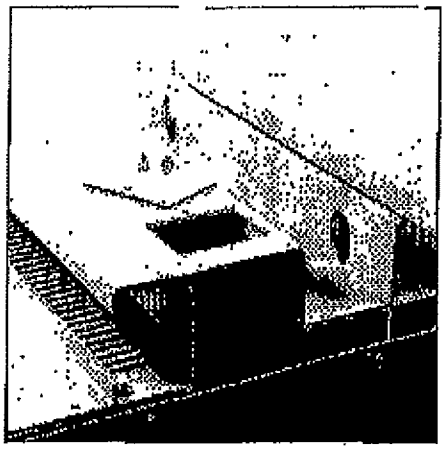


Figure 3-8 Top Conduit Cover Plate

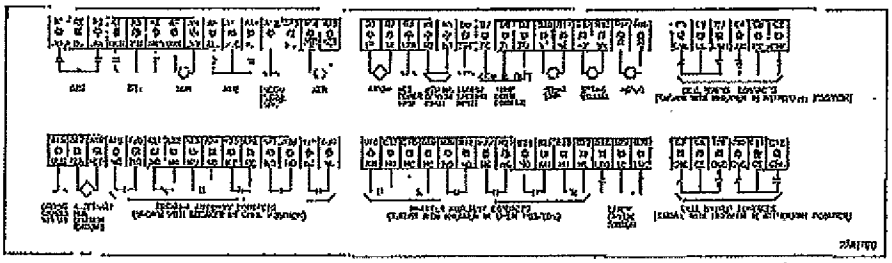


Figure 3-7 Secondary Disconnect Terminal Arrangement

3.2.4 AUXILIARY COMPARTMENT

Auxiliary compartments are normally the same physical size as a circuit breaker cell. They are used to house and mount instruments, control components and other auxiliary devices. The compartment has a hinged front door that is used for mounting a variety of devices (Figure 3-10).

3.2.5 AUXILIARY/TRANSITION SECTION

Full height auxiliary sections with hinged front doors or transition sections with bolted covers are provided for a variety of reasons; (1) additional bus space needed for matching up to different equipment assemblies; (2) close coupling to transformer; (3) mounting and wiring of additional control equipment. These vertical sections are 22 inches (559 mm) wide.

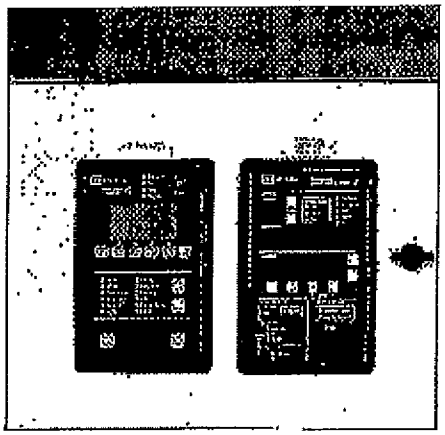


Figure 3-10 Auxiliary Compartment Door

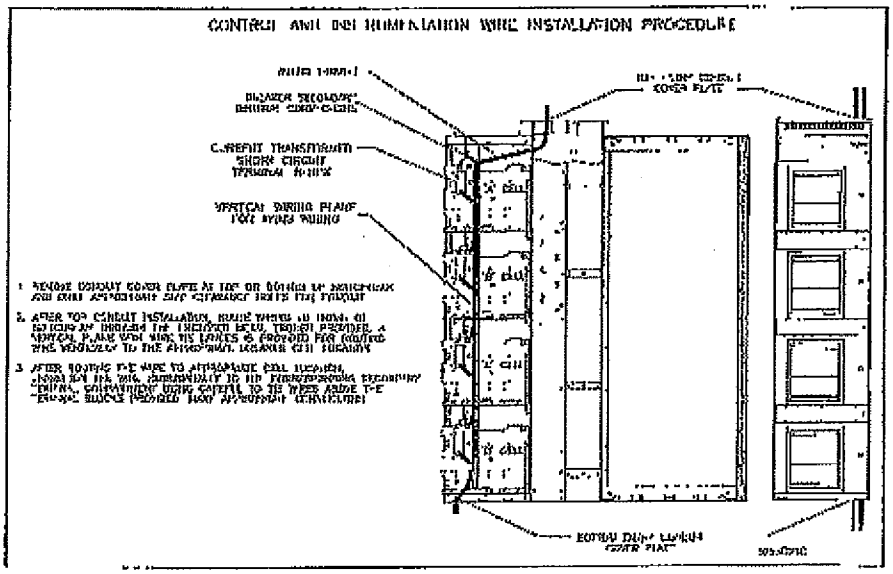


Figure 3-9 Field Installed Control Wiring

3.3 BUS COMPARTMENT

The bus compartment provides space for vertical and horizontal bus. The compartment is located just behind the front compartment and is fully isolated from breaker and auxiliary cells. (See Figure 3-1) In addition, optional grounded steel barriers may be placed between the bus and rear cable connections, providing an additional degree of safety. This helps prevents accidental contact with the main bus during maintenance procedures.

The horizontal main bus ties the vertical sections together electrically; the vertical bus feeds the individual breaker compartments. Bus sizing is based on ANSI standard temperature rise criteria of 65 Degrees C over 40
Degrees C ambient. All bus meets industry standard phase-to-phase clearance without utilizing insulated bus. Standard main and section bus is silver-plated copper with tin-plated copper optional.

3.4 CABLE COMPARTMENT

The cable compartment is located behind the bus compartment and provides sufficient room for easy cable installation. Bus bars extend the line or load side of the stationary disconnecting contacts into the cable compartment. Lug landings will accept compression or mechanical lugs. They are mounted on a 45 degree angle (Figure 3-11), up or down, to facilitate cable termination with minimum bending. On four-wire systems, an isolated neutral bus extends the length of the line up and includes a tap for outgoing neutral cable for each feeder breaker.

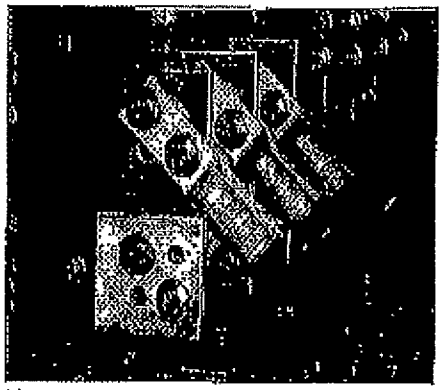


Figure 3-11 Lug Adapters

3.5 GROUND BUS

A permanent, low-resistance ground connection is essential for safe operation. A terminal for the connection to the station ground is provided in the service entrance section.

The ground bus is located at the bottom rear of the cable section and includes terminals for customer's connections (Figure 3-12).

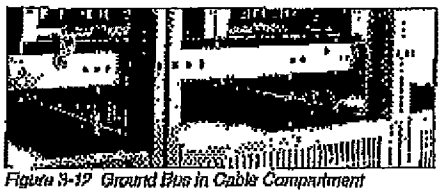


Figure 3-12 Ground Bus in Cable Compartment

3.6 OUTDOOR ENCLOSURE TYPE 3R

The Magnum DS outdoor design is the indoor design enclosed in a separate outdoor enclosure (Figure 3-13). The rigid structure foundation base is easily anchored to a pad using the supplied lifting/tie down angles. A separate channel base is not required.

A front operating and maintenance aisle extends through all units of the assembly. A large reinforced door with panic hardware is standard at each end of the aisle. These doors can be opened from the inside, even when padlocked from the outside. The rear access doors are hinged and provided with door stops. These braces keep the doors open at a 90 degree angle.

The outdoor structure also includes, as standard, filtered ventilation openings (filters can be changed without opening aisle or rear compartment doors), aisle lighting, GFI protected convenience receptacles and space heaters. When specified, a thermostat is mounted in the cable compartment. Space heaters are located in the "D" position breaker cell, bus compartment and cable compartment of each vertical section.

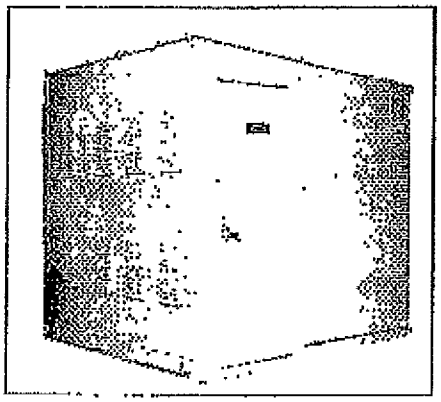


Figure B-13 Outdoor Enclosure

3.7 TYPE MAGNUM DS CIRCUIT BREAKERS

Refer to the latest revision of Instruction Book 2C12060 for receiving, handling and storing, description and operation, installation, adjustments, and maintenance instructions. Circuit breaker data, and renewal parts information is also included.

4: INSTALLATION

DANGER

BEFORE PROCEEDING WITH ANY INSTALLATION, TESTING, START-UP OR MAINTENANCE, REVIEW ALL OF SECTION 1 FOR SAFETY PRACTICES AND RECOMMENDATIONS. FAILURE TO DO SO COULD RESULT IN DEATH, SERIOUS BODILY INJURY OR PROPERTY DAMAGE.

4.1 GENERAL INFORMATION

This section contains instructions for installing Magnum DS Metal-Enclosed Low-Voltage Switchgear Assemblies. Proper installation of Magnum DS Metal-Enclosed Low-Voltage Switchgear is of prime importance. Too much emphasis cannot be placed on this phase of the work. Study the associated instruction manuals and drawings carefully.

CAUTION

PERSONNEL INSTALLING THIS EQUIPMENT MUST BE THOROUGHLY FAMILIAR WITH ALL ASSOCIATED INSTRUCTION MANUALS AND APPLICABLE GOVERNING CODES. ADDITIONALLY, ALL DRAWINGS, WHETHER MECHANICAL OR ELECTRICAL, MUST BE UNDERSTOOD AND STRICTLY FOLLOWED TO PREVENT POSSIBLE DAMAGE TO THE SWITCHGEAR OR EQUIPMENT BEING PROTECTED.

4.2 LOCATION AND FOUNDATION

Magnum DS Metal-Enclosed Low-Voltage Switchgear is assembled at the factory on smooth level surfaces to assure correct alignment of all parts. Extra care by the purchaser in selecting the location and preparing the foundation will result in reduced installation costs, as well as good equipment performance.

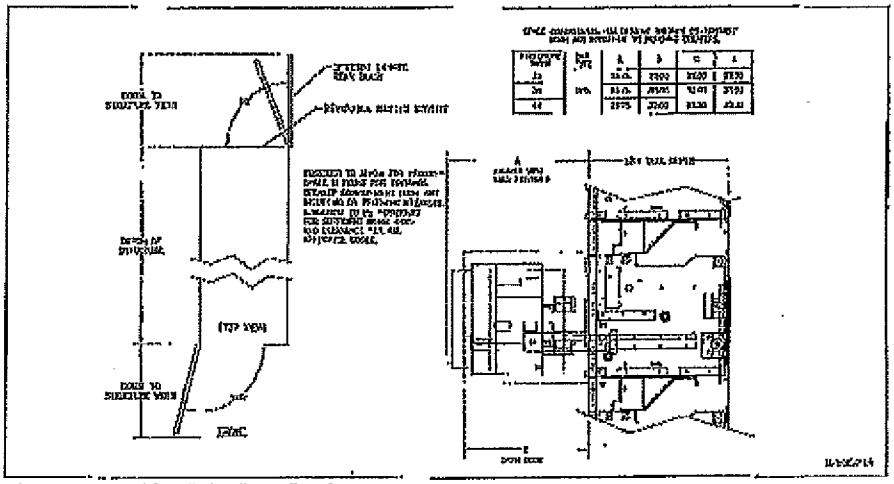


Figure 4-1 Typical Installation Space Requirements

4.2.1 LOCATION

In general, the location will have been determined during the specification and/or procurement phases. Indoor locations impose certain requirements which must be met so that the switchgear assembly may operate efficiently with the least amount of maintenance. Consideration must be given to the aisle space required at the front and rear of the equipment, space at the ends of the lineup, and equipment ventilation (Figure 4-1). In addition to Figure 4-1, refer to floor plan drawings supplied as part of the equipment drawing package.

