SIEMENS

Series 81000™
720 Ampere Vacuum Controller

Type 96H6

(Distribution Voltage 2400-4800 VAC; Utilization Voltage 2300-4600 VAC)

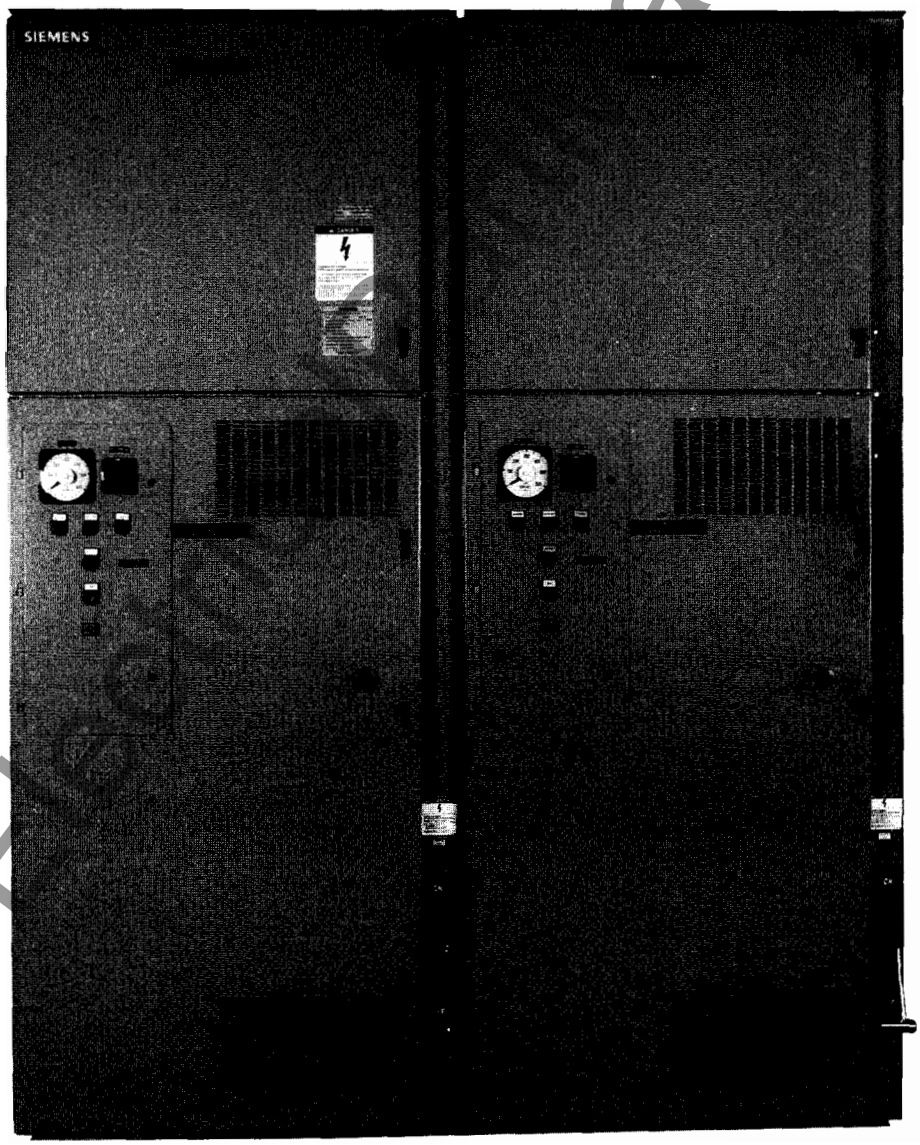
Instructions

Installation

Operation

Maintenance

SGIM-9098B



⚠ DANGER

Hazardous voltages.

Will cause death, serious personal injury or equipment or property damage.

Always de-energize and ground the equipment before maintenance. Read and understand this instruction manual before installing, operating, or maintaining the equipment. Maintenance should be performed only by qualified personnel. The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel may result in dangerous conditions which may cause death or serious personal injury or equipment or property damage. Follow all safety instructions contained herein.