The space at the front must be sufficient to permit the opening of doors, the insertion and withdrawal of circuit breakers, and the transfer of circuit breakers to other compartments by means of an overhead lifter or portable lifting device. The space at the rear must be sufficient to meet local codes, open rear doors, install cables, inspect equipment and perform maintenance.

Switchgear equipment should be placed in a clean, dry area, allowing air to freely circulate. The bus and cable compartments are ventilated by means of air entering the ventilation openings in the rear of the enclosure and leaving through a ventilator in the bus compartment roof.

4.2.2 FOUNDATION

The floor or foundation must be smooth, level (within 1/8 inch per three feet [3.5 mm/meter] in any direction) and strong enough to support the weight of the equipment without sagging. Table 4-1 outlines the approximate weights for various ratings of indoor switchgear assemblies.

Actual weights will depend upon the amount of equipment in the individual sections. Adequate safety factors must be included in any weight calculation. If the foundation is subject to vibration and/or impact loads, special mounting considerations must take place to prevent the transmission of vibration or shock to the equipment.

4.2.3 INDOOR EQUIPMENT

The preferred method of anchoring an indoor assembly is by fastening it to level steel channels which are embedded in the concrete floor. Holes that remain after the wooden skids are removed from indoor assemblies are used for securing the assembly permanently in position. Four inch (5.4 lb/ft) structural channels are recommended as a minimum size for the average lineup of indoor equipment.

Magnum DS Switchgear Structure Weights
Weights in Lbs. (Kg) Approximate
Dimension in inches (mm) Approximate

Indoor Switchgear Assemblies Less Breakers		
Width	Depth	Weights
BREAKER STRUCTURES		
22 (558.8)	60-66 (1524-1676)	1300 (590)
22 (558.8)	72-78 (1829-1981)	1400 (636)
22 (558.8)	84-90 (2133-2286)	1500 (680)
44 (1117.6)	60-66 (1524-1676)	1500 (680)
44 (1117.6)	72-78 (1829-1981)	1600 (726)
44 (1117.6)	84-90 (2133-2286)	1700 (771)
AUXILIARY STRUCTURES		
22 (558.8)	60-66 (1524-1676)	1000 (454)
22 (558.8)	72-78 (1829-1981)	1100 (499)
22 (558.8)	84-90 (2133-2286)	1200 (544)
44 (1117.6)	60-66 (1524-1676)	1100 (499)
44 (1117.6)	72-78 (1829-1981)	1200 (544)
44 (1117.6)	84-90 (2133-2286)	1300 (590)
TRANSFORMER TRANSITION STRUCTURES		
22 (558.8)	60-90 (1524-2286)	1000 (454)
BUSSED TRANSITION STRUCTURES		
12 (305)	60-66 (1524-1676)	500 (318)

Breaker Element *)		
	Fixed	Drawout
MDS-408	110 (50)	150 (68)
MDS-608	110 (50)	130 (59)
MDS-808	120 (54)	140 (64)
MDS-C08	120 (54)	145 (66)
MDS-616	110 (50)	130 (59)
MDS-816	120 (54)	145 (66)
MDS-C16	120 (54)	145 (66)
MDS-620	120 (54)	145 (66)
MDS-820	120 (54)	140 (66)
MDS-C20	120 (54)	145 (66)
MDS-632	125 (61)	175 (80)
MDS-832	125 (61)	175 (80)
MDS-C32	125 (61)	175 (80)
MDS-640	215 (90)	310 (141)
MDS-840	215 (98)	310 (141)
MDS-850	250 (113)	310 (141)
MDS-C50	250 (113)	310 (141)
MDS-860		310 (141)
MDS-C60		310 (141)

*) Impact weight equals 1.6 times breaker static weight.

Table 4-1 Switchgear Weights

CAUTION

THE FRONT AND REAR CHANNELS MUST BE SET AND ALIGNED WITH EACH OTHER AND MUST BE LEVEL (0.125" PER THREE FEET [3.5 MM/METER]) OVER THEIR ENTIRE LENGTH TO AVOID DISTORTION OF THE STRUCTURE. THE FINISHED FLOOR MAY HAVE A SLIGHT PITCH AWAY FROM THE CHANNELS BUT IN NO CASE SHOULD THE FINISHED FLOOR BE HIGHER THAN THE CHANNELS.

Each unit is fastened to the floor channels by either bolting or welding. Welding is a quick and easy method of securing the switchgear assembly in place, while eliminating the layout of the mounting holes in the channels.

4.2.4 OUTDOOR EQUIPMENT

Outdoor assemblies do not require floor channels. Hold down plates are provided by rotating the lifting angles 180 degrees and then permanently bolted to the foundation. As was the case with the indoor foundation, the outdoor foundation should also be level from front to rear and side to side to prevent distortion. For further details see the foundation plans provided with the equipment.

4.2.5 CONDUITS

Provisions must be made in the foundation for all conduits entering from below. Specific floor plan details provided with the equipment must be used to determine the final conduit layout, spacing of floor channels, and floor space required for each lineup (Figure 4-2).

Power conduits should project above the finished floor not more than two inches (51 mm) for an indoor assembly. Control wire conduits should not extend higher than 1 inch (25 mm). It will simplify moving the groups into place if the conduits are flush with the concrete surface and appropriate extension sleeves added after the units are in their final location. See the floor plan information supplied with the assembly for conduit space and location.

4.3 SHIPPING GROUP ASSEMBLY

Before assembling the switchgear equipment, all components should be available at the site location. The prepared foundation should be ready and all embedded conduits installed and capped.

4.3.1 ASSEMBLY PROCEDURES

When correctly installed, both indoor and outdoor assemblies should conform to the following requirements:

DANGER

PRIOR TO INSTALLATION AND ASSEMBLY, BE CERTAIN THE FOUNDATION IS LEVEL AND FREE OF ANY DEBRIS TO PREVENT EQUIPMENT DAMAGE.

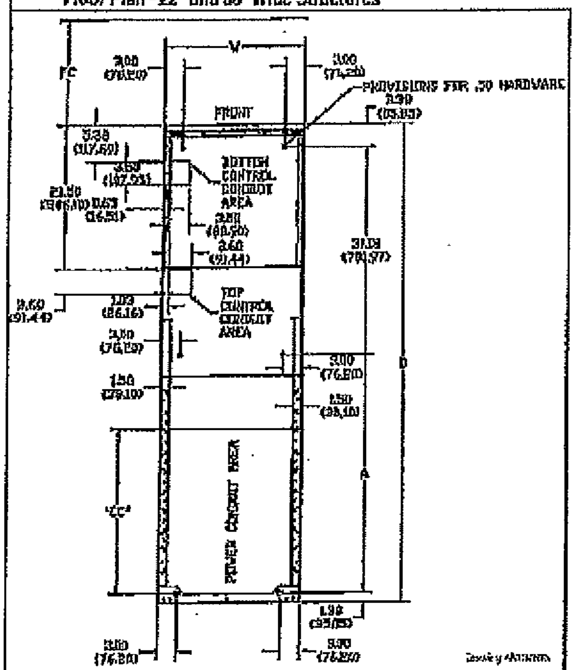
1. Front panels should form a straight line. When transformers and/or other gear are included, equipment should be located in keeping with the plan drawings supplied with the equipment.
2. Vertical sections must be correctly spaced from center to center and plumb. A suggestion for lining up the shipping groups is to establish a base line a few inches in front of the switchboard and parallel to the final location. Equalize the distances from the front of the shipping groups to the base line, thus making the face of the assembly parallel to the base line. Check each vertical section by dropping a plumb line from the top corner of each vertical section. It should align with the bottom corner.
3. The entire assembly of vertical sections should be securely fastened to floor channels or base pad.
4. Shipping groups must be securely bolted together and all bus and control wiring connections properly made.

After the first shipping group has been located, the second shipping group should be moved into position and similarly checked. The shipping groups are fastened together in accordance with the instructions given in drawing 9253C18. This drawing is included in the information packet attached to the side of the switchgear assembly. Should additional copies of this drawing be needed, contact your nearest Cutler-Hammer sales office.

4.3.1.1 DRIP/SPRINKLER RESISTANT ASSEMBLY

As an option, drip shields are provided for mounting along the front and rear of the switchgear to protect doors against entry of water. In addition, a drip shield is supplied for mounting over the ventilation opening located above the bus compartment. These components are shipped loose to avoid damage during shipment and to facilitate lifting of the equipment without removal of the drip shields. Drip shields are provided for a shipping unit and must be bolted in place during installation of the equipment. See Figure 4-3 for installation instructions.

Floor Plan - 22" and 30" Wide Structures



FC	W	H	A	CC
36 (914)	22 (559)	54(1372)	18(457)	7.3(185)
		60(1524)	24(610)	13.3(338)
		66(1676)	30(762)	19.3(490)
		72(1829)	36(914)	25.3(643)
		78(1981)	42(1067)	31.3(795)
		84(2134)	48(1219)	37.3(948)
		90(2286)	54(1372)	43.3(1100)
36 (914)	30 (762)	54(1372)	18(457)	7.3(185)
		60(1524)	24(610)	13.3(338)
		66(1676)	30(762)	19.3(490)
		72(1829)	36(914)	25.3(643)
		78(1981)	42(1067)	31.3(795)
		84(2134)	48(1219)	37.3(948)
		90(2286)	54(1372)	43.3(1100)
36 (914)	44 (1118)	54(1372)	18(457)	7.3(185)
		60(1524)	24(610)	13.3(338)
		66(1676)	30(762)	19.3(490)
		72(1829)	36(914)	25.3(643)
		78(1981)	42(1067)	31.3(795)
		84(2134)	48(1219)	37.3(948)
		90(2286)	54(1372)	43.3(1100)

① FC is the recommended front clearance for breaker removal with top-of-switchgear-mounted breaker lifter. If a portable breaker lifter is to be used, allow at least 84 inches (2134mm) of aisle space.

② Hinged rear doors add 12.5 inches (325mm).

③ Bolt hole location for mounting the center floor channel when required. Floor channels not included.

④ When a zero-sequence ground-fault CT is mounted on line-side or load-side of a breaker, reduced CC dimension by 10 inches (254 mm).

⑤ Stub conduit 2 inches (50mm) maximum in power cable area. 1-inch (25mm) maximum in control wiring area.

⑥ For available area for bus duct connection, contact Cutler-Hammer.

Center of Gravity Location

Center of Gravity
For seismic calculations, the following dimension should be used to locate the center of gravity for Indoor Magnum DS Switchgear:
Vertical .... 60 inches (1524 mm)
Left-to-right .... center of lineup
From the front .... 26 inches (660 mm)

Figure 4-2 Indoor Equipment Location of Anchor Points and Conduit Location (see next page for continuation)

Floor Plan - 44" Wide Structures

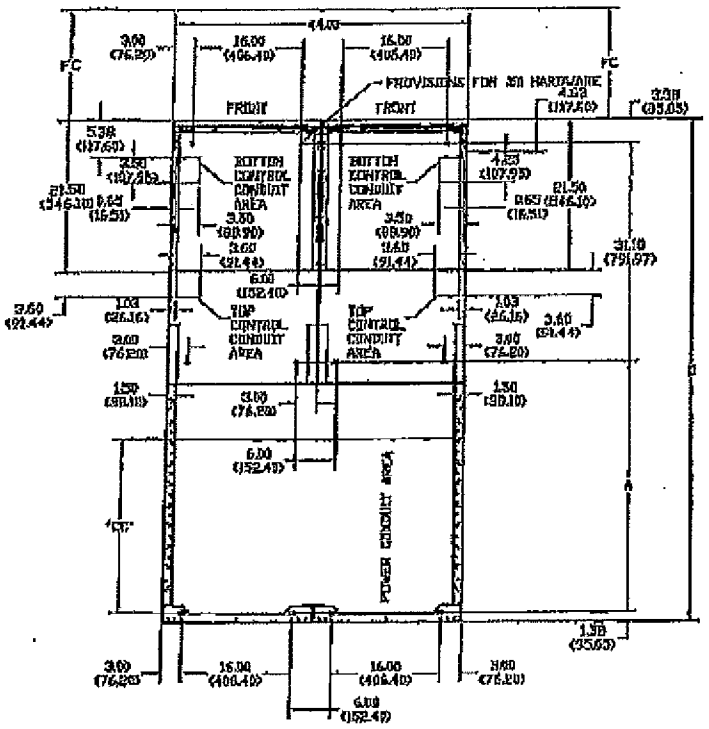


Figure 4-2 Indoor Equipment Location of Anchor Points and Conduit Location (continued)

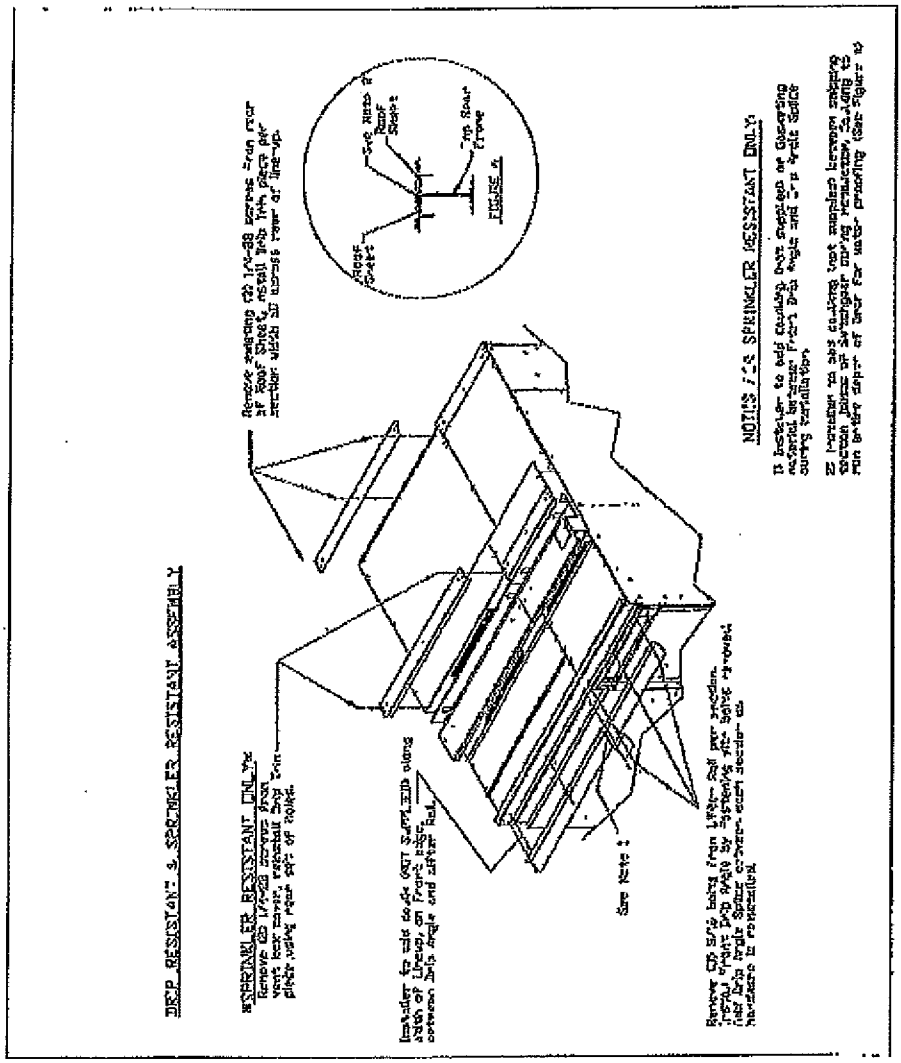


Figure 4-3 Installation of Drip/Sprinkler Shields

4.4 BUS, CABLE AND CONTROL CONNECTIONS

4.4.1 BUS CONNECTIONS

All connections of the main and neutral buses, and the ground bus at shipping breaks are made by means of bolted splice plates. These are always plated, bolted joints. Required hardware and splice plates are provided. Provision is made at the ends of the lineup, and adjacent to transformers, for future expansion by means of bolted bus joints.

See drawing 9253C78 for typical shipping split cross bus and neutral installation instructions. This drawing is included in the information packet attached to the side of the switchgear assembly. Should additional copies of this drawing be needed, contact your nearest Cutler-Hammer sales office.

4.4.2 BUS JOINT PREPARATION

The bolting areas of all bus materials are plated to provide a reliable joint. In some atmospheres the plating will become tarnished, but this does not reduce its effectiveness. Dirt, grease and other foreign material must be removed from the surfaces before they are joined. For dirty surfaces use a lint-free, water-dampened cloth. If this does not produce satisfactory results, use a lint-free cloth dampened with a mild solvent such as mineral spirits, Stoddard solvent or isopropyl alcohol. Again, wipe it dry after cleaning.

CAUTION

THE MILD SOLVENTS DESCRIBED ARE FLAMMABLE. PROVIDE ADEQUATE VENTILATION AND KEEP AWAY FROM FLAMES AND OTHER IGNITION SOURCES. CONSULT YOUR SAFETY DEPARTMENT BEFORE USING. NO SOLVENT IS SAFE IN AN UNVENTILATED OR POORLY VENTILATED SPACE.

4.4.3 BOLT TIGHTNESS

All fasteners holding structural members, barriers and covers are installed at the factory tight enough to assure rigidity of the assembly and to prevent vibration of the covers after the equipment is energized. When covers or barriers are removed during installation, care should be taken to solidly tighten all bolts after replacing.

Bolts installed in bus joints and connections are high strength steel, SAE Grade 5. The reliability of current conducting joints is dependent upon the tightness of the joint. Therefore, extreme care must be taken when making or remaking bus joints in the field to assure their tightness. Bolts in bus connections should be tightened according to Table 4-2.

TORQUE FOR BOLTS IN BUS BAR JOINTS (USING GRADE 5 STEEL BOLTS)	
BOLT SIZE	TORQUE FT-LBS (NEWTON/METERS)
3/8 - 16	20 (27)
1/2 - 13	50 (65)

Table 4-2 Bolt Tightness For Bus Connections

4.4.4 GROUND BUS

The joint in the ground bus is made by means of a single splice plate bolted directly to the inside of the rear steel frame (Figure 3-12). It is important that the ground bus be connected first since it provides an integral ground for all the equipment. It must be connected to the station ground before energizing equipment.

Terminals are provided on the ground bus for connection to the station ground. This connection should be a direct connection and not run in metal conduit. The grounding conductor should be capable of carrying the maximum line-to-ground current for the duration of the fault.

DANGER

A PERMANENT, LOW-RESISTANCE GROUND IS ESSENTIAL FOR ADEQUATE PROTECTION. A POOR GROUND COULD BE WORSE THAN NONE, SINCE IT GIVES A FALSE FEELING OF SAFETY TO THOSE WORKING AROUND THE EQUIPMENT. IMPROPERLY GROUNDED EQUIPMENT COULD RESULT IN DEATH, BODILY INJURY OR PROPERTY DAMAGE.

4.4.5 POWER CABLE LASHING

Each switchgear assembly is provided with either crimp or mechanical lug landings arranged so that the lugs are pointed up or down at a 45 degree angle to reduce the cable bending required for installation. (Figure 4-4).

The lashing of cables are required for the following conditions:
(1) All 800 ampere frame breakers

(2) All breaker frames with short circuit ratings above 65kA.
(3) When lugs described in 4.4.5 (A) or (B) are not used.

To assure the short circuit ratings of the switchgear, the following cable lugs are to be used for power cables:

A) COMPRESSION CRIMP LUGS

1) Two mounting holes.
2) Minimum of double crimp.
3) Must be crimped with hydraulic crimper with minimum of 12 tons (11 metric tons) compression.

B) MECHANICAL SCREW LUGS

1) Aluminum body lug with two mounting holes.
2) One 1/2" hex cable holding screws torqued to 500 in. lbs. (56.5 Newton/Meters)

If cable lashing is required, follow the methods given in Figure 4-5.

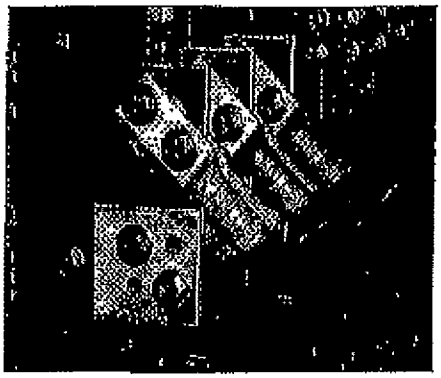
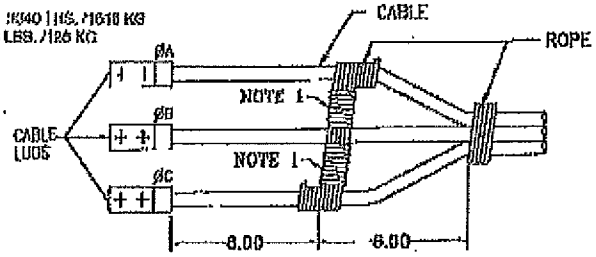


Figure 4-4 Lug Landings

CABLE LASHING INSTALLATION INSTRUCTIONS

ROPE REQUIREMENTS
3/8" DIAMETER
NYLON, TWISTED
SIZE = 8/12
3 STRAND
TENSILE STRENGTH = 3640 LBS. /1618 KG
WORKING LOAD = 278 LBS. /126 KG



INSTRUCTIONS:

AT EACH CABLE IS ROUTED AS CLOSE TOGETHER AS POSSIBLE, THE ROPE IS TO BE WRAPPED AROUND THE CABLE 6" (150M) FROM LUGS (SEE NOTE 1). THE SECOND WRAP IS TO BE APPLIED 6" (150M) FROM THE FIRST WRAP. AFTER THE SECOND WRAP, THE CABLES SHOULD BE WRAPPED AT 12" (300M) INCREMENTS TO THE ENTRY OR EXIT POINT OF THE SWITCHGEAR. EACH SET OF WRAPS CONTAINS 5 LOOPS.

NOTE 1: IF THE CABLE IS NOT COMPLETELY BUNDLED TOGETHER, THE ROPE BETWEEN CABLES SHOULD BE WRAPPED TO PROVIDE SUPPORT.

Figure 4-5 Cable Lashing Instructions

4.4.5.1 LUG LANDING BOOTS

Boots for lug landings are provided for 800, 1600, 2000 and 3200 ampere frames on an optional basis or when service entrance requirements mandate. These boots are mounted on the lug landings when shipped from the factory. Prior to terminating cables, these boots must be removed. Removal of these boots is completed by cutting the wire ties which hold the boot closed. After the wire ties are removed, a flexible integral hinge permits easy removal of the boot.