IMPORTANT

The information contained herein is general in nature and not intended for specific application purposes. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased. Siemens reserves the right to make changes in the specifications shown herein or to make improvements at any time without notice or obligations. Should a conflict arise between the general information contained in this publication and the contents of drawings or supplementary material or both, the latter shall take precedence.

QUALIFIED PERSON

For the purpose of this manual and product labels a qualified person is one who is familiar with the installation, construction, operation, or maintenance of the equipment and the hazards involved. In addition, this person has the following qualifications:

(a) **is trained and authorized** to energize, de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.

(b) **is trained** in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.

(c) **is trained** in rendering first aid.

NOTE

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local Siemens sales office.

The contents of this instruction manual shall not become part of or modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligation of Siemens Power Transmission & Distribution^{LLC}. The warranty contained in the contract between the parties is the sole warranty of Siemens Power Transmission & Distribution^{LLC}. Any statements contained herein do not create new warranties or modify the existing warranty.

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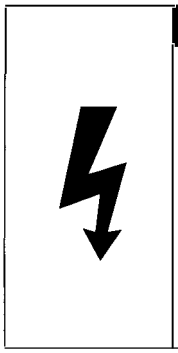
Introduction
Siemens Series 81000™ medium voltage controllers are designed to meet all applicable provisions of the NEMA Standards. Successful application and operation of this equipment depends as much upon proper installation and maintenance by the user as it does upon careful design and fabrication by Siemens.

The purpose of this Instruction Manual is to assist the user in developing safe and efficient procedures for the installation, maintenance and use of the equipment.

These instructions are prepared as a supplement to the Series 81000 Controller Instruction Manual, MVC-9068. The instructions contained herein are specific to controllers rated 720 amperes at 5000 volts maximum. For instructions for contactors rated other than 720 amperes at 5000 volts, refer to the appropriate instruction manual. Read MVC-9068 and these instructions before beginning any work on this equipment.

Contact the nearest Siemens representative if any additional information is desired.



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Will cause death, serious personal injury or property damage.

Always de-energize and ground the equipment before maintenance. Installation, operation, or maintenance should be performed only by qualified persons thoroughly familiar with the equipment, instruction manuals and drawings. Read and understand this instruction manual before using the equipment.

Qualified Person
For the purpose of this manual and product labels, a **Qualified Person** is one who is familiar with the installation, construction or operation of the equipment and the hazards involved. In addition, this person has the following qualifications:

- Training and authorization to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.
- Training in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses, face shields, flash clothing, etc., in accordance with established safety procedures.
- Training in rendering first aid.

Signal Words
The signal words "Danger", "Warning" and "Caution" used in this manual and product labels indicate the degree of hazard that may be encountered by the user. These words are defined as follows:

Danger - Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

Warning - Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

Caution - indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Dangerous Procedures
In addition to other essential safety precautions described in this manual, user personnel must adhere to the following:

1. **Always work on de-energized equipment. Always de-energize a contactor or fuse carriage, and remove it from the equipment before performing any tests, maintenance or repair.**
2. **Always let an interlock device or safety mechanism perform its function without forcing or defeating the device.**

Field Service Operation
Siemens can provide competent, well-trained Field Service Representatives to provide technical guidance and advisory assistance for the installation, overhaul, repair and maintenance of Siemens equipment, processes and systems. Contact regional service centers, sales offices or the factory for details, or telephone Siemens Field Service at 1-800-241-4453.

General Description

General
Siemens Series 81000 vacuum controllers rated 720 amperes are constructed using a fixed mounted Type 96H6 vacuum contactor and a drawout carriage containing the main power fuses and control power transformer. The standard dimensions for a FVNR controller, illustrated in **Figure 1**, are 36 inches (914mm) wide, 36 inches (914mm) deep, and 90 inches (2286mm) high.

The contactor and drawout fuse carriage occupy the lower 60 inch (1524mm) high compartment of the structure. The upper 30 inch (762mm) high compartment contains the optional horizontal bus in the rear. The front portion of this upper compartment can be used to mount additional low voltage control devices. A low voltage panel for control devices can also be mounted on the lower 60 inch (1524mm) door.