Provisions exist in the boot for bottom or top cable entry. In preparation for installation of the boot over the lug landings, the appropriate projections located on the seamed surface of the boot must be selected and the tip removed (cut) to accommodate the cable diameter. In addition, for each projection utilized, a slit must be provided by cutting from the cable opening to the seam of the boot. After the appropriate openings and slits are provided, the boot can be installed over the lug landing by opening the boot around the landing and closing the boot. Care should be exercised in routing the slits provided in the boot around the cables. After boot installation, fastening is completed by securing both halves of the boot together with wire ties in the holes provided around the seam of the boot.

4.4.6 CONTROL CONNECTIONS

All control wiring that connects between two shipping sections must be reconnected to their correct points on the terminal blocks located on top of the vertical section as shown in Figure 4-6. These connection points are located beneath the top cover of the breaker compartment.

Molded male pull-a-part terminal blocks are utilized for shipping section control wiring connections (Figure 4-6). The connections are made by plugging the appropriate male block into the corresponding female connector. Control wiring should be checked with the connection diagram to ensure that all connections have been made properly, all fuses installed, current transformer circuits completed, and connections tightened.

Before applying control power, check all control circuits for grounds, except current and voltage transformer secondaries. Integrally supplied AC control sources are provided with a safety ground on the neutral side of 120 V circuits. No grounds should be present on DC circuits. Make sure all circuits are clear and that any electrically operated circuit breakers are in the "remove" position.

If the control power source is other than a self-contained control power transformer, the conductors from the source to the assembly must be of adequate size to avoid excessive voltage drop during operation.

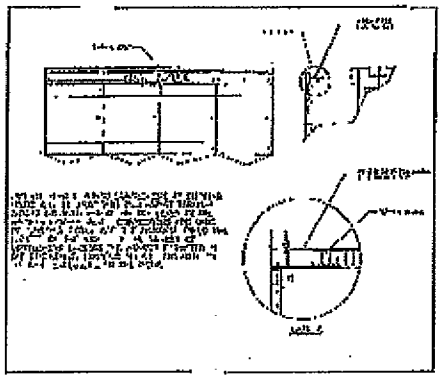


Figure 4-6 Shipping Split Control Terminal Block Connection

4.5 TRAVELING CIRCUIT BREAKER LIFTER

The traveling overhead circuit breaker lifter is a standard device installed on outdoor assemblies. Check to be certain that the carriage assembly moves freely across the entire length of the switchgear.

Indoor switchgear assemblies are supplied with overhead lifters as an optional item. When an optional lifter is supplied, it is shipped in a separate carton (Figure 2-1) with instructions for assembly.

In general, the installation of the lifter assembly is not difficult. Certain steps should, however, be carefully followed to ensure smooth operation.

For proper installation of the overhead breaker lifter follow the instructions in Figure 4-7 and 4-8. Figure 4-9 shows how to attach to the breaker for lifting.

DANGER

DO NOT STAND UNDER THE CIRCUIT BREAKER DURING HOISTING OPERATIONS. THE CIRCUIT BREAKER MIGHT SLIP AND CAUSE PERSONAL INJURY. KEEP HANDS AND TOOLS AWAY FROM SPREADER BAR, LIFTING HOOKS AND BREAKER. SEVERE INJURY MAY RESULT. SUDDEN MOTIONS ARE COMMON IN A CABLE UNDER TENSION AS IT WINDS AROUND A WINCH DRUM.

4.6 MOVING PARTS

There are few moving parts in the stationary structures of switchgear assemblies. It is recommended that all moving parts be carefully operated by hand. This will ensure that no binding or damage has occurred during shipment or handling. In some cases, accessories may be blocked or braced for shipment. Thoroughly check apparatus, such as meters and relays, for forms of blocking or bracing which must be removed.

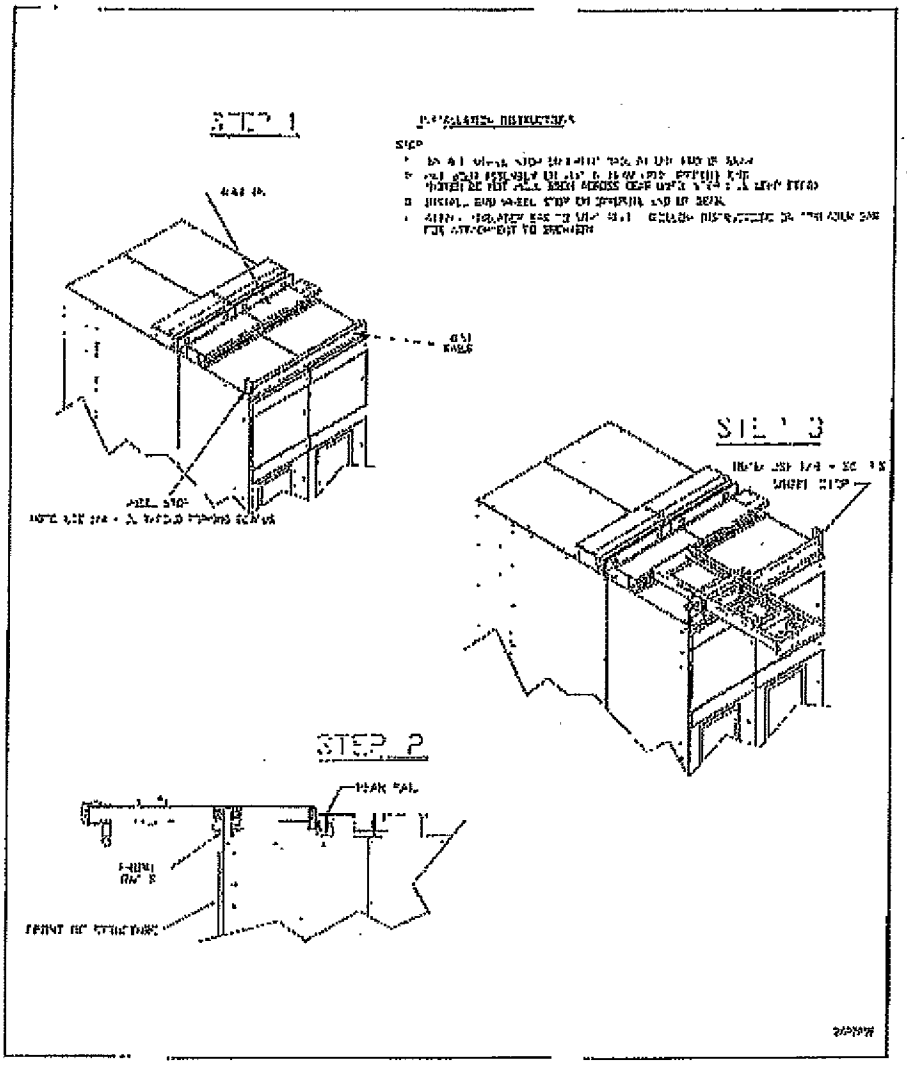


Figure 4-7 Breaker Lifter Installation

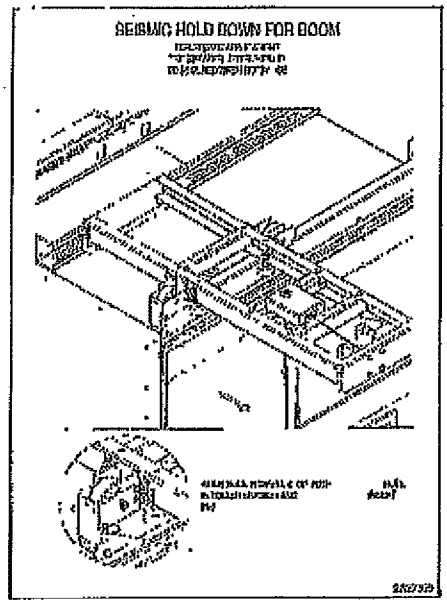


Figure 4-8 Breaker Lifter Installation

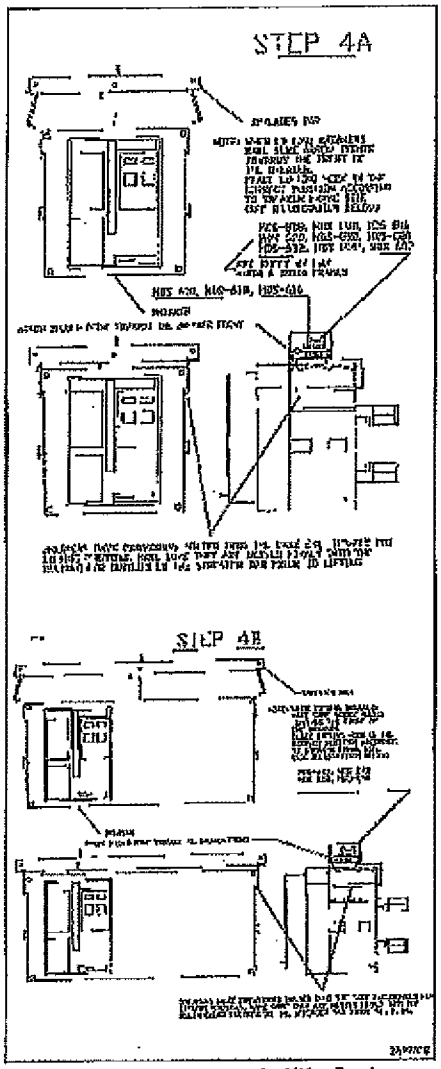


Figure 4-9 Hooking Arrangement for Lifting Breakers

5: INSPECTION AND TESTING PRIOR TO OPERATION

DANGER

BEFORE PROCEEDING WITH ANY INSTALLATION, TESTING, START-UP OR MAINTENANCE, REVIEW ALL OF SECTION 1 FOR SAFETY PRACTICES AND RECOMMENDATIONS. FAILURE TO DO SO COULD RESULT IN DEATH, SERIOUS BODILY INJURY OR PROPERTY DAMAGE.

5.1 GENERAL INFORMATION

After the switchgear assembly and apparatus to be controlled have been installed and all interconnections made, the equipment should be given a final check and tested before being placed in service. This is necessary to assure that the equipment has been correctly installed and that all connections are complete and have been properly made.

DANGER

TO AVOID POSSIBLE DEATH, BODILY INJURY OR ELECTRICAL SHOCK, EXTREME CARE MUST BE EXERCISED TO PREVENT THE EQUIPMENT FROM BEING CONNECTED TO THE POWER SYSTEM WHILE THE PRELIMINARY TESTS ARE BEING CONDUCTED. IF DISCONNECTING SWITCHES ARE NOT AVAILABLE, LINE LEADS SHOULD BE DISCONNECTED TO ACCOMPLISH THIS NECESSARY STEP.

Directions for testing relays, instruments, meters, circuit breakers and other electronic devices, which may be a part of the assembly, are given in the instruction book for each individual device. The proper settings for protective devices are normally determined from a coordination study performed by the purchaser or consultant. Factory settings were those used for production testing and do not reflect specific site requirements.

5.2 TEST EQUIPMENT

Test equipment will depend on the rating and type of installation. Portable voltmeters of the multi-scale type will be required. For larger installations, ammeters should be available in case unexpected circumstances arise. An ohmmeter and "megger" will prove invaluable in checking insulation and continuity of the circuits. A simple portable device for "ringing" or "lighting-out" circuits may be used for the continuity check.

5.3 CONNECTIONS

Wire connections, accessible bolted bus connections and barriers should be examined to be sure that they have not been loosened or damaged during shipment or installation.

The connections to equipment external from the switchgear assembly such as remote control, interlock circuits and auxiliary switches should be checked for continuity to ensure that they are also correct. There must be definite assurance that connections are correct before an attempt is made to operate the equipment.

Verify that all shipping split wiring has been correctly connected.

5.4 AUXILIARY EQUIPMENT

If space heaters are supplied, they should be energized to confirm correct operation.

Relays included on the instrument panels are normally set for production testing levels when shipped. The final settings of the relays should be coordinated with other parts of the system in accordance with the purchaser's standards or operation practice. Any necessary modifications to the relay settings should be carried out in accordance with the instruction leaflet for that particular relay.

All covers for meters, relays and other devices removed during testing, should be carefully handled when removed. The covers should be put back in place promptly to keep dust and dirt from collecting.

5.5 GROUND FAULT SYSTEMS (PER THE NATIONAL ELECTRIC CODE)

Ground fault protection of service entrance equipment shall be provided for solidly grounded wye electrical services of more than 150 volts to ground, but not exceeding 600 volts phase-to-phase, for each service disconnecting means rated 1000 amperes or more. The ground fault protection system shall be performance tested when first installed on site. The test shall be conducted in accordance with instructions outlined in Section 230-95 of the National Electrical Code.

Performance testing of ground fault protection systems should be undertaken only by qualified personnel. In the tests requiring the use of high current test equipment, it is usually necessary to obtain the services of a qualified testing organization. See IB 32-693 for Magnum DS Breaker ground fault conformance testing.

5.6 ELECTRIC AND ARC FLASH HAZARD

NEC Article 110.16 requires that low-voltage switchgear be marked to indicate the potential for electric and arc flash hazard. Labels to this effect are to be applied at the installation site prior to energizing the equipment. Two labels are supplied and are contained in the document sleeve mounted on the side of the equipment. One label is to be applied on the front and the other on the rear of the equipment.

5.7 CIRCUIT BREAKERS AND TRIP UNITS

All circuit breakers should be checked to be sure that they are in accordance with the requirements of the circuits. The circuit breakers and associated safety interlocks should have been checked mechanically during the equipment installation phase. This was, however, only preliminary and a more detailed inspection and testing procedure, both electrical and mechanical, must take place prior to putting the equipment into service. For information on complete testing and maintenance of the circuit breakers and trip units, refer to the separate circuit breaker and trip unit instruction manuals.

5.8 BASELINE TEST DATA

Certain baseline tests should be performed and recorded for diagnostic maintenance purposes. Take "megger" readings again between the buses and ground and between phases. Keep a record of these readings for future reference in determining when trends occur that would indicate a decrease of resistance.

DANGER

A one-minute dielectric test was performed on all bus at the factory in accordance with ANSI C37.20.1. Repeating these tests is not required for field installation unless the equipment has been in extended or outdoor storage, or major bus modifications have been made. If required, 2200 Vac should be applied between each phase, and each phase-to-ground. All connections to the bus from control power or metering circuits must first be isolated from the bus. Circuits Breakers must be in the withdrawn or removed position. Devices such as lightening arresters and capacitors must also be disconnected.

5.9 FINAL STEPS

ENERGIZING THE SWITCHGEAR FOR THE FIRST TIME IS POTENTIALLY DANGEROUS. THEREFORE, ONLY QUALIFIED PERSONNEL SHOULD BE PRESENT WHEN THE EQUIPMENT IS ENERGIZED. IF PROBLEMS CAUSED BY DAMAGE OR POOR INSTALLATION PRACTICES HAVE NOT BEEN DETECTED IN THE CHECKOUT PROCEDURE (PREVIOUSLY DESCRIBED), DEATH, PERSONAL INJURY OR SERIOUS DAMAGE CAN RESULT WHEN POWER IS APPLIED.

Before energizing, another thorough check should be made using the following checklist.

1. Have circuit breakers and other operation mechanisms been exercised?
2. Has electrical insulation resistance been tested phase-to-phase and phase-to-ground? Record these readings for future reference.
3. Have relay, meter and instrument connections been checked?
4. Have the electrically operated mechanisms of all circuit breakers been checked?
5. Has the ground fault protection system been checked in accordance with the National Electrical Code?
6. Are the adjustable trip units properly set?
7. Is all field wiring secured and not in contact with live bus?
8. Are all grounding connections properly made?
9. Has an inspection been performed to ensure that all debris, dirt, tools, scrap wire, and any other foreign objects were removed and that all vent openings are free from obstructions?
10. Have all barriers and covers been replaced and doors closed and latched?
11. Turn all circuit breakers to the OFF position before energizing the bus.
12. Electrically-operated breakers:

    Have all breakers in the disconnected position. Rack each breaker in one at a time after the assembly is energized. This way only one breaker will be electrically charged at a time. This is done so that control circuit fuses are not overloaded by all breakers charging at the same time.

SECTION 6: PERIODIC INSPECTION AND TESTING

6.1 GENERAL INFORMATION

DANGER

BEFORE PROCEEDING WITH ANY INSTALLATION, TESTING, START-UP OR MAINTENANCE, REVIEW ALL OF SECTION 1 FOR SAFETY PRACTICES AND RECOMMENDATIONS. FAILURE TO DO SO COULD RESULT IN DEATH, SERIOUS BODILY INJURY OR PROPERTY DAMAGE.

DANGER

WHEN INSPECTING, REPAIRING AND PREFORMING MAINTENANCE ON A MAGNUM DS SWITCHGEAR ASSEMBLY, THE FACT THAT DANGEROUS VOLTAGES MAY EXIST MUST BE KEPT IN MIND. PRECAUTIONS MUST BE TAKEN TO ENSURE THAT PERSONNEL DO NOT COME IN CONTACT WITH ENERGIZED PARTS. FAILURE TO DO SO COULD RESULT IN DEATH, PERSONAL INJURY OR ELECTRICAL SHOCK.

Some common general precautions for primary power circuits are:

1. All connections should be considered energized until the crew expecting to work on them is assured that the circuits are de-energized, and all precautions have been taken to ensure that there is no chance of a circuit being energized after work is underway.
2. Breakers which have been opened to de-energize a circuit to permit work on the equipment should be locked open and a suitable visible warning device placed on them.
3. Do not work on parts normally carrying high current until they have been disconnected from the system and connected to the ground bus. When performing maintenance, provisions should be made for connecting adequate flexible ground leads to every part of the switching equipment.
4. A good and reliable ground connection is necessary for every switchgear assembly installation. This ground connection should be of sufficient capacity to take care of any abnormal condition that might occur on the system and should be independent of the grounds used for any other apparatus.

6.2 ACCESS TO SWITCHGEAR ASSEMBLY PARTS

6.2.1 MAIN BUS AND CABLE COMPARTMENT

A Magnum DS Metal-Enclosed Low-Voltage Switchgear Assembly is designed so that internal compartments provide isolation between the Magnum DS circuit breaker compartment and the main bus compartment. Access to high current parts is provided by removable covers and barriers.

DANGER

BARRIERS AND COVERS SHOULD NOT BE REMOVED UNLESS THE PARTS TO BE EXPOSED ARE DE-ENERGIZED. ADDITIONALLY, BE CERTAIN THAT ALL BARRIERS AND COVERS ARE PROPERLY REPLACED IMMEDIATELY UPON CONCLUSION OF MAINTENANCE OR INSPECTION PROCEDURES. FAILURE TO DO SO COULD CAUSE DEATH, BODILY INJURY OR PROPERTY DAMAGE.

6.2.2 DRAWOUT MAIN DISCONNECTING CONTACTS AND CURRENT TRANSFORMERS

The primary stationary disconnecting contacts and ring-type current transformers are located on the breaker cell rear wall. These contacts and transformers are easily exposed unless provided with an optional safety shutter system.

DANGER

BE EXTREMELY CAREFUL NOT TO TOUCH ANY CONTACTS OR TRANSFORMERS UNLESS ALL UPPER AND LOWER HIGH CURRENT PARTS ARE DE-ENERGIZED. FAILURE TO DO SO COULD CAUSE DEATH, PERSONAL INJURY OR ELECTRICAL SHOCK.

6.2.3 CONTROL EQUIPMENT

With the exception of apparatus such as current transformers and space heaters, control equipment is generally accessible without exposing high voltage parts.

6.3 INSPECTION AND MAINTENANCE SCHEDULE

To assure high quality service, a definite maintenance schedule is essential. Plant operation and local conditions vary to such an extent that the schedule should be tailored to the conditions. The following general requirements should be helpful in establishing a program.

DANGER

WHEN ENERGIZED, A CIRCUIT BREAKER IS PART OF A HIGH POWER SYSTEM. BEFORE ATTEMPTING ANY INSPECTION OR MAINTENANCE, BE SURE THAT ALL PRIMARY AND CONTROL CIRCUITS HAVE BEEN DE-ENERGIZED AND GROUNDED AS REQUIRED. ALSO MAKE CERTAIN THAT PROPER STEPS HAVE BEEN TAKEN TO BE SURE THAT THEY WILL REMAIN DE-ENERGIZED UNTIL ALL WORK IS COMPLETED. FAILURE TO DO SO COULD RESULT IN DEATH, BODILY INJURY OR ELECTRICAL SHOCK.

6.3.1 INDIVIDUAL DEVICES

The maintenance schedule for individual devices, such as circuit breakers, relays and instruments, should be based first on the recommendations contained in their individual instruction books. These operations should be coordinated with the overall program to result in the least operating inconvenience and circuit shutdown.

6.3.2 OVERALL ASSEMBLY MAINTENANCE

When operating and local conditions are normal, the switchgear assembly should be given a thorough overall maintenance check at least annually. Where abnormal conditions exist, more frequent inspection and maintenance is necessary.

6.3.3 BUSES AND CONNECTIONS

DANGER

THE MILD SOLVENTS DESCRIBED ARE FLAMMABLE. PROVIDE ADEQUATE VENTILATION AND KEEP AWAY FROM FLAMES AND OTHER IGNITION SOURCES. CONSULT YOUR SAFETY DEPARTMENT BEFORE USING.

De-energize primary circuits and remove barriers from primary compartments. Before cleaning, record "megger" readings between phases and to ground. Inspect for signs of overheating or weakened insulation. Remove as much dirt, dust and other foreign material as possible from the insulation and conductors with minimum exposure to any solvents. The recommended cleaning procedure is to use an industrial quality vacuum cleaner and/or a lint-free cloth. In most cases, this will be sufficient. For accumulations which cannot be removed by the above procedure, a lint-free cloth slightly dampened with water can be used. Allow the switchgear apparatus to dry for at least four hours at room temperature before energizing. If this procedure does not produce satisfactory results, use lint-free cloth dampened with a mild solvent, such as mineral spirits, Stoddard solvent, or isopropyl alcohol. Dry the same as when using a water dampened cloth.

After buses and insulation have been dusted, wiped clean, and dried, take "megger" readings again between the buses and ground and between phases. Keep a record of these readings for future reference in determining when trends occur that would indicate a decrease of resistance.

A one-minute dielectric test was performed on all bus at the factory in accordance with ANSI C37.20.1. Repeating these tests is not required for field installation unless the equipment has been in extended or outdoor storage, or major bus modifications have been made. If required, 2200 Vac should be applied between each phase, and each phase-to-ground. All connections to the bus from control power or metering circuits must first be isolated from the bus. Circuits Breakers must be in the withdrawn or removed position. Devices such as lightening arresters and capacitors must also be disconnected.

6.3.4 DRAWOUT, MAIN DISCONNECTING CONTACTS AND SUPPORTS

Remove each breaker from its cell. Remember, all circuits should be de-energized. Expose primary contacts and their supports. Inspect for abnormal wear or overheating. Discoloration of the surface is not harmful unless corrosion due to atmospheric conditions is severe, leaving deposits on the surface. Follow the cleaning instructions outlined in Section 6.3.3. Check each breaker while it is out of the housing for all items recommended in the instruction book applying to the breaker.