The medium voltage compartment contains the carriage cell module upon which the racking mechanism, shutter mechanism, line and load connections, and mechanical and electrical interlocks are mounted. Also mounted in the medium voltage compartment are the current transformers and outgoing motor terminals.

In order to open the medium voltage compartment door, the contactor must be de-energized and the drawout fuse carriage must be completely racked out. A mechanical interlock prevents racking the fuse carriage in or out until the contactor is open. Low voltage compartment doors may be opened without disconnecting power.

Series 81000 720 ampere controllers can be connected together in a lineup with power distributed by a common horizontal bus. Each vertical section containing a 720 ampere controller is fed by a vertical bus connecting the horizontal bus to the line stabs of the controller. Both the horizontal and vertical bus are isolated from the front by barriers.

Series 81000 720 ampere controllers are rated in accordance with **Tables 1** through **4**. For detailed ratings applicable to a particular controller, refer to the nameplate on the front of the enclosure.

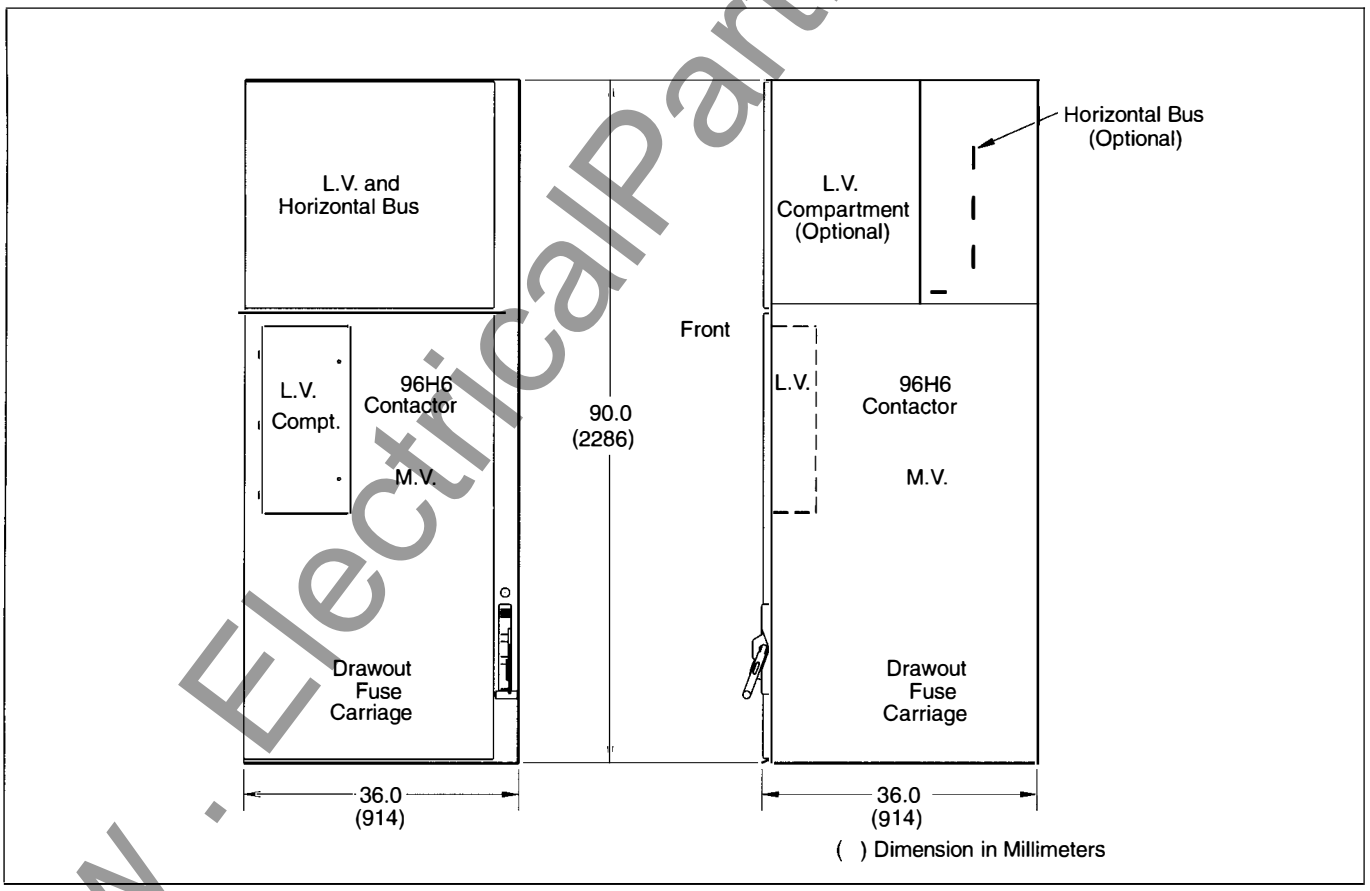


Figure 1. Typical Construction

Table 1. Controller Maximum Ratings

Contactor Type	Continuous Ampere Rating	Interrupting Capacity		Impulse Level (BIL)
		Controller Without Fuses	Controller With Fuses (MVA)	
96H6	720	7.2kA	200@2300V 350@4000V 400@4600V	60kV

Table 2. Maximum Rating for Motor Loads (**Note 1**)

Horsepower Rating at Utilization Voltage					
2300V, 3-phase			4000-4600V, 3-phase		
Synchronous Motors		Induction Motors	Synchronous Motors		Induction Motors
0.8PF	1.0PF		0.8PF	1.0PF	
3000	3500	3000	5500	6000	5500

Note 1. Above data per NEMA ICS 3-1993, Table 2-4-1.

Table 3. Maximum Rating for Transformer Loads