6.3.5 INSTRUMENTS, RELAYS AND OTHER PANEL DEVICES

Individual devices should be maintained according to the specific instructions supplied for each device. Remove relay covers and inspect interiors for dust or dirt. All devices should be checked for correct operation.

6.3.6 SECONDARY WIRING, BLOCKS AND CONNECTIONS

Check all wiring connections for tightness, including those at the current and voltage transformers and at the terminal blocks where circuits leave the assembly. Make sure that all transformer secondary wiring connections are properly connected to the switchgear assembly ground bus where so indicated. Visually inspect control circuit secondary contact blocks, both fixed in the cell and moveable on the breaker, for abnormal signs of wear, fatigue or overheating.

6.3.7 MECHANICAL PARTS

Visually check and manually operate mechanical moving parts, such as cell switches, position interlocks, cell protective shutters (when provided), door latches/hinges, and drawout rails.

6.3.8 VENTILATION

Check all air passages and intakes for obstructions and accumulations of dirt. When filters are used, replace or clean when dirty.

6.3.9 RECORDS

The condition of each vertical section at the time of inspection should be listed in a permanent record to become a guide for anticipating the need for replacements or for special attention between regular maintenance periods.

6.3.10 ABNORMAL CONDITIONS

Type Magnum DS Switchgear Assemblies have been designed for "NORMAL" operating conditions as defined in ANSI C37.20.1. Local conditions such as high humidity, salt-laden atmosphere, corrosive gases, heavy dust, or severe circuit operating conditions are considered to be abnormal. Any of these conditions will require more frequent inspections.

It should be emphasized that a series of quarterly inspections are advisable until the progressive facts of the local conditions can be analyzed to determine a schedule which will maintain equipment in satisfactory condition.

In some locations, conditions may be so bad that the frequency of maintenance will interfere with operation and production schedules. In such cases, consideration should be given to the possibility of enclosing the switchgear assembly in a relatively air tight room. If this approach is followed, a sufficient quantity of clean air must be supplied to the room to ensure that a positive pressure is maintained in the room. Under such conditions, a more normal maintenance schedule can be established. Such an arrangement could also provide for cooling the air where the ambient temperature is relatively high, further improving operation conditions.

CAUTION

FAILURE TO INSPECT, CLEAN, LUBRICATE AND MAINTAIN THE SWITCHGEAR ASSEMBLY AT RECOMMENDED FREQUENCIES COULD RESULT IN FAILURE OF THE EQUIPMENT TO OPERATE PROPERLY UNDER FAULT CONDITIONS, WHICH COULD CAUSE EQUIPMENT DAMAGE, DEATH AND/OR BODILY INJURY.

6.3.11 LUBRICATION

A metal-enclosed low-voltage switchgear assembly is designed so that lubrication is not required under normal conditions. Abnormal local conditions, such as high humidity, salt-laden atmosphere, corrosive gases, or severe circuit operating conditions, may demand the use of lubricants. In such cases, a dry or powder lubricant may be used on moving or mating mechanical parts, and a thin film of "Vaseline" on disconnecting contacts. The application of the lubricants should be held to minimum to reduce the accumulation of dust and dirt. During routine maintenance old lubricants should be wiped off before fresh lubricants are applied.

6.3.12 RENEWAL PARTS

When ordering renewal or spare parts, include as much information as possible. In many cases, the style number of the new part can be obtained from identification on the old part. Always include a description of the old part. Specify the rating, vertical section and compartment number. Always supply the general order number and/or the shop order number of the assembly itself.

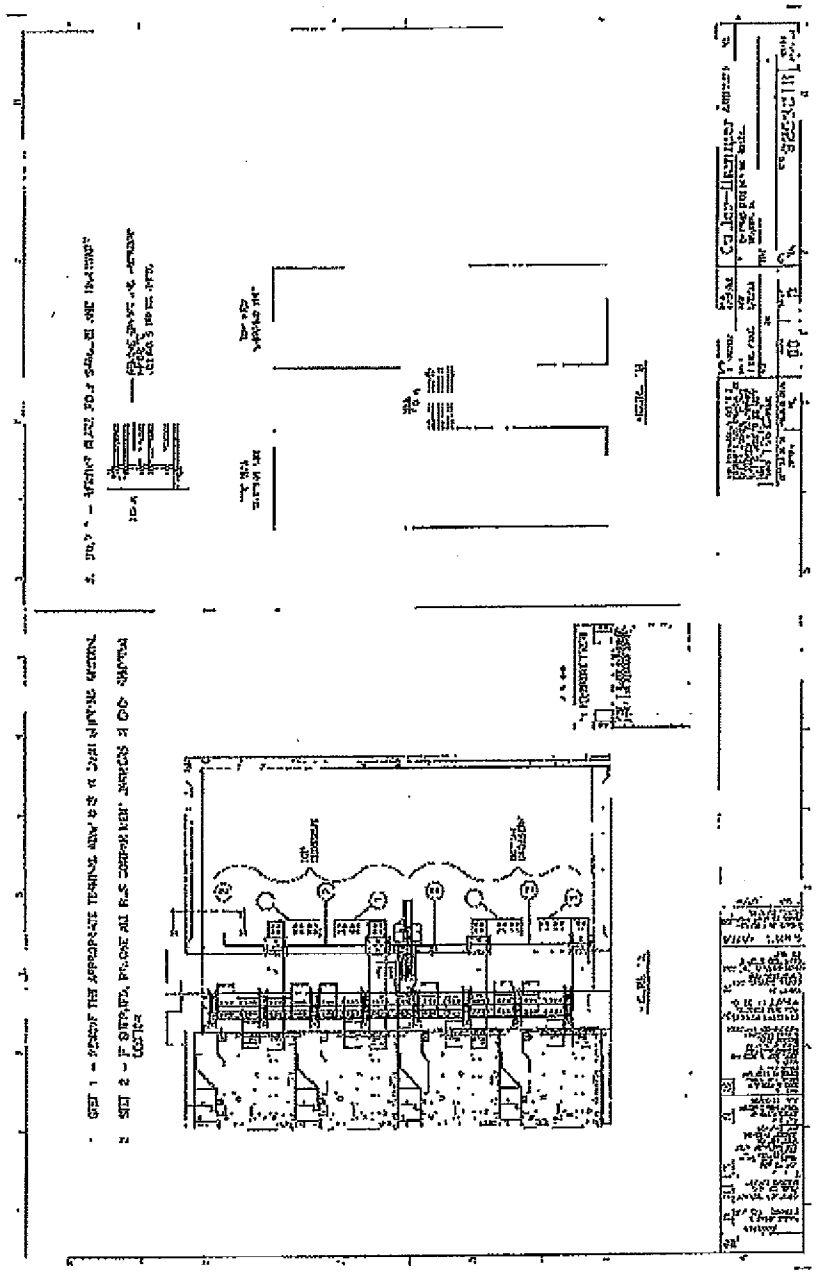
GROUND FAULT TEST RECORD

Ground Fault Test Record should be retained by those in charge of the building's electrical installation in order to be available to the authority having jurisdiction.

(See Article 5.5 in this instruction)

Test Date	Circuit Breaker No.	Results	Tested By

CUTLER HAMMER MAGNUM DS SHIPPING SPLIT BUS INFO



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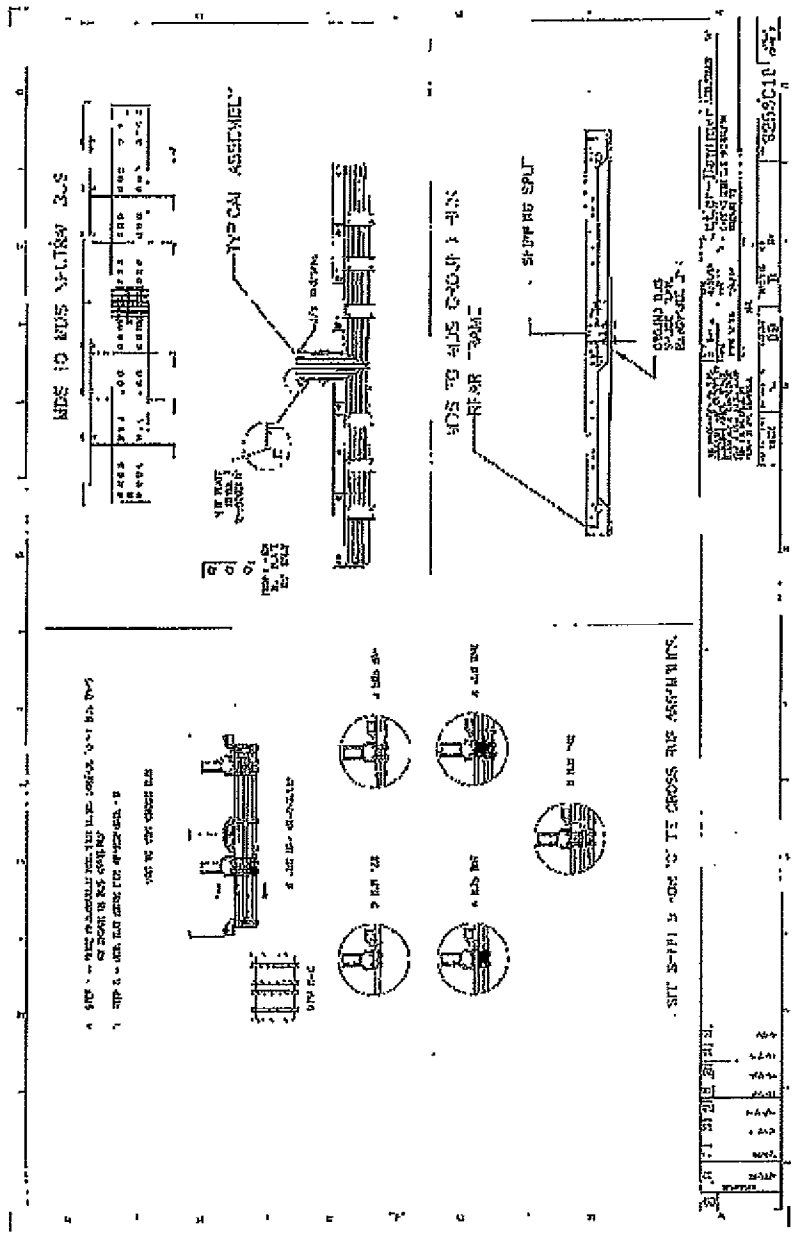
CUTLER HAMMER MAGNUM DS SHIPPING SPLIT BUS INFO