Maximum 3-Phase Transformer kVA at Distribution Voltage			Maximum Power Fuse Rating
2400V	4160V	4800V	
2000	3500	4000	600E

Table 4. Maximum Rating for Capacitor Loads (**Note 1**)

Maximum 3-Phase Capacitor Load (kVAR) at Distribution Voltage			Maximum Power Fuse Rating
2400V	4160V	4800V	
2000	2000	2000	600E

Note 1. When applied to a capacitor load, the controller should be equipped with space heaters.

Operating Data-Type 96H6 Contactor
Refer to **Table 5** for electrical operating data for the Type 96H6 vacuum contactor.

Table 5. 96H6 Contactor Operating Data

Contactor Type	Magnetically Held	Latched
Rated Voltage	5000 Volts	
Rated Current	720 Amperes (enclosed)	
Interrupting Capacity	7.2kA RMS Symmetrical	
Permissible Switching Frequency	600/hour	300/hour
Mechanical Life (operations)	1,000,000	200,000
Electrical Life (operations)	200,000	
Closing Time	60-70ms	
Opening Time	30-35ms	
Pickup Voltage, AC or DC, nominal	85% Rated (Hot) - 70% Rated (Cold)	
Dropout Voltage, AC or DC, nominal	50% Rated (Hot) - 40% Rated (Cold)	——
Rated Control Voltage AC (Main Coil)	115-240V 50/60Hz	
Rated Control Voltage DC (Main Coil)	125-250V	
Rated Control Voltage DC (Trip Coil)	——	24V, 32V, 48V, 125V, or 250V
Coil Circuit Inrush	840VA	875W
Coil Circuit Holding	48VA	——
Trip Current	——	4.8A
Auxiliary Contact Arrangement	3NO-3NC	3NO-3NC
Auxiliary Contact Rating	10A, 600V (NEMA Class A600)	

Service Conditions
The 96H6 controller should be used in the conditions shown in **Table 6**:

Table 6. Normal Service Conditions

Altitude	Less than 1000m (3300ft) — full ratings For altitudes between 1000m (3300ft) and 2000m (6600ft), derate per **Table 8.** Above 2000m, consult factory
Ambient Temperature	-5°C min to +40°C max Average over a period of 24 hours does not exceed +35°C
Relative Humidity	45% min to 85% max

If the controller is to be used in conditions other than those specified above, consult Siemens.