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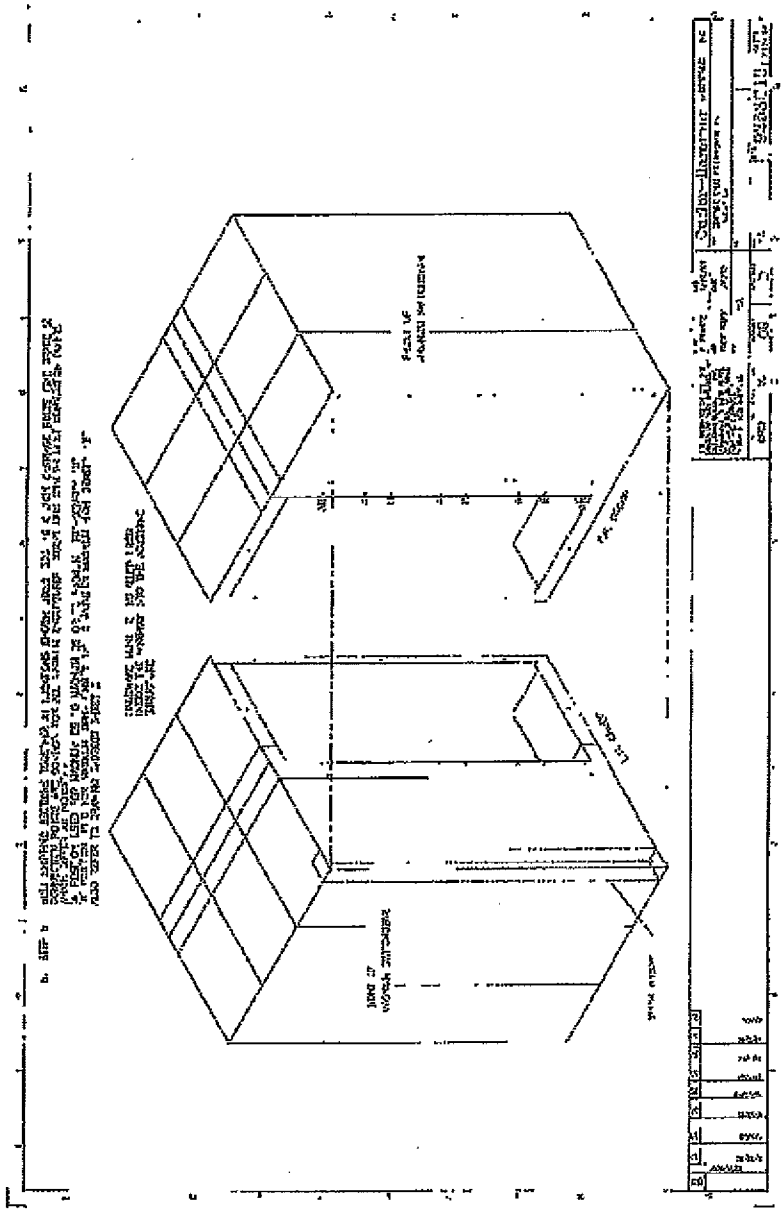

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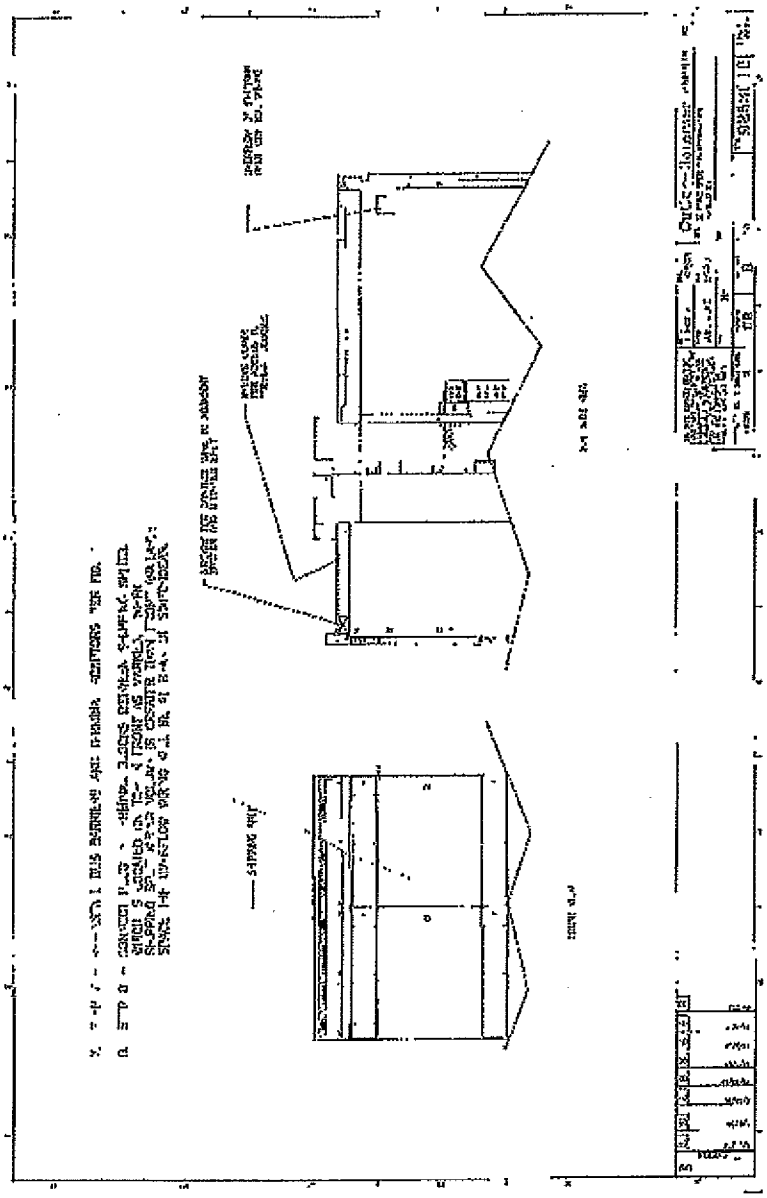

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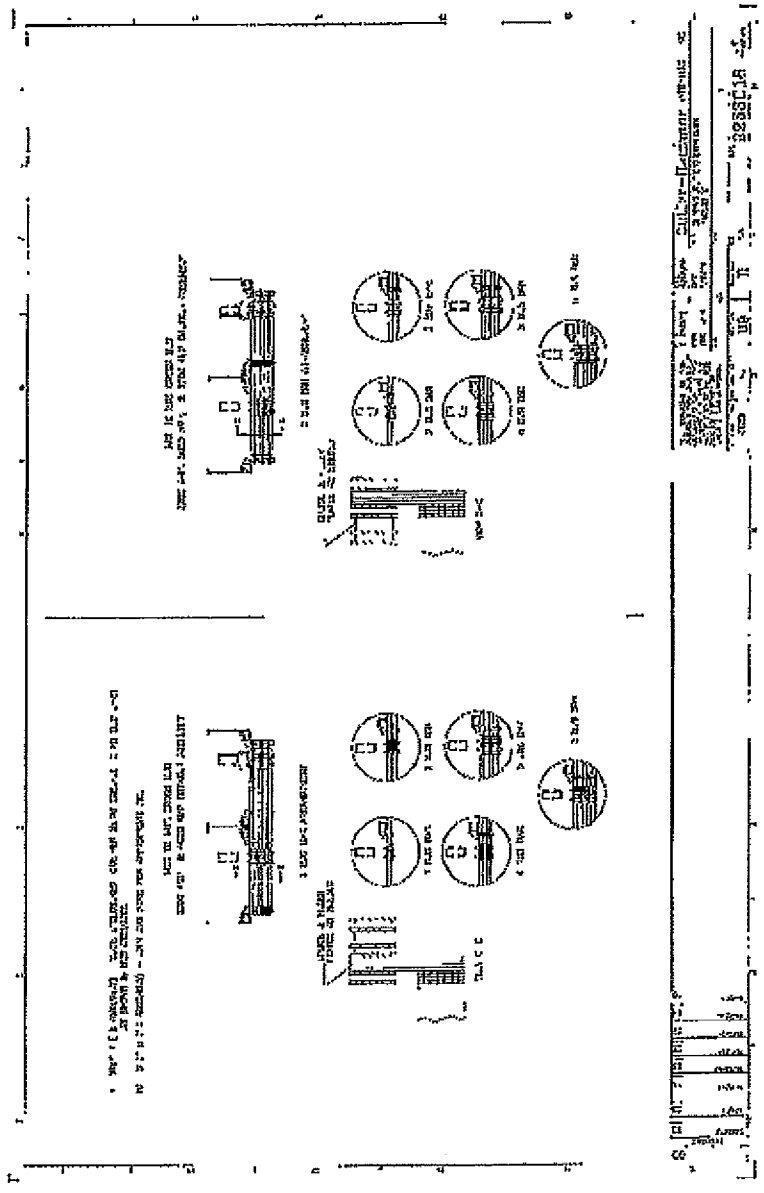
CUTLER HAMMER MAGNUM DS SHIPPING SPLIT BUS INFO



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FOR RENEWAL PARTS INFORMATION CALL YOUR LOCAL AUTHORIZED CUTLER-HAMMER DISTRIBUTOR. FOR THE NAME OF THE NEAREST CUTLER-HAMMER DISTRIBUTOR, PLEASE CALL:

1-800-525-2000

TO ASSURE SAFETY OF OPERATION AND CONTINUITY OF SERVICE, ALWAYS USE GENUINE CUTLER-HAMMER AFTERMARKET PARTS AND PRODUCT UPGRADES.

SHOULD YOU NEED FACTORY ASSISTANCE ON THIS MAGNUM DS LOW-VOLTAGE ASSEMBLY OR OPTIONS FOR UPGRADING YOUR OTHER LOW-VOLTAGE ASSEMBLIES PRODUCTS, CALL:

1-800-BKR-FAST
(1-800-257-3278)

This instruction booklet is published solely for information purposes and should not be considered all inclusive. If further information is required, you should consult Cutler-Hammer.

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Cutler-Hammer

221 Heywood Road
Arden, NC 28704

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Printed in U.S.A.(CG)

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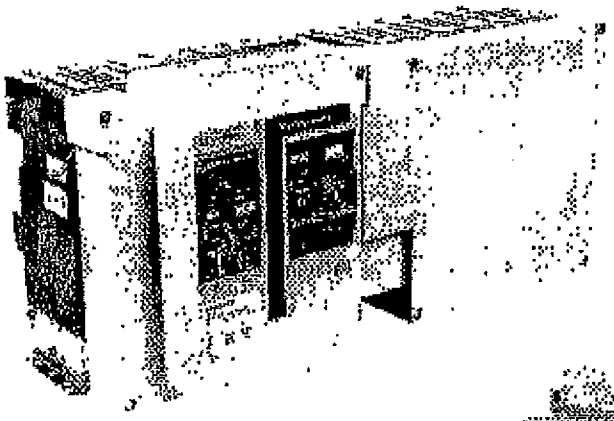
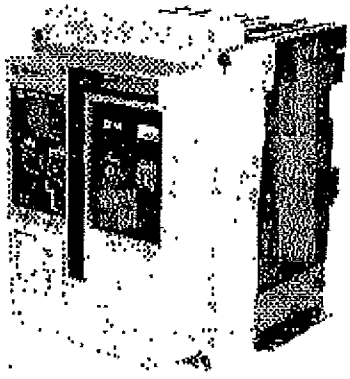
Instructions for Installation, Operation and Maintenance of Magnum DS, DSX and DSL Low Voltage Power Circuit Breakers

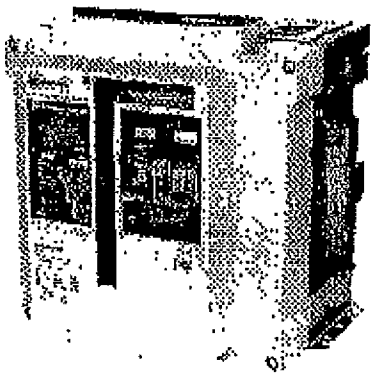
I.B. 2C12000H08 Supersedes I.B. 2C12000H07 dated April 2005
Effective May 2008



Double-wide Fixed



Narrow Frame Fixed



Standard Frame Fixed

PURPOSE

This instruction manual is expressly intended to cover the installation, operation and maintenance of Magnum DS (MDS), DSX (MDSX) and Magnum DSL (MDSL) Power Circuit Breakers. These circuit breakers may be supplied as part of complete switchboard assemblies or as separate components. This manual applies only to the circuit breaker and (if drawout) it's mating cassette. The Magnum DSL circuit breaker can only be supplied as a drawout device. In the case of fixed versions of Magnum DS circuit breakers, certain sections of this manual, referring to such items as position interlocks and the drawout mechanism, will not apply.

Trip units associated with Magnum DS, DSX and DSL Power Circuit Breakers will be addressed in a general manner in this manual. Specific trip unit details and time-current characteristic curves are covered in separate documents specific to the trip units.

Magnum DS, DSX and DSL circuit breaker accessory items are discussed briefly in this manual. Field installation instructions for such items, however, are covered in individual instruction leaflets specific to the accessory. This information is also available from the Cutler-Hammer website at www.EatonElectrical.com

For application information, consult Cutler-Hammer or see applicable Product Guides, Technical Documents, Application Publications and/or Industry Standards.

SAFETY

All safety codes, safety standards and/or regulations must be strictly observed in the installation, operation and maintenance of this equipment.

WARNING

THE WARNINGS AND CAUTIONS INCLUDED AS PART OF THE PROCEDURAL STEPS IN THIS MANUAL, ARE FOR PERSONNEL SAFETY AND PROTECTION OF EQUIPMENT FROM DAMAGE. AN EXAMPLE OF A TYPICAL WARNING LABEL HEADING IS SHOWN ABOVE TO FAMILIARIZE PERSONNEL WITH THE STYLE OF PRESENTATION. THIS WILL HELP TO INSURE THAT PERSONNEL ARE ALERT TO WARNINGS. IN ADDITION, CAUTIONS ARE ALL UPPER CASE AND BOLDFACE.

All possible contingencies which may arise during installation operation or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance of particular equipment, contact the local Cutler-Hammer Inc. representative.

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SECTION 1: INTRODUCTION

1-1 GENERAL INFORMATION

The Magnum DS and DSX Power Circuit Breakers can be fixed or drawout air circuit breakers utilizing an electronic tripping system. The Magnum DSL circuit breaker utilizes the same tripping system, but is available only in the drawout configuration. MDSL and MDSX versions have current-limiting characteristics as indicated by the "Current Limiting" badge on the front covers. All breakers are designed for use in both switchboard and metal-enclosed switchgear assemblies having maximum voltages of 635 volts ac MDS type breakers, 600 volts ac for MDSL type breakers, and 480 volts ac for MDSX type breakers. Magnum DS circuit breakers are available in three physical frame sizes with continuous current ratings from 800 through 5000A, and interrupting capacities from 42 kA to 200 kA. The three MDS physical frame sizes have common height and depth dimensions, differing only in width (Figure 1-1). Magnum DSL circuit breakers are available in one frame size with continuous current ratings from 800 through 2000A and an interrupting capacity up to 200,000A (Figure 1-5). Circuit breaker nameplates provide complete rating information. All Magnum DS, Magnum DSX, and Magnum DSL circuit breakers are 100 percent rated, UL listed, and are built and tested in an ISO 9002 certified facility to applicable NEMA, ANSI, IEEE and UL standards (Tables 1.1 and 1.2, Figures 1-2, 1-3 and 1-4).

Magnum circuit breakers use a rigid frame housing of engineered thermoset composite resins which has high strength structural properties, excellent dielectric characteristics and arc tracking resistance.

MDS, MDSX and MDSL drawout circuit breakers are a through-the-door design having three breaker positions with the compartment door closed (CONNECT, TEST, DISCONNECT) and one position out of its compartment on extension rails (REMOVE). The operating mechanism is a two-step stored energy mechanism, either manually or electrically operated.

When withdrawn on captive compartment cassette extension rails, MDS, MDSX and MDSL circuit breakers can be inspected, accessory items added, and minor maintenance performed. The inside of the compartment can also be inspected with the circuit breaker on its extension rails.

NOTICE

Please read and understand these instructions before attempting to unpack, install, operate or maintain this equipment. Study the breaker and its mechanism carefully before attempting to operate it on an energized circuit.

⚠ WARNING

MAGNUM CIRCUIT BREAKERS SHOULD NOT UNDER ANY CIRCUMSTANCES BE APPLIED OUTSIDE THEIR NAMEPLATE RATINGS. OPERATION OUTSIDE OF THESE RATINGS COULD RESULT IN DEATH, BODILY INJURY OR PROPERTY DAMAGE.

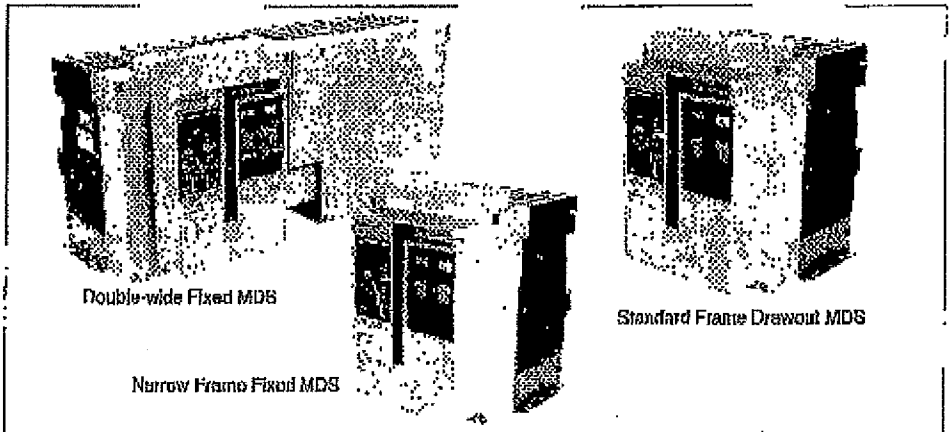


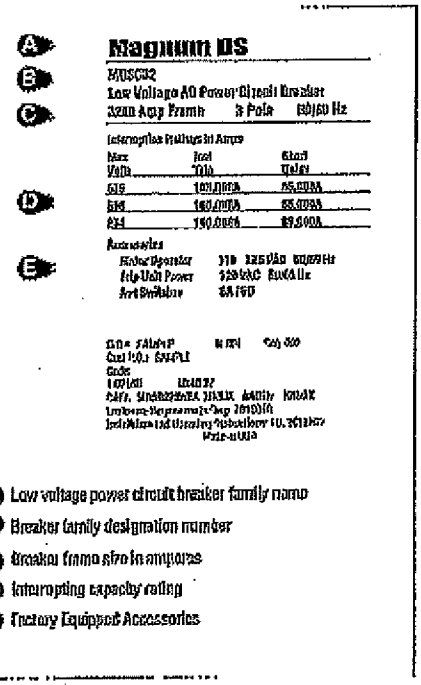
Figure 1-1 Family of Magnum DS (MDS) Low Voltage Power Fixed and Drawout Circuit Breakers (800-5000 Amperes)

1-2 SAFETY FEATURES

Magnum DS, DSX and DSL circuit breakers and associated drawout equipment are manufactured with built-in interlocks and safety related features. They are provided to reduce hazards to operating personnel and provide proper operating sequences.

Table 1.1 Magnum DS/DSX Ratings at 240, 480, 600 volts

Maximum Amperes	Breaker Designation	Interrupting Rating	Short Time Rating
800	MDN-408	42 kA	42 kA
	MDN-508	50 kA	50 kA
	MDN-608	65 kA	65 kA
	MDS-308	200 kA (240v, 480v)	30 kA
	MDS-408	42 kA	42 kA
	MDS-508	50 kA	50 kA
	MDS-608	65 kA	65 kA
	MDS-808	85 kA	85 kA
	MDS-1008	100 kA	85 kA
1200	MDN-412	42 kA	42 kA
	MDN-512	50 kA	50 kA
	MDN-612	65 kA	65 kA
	MDS-312	200 kA (240v, 480v)	30 kA
	MDS-412	42 kA	42 kA
	MDS-512	50 kA	50 kA
	MDS-612	65 kA	65 kA
	MDS-812	85 kA	85 kA
	MDS-1012	100 kA	85 kA
1600	MDN-416	42 kA	42 kA
	MDN-516	50 kA	50 kA
	MDN-616	65 kA	65 kA
	MDS-316	200 kA (240v, 480v)	30 kA
	MDS-416	42 kA	42 kA
	MDS-516	50 kA	50 kA
	MDS-616	65 kA	65 kA
	MDS-816	85 kA	85 kA
	MDS-1016	100 kA	85 kA
2000	MDS-620	50 kA	50 kA
	MDS-220	200 kA (240v, 480v)	30 kA
	MDS-620	65 kA	65 kA
	MDS-820	85 kA	85 kA
	MDS-1020	100 kA	85 kA
2500	MDS 625	50 kA	50 kA
	MDS 325	200 kA (240v, 480v)	50 kA
	MDS 625	65 kA	65 kA
	MDS 825	85 kA	85 kA
	MDS 1025	100 kA	85 kA
3200	MDS-632	65 kA	65 kA
	MDS-832	85 kA	85 kA
	MDS-1032	100 kA	85 kA
4000	MDS-X32, 40	200 kA (240v, 480v)	50 kA
	MDS 640	65 kA	65 kA
	MDS 840	85 kA	85 kA
	MDS 1040	100 kA	85 kA
4000	MDS-X40	200 kA (240v, 480v)	50 kA
	MDS-840, 840	85 kA	85 kA
	MDS 1040, 1040	100 kA	100 kA
5000	MDS-X50	200 kA (240v, 480v)	50 kA
	MDS-650, 850	85 kA	85 kA
	MDS 1050, 1050	100 kA	100 kA
6000	MDS-660, 860	85 kA	85 kA
	MDS-1060, 1060	100 kA	100 kA



A Low voltage power circuit breaker family name
B Breaker family designation number
C Breaker frame size in amperes
D Interrupting capacity rating
E Factory Equipped Accessories

Figure 1-2 Typical Magnum DS (MDS) Nameplate

WARNING

MAGNUM DS, DSX AND DSL CIRCUIT BREAKERS ARE ROBUST AND ARE PROVIDED WITH SAFETY FEATURES. NEVERTHELESS, THE VOLTAGES, CURRENTS AND POWER LEVELS AVAILABLE IN AND AROUND THIS EQUIPMENT WHEN IT IS IN OPERATION ARE EXTREMELY DANGEROUS AND COULD BE FATAL. UNDER NO CIRCUMSTANCES SHOULD INTERLOCKS AND OTHER SAFETY FEATURES BE MADE INOPERATIVE, AS THIS MAY RESULT IN DEATH, BODILY INJURY OR PROPERTY DAMAGE.

1-3 SAFETY PRACTICES

To protect personnel associated with the installation, operation and maintenance of this equipment, the following practices must be followed:

IN THE SUPREME COURT OF THE STATE OF NEVADA

CASHMAN EQUIPMENT COMPANY, a Nevada corporation,

Appellant,

vs.

WEST EDNA ASSOCIATES, LTD., dba MOJAVE ELECTRIC, a Nevada corporation; WESTERN SURETY COMPANY, a surety; THE WHITING TURNER CONTRACTING COMPANY, a Maryland corporation; FIDELITY AND DEPOSIT COMPANY OF MARYLAND, a surety; TRAVELERS CASUALTY AND SURETY COMPANY OF AMERICA, a surety; QH LAS VEGAS LLC, a foreign limited liability company; PQ LAS VEGAS, LLC, a foreign limited liability company; L W T I C SUCCESSOR LLC, an unknown limited liability company; FC/LW VEGAS, a foreign limited liability company;

Respondents.

Electronically Filed
Jun 17 2015 01:03 p.m.
Tracie K. Lindeman
Clerk of Supreme Court

Case No: 66452
Case No: 61715
Case No: 65819

District Court Case Nos.: **A642583 & A653029**

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Las Vegas, NV 89101
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