The location in which the controller is to be used should be free from dust, corrosive gas, or moisture. When it is to be used in chemical facilities, in outdoor enclosures, or in similar locations, take necessary precautions against corrosion, water seepage, and condensation.

Blown Fuse Trip Mechanism (option)
The drawout fuse carriage can be equipped with an optional anti-single phase trip mechanism (450E maximum fuse size) which offers protection from single phasing due to a blown power fuse. A drawout fuse carriage equipped with the blown fuse trip mechanism is arranged so that the opening of one or more power fuses results in de-energizing the contactor main coil, thus causing the contactor to dropout. When a power fuse blows, a plunger extends from one end of the fuse. This plunger causes the spring-loaded trip bar to rotate, and releases a pre-compressed microswitch on the fuse carriage. A contact on the microswitch opens at this time and de-energizes the contactor magnet coil.

Mechanically Latched Contactors (option)
Mechanically latched contactors are available which consist of a standard 96H6 contactor with the addition of a mechanical latch assembly. The mechanical latch holds the armature of the contactor closed against the magnet core after the contactor is energized (closed), even if control power is removed. A mechanical pushbutton on the high voltage compartment door, when manually depressed, trips the contactor by releasing the mechanical latch.

Electrical trip using an internal trip solenoid (trip coil) is optionally available. The trip solenoid may be powered from a DC source, or from a capacitor trip device which is connected to the normal AC control source. The capacitor trip device provides reliable tripping power for approximately 5 minutes after loss of AC control power.

Surge Protection (option)
The 96H6 vacuum contactors are suitable for application without protection from surges related to switching with vacuum, except for jogging or inching duty with small (under 100HP) motors. For such applications, metal-oxide surge arrestors or surge limiters should be specified. Since an application of a 720 ampere type 96H6 contactor to a small motor is highly unusual, surge protection is not normally recommended or necessary.

Regardless of the switching means employed, if the insulation integrity of the motor is suspect, such as for very old machines, it may be desirable to add surge protection for the machine, or to consider upgrading the machine to modern insulation standards.

Isolation and Automatic Shutter Mechanisms
Non-load break finger type stab assemblies mounted on the drawout fuse carriage provide the means for manual isolation of the power circuit in accordance with NEMA Standards. When the fuse carriage is racked out, the finger assemblies isolate both line and load sides of the power fuses.

The shutter mechanism operation is directly controlled by the position of the racking mechanism, and the movable insulated shutter is linked to the racking cams.

As the handle of the racking mechanism is moved towards the ON position, the insulated shutter uncovers the line stab assembly just prior to engagement of the fuse carriage line and load stab fingers. In the reverse operation, when the handle is moved towards the OFF position, the insulated shutter covers the line stabs after the fingers have disengaged, effectively isolating all line-side live high voltage parts.

Labels on the stationary part of the shutter clearly indicate if the isolating means (carriage) is OPENED (disengaged).

Racking Mechanism and Mechanical Interlocks
Racking of the drawout fuse carriage is accomplished by a compound four-bar mechanism operated by an external enclosure mounted handle. The racking handle can be locked with up to three padlocks in the OFF position.

Mechanical and electrical interlocks are provided in association with the racking mechanism as follows:

- Medium Voltage Compartment Door Interlock
- Door-Handle Interlock
- Contactor Interlock
- Door-to-Door Interlocks
- Mechanical Latch
- Detent Lever
- Carriage Engagement Warning Light
- Line Switch Interlock (LSI)
- Racking Switch Interlock (RSI)

Medium Voltage Compartment Door Interlock
The racking handle is interlocked with the door such that the handle cannot be moved to the ON position with the door open. Refer to **Figure 2**.

Door-Handle Interlock
The door-handle interlock (item 2 in **Figure 2**) prohibits closing or opening the medium voltage compartment door except when the racking handle is in the OFF position. The flat profile on the end of the handle shaft will not allow the door-handle interlock to pass in or out unless the handle is in the OFF position. Refer to **Figure 2**.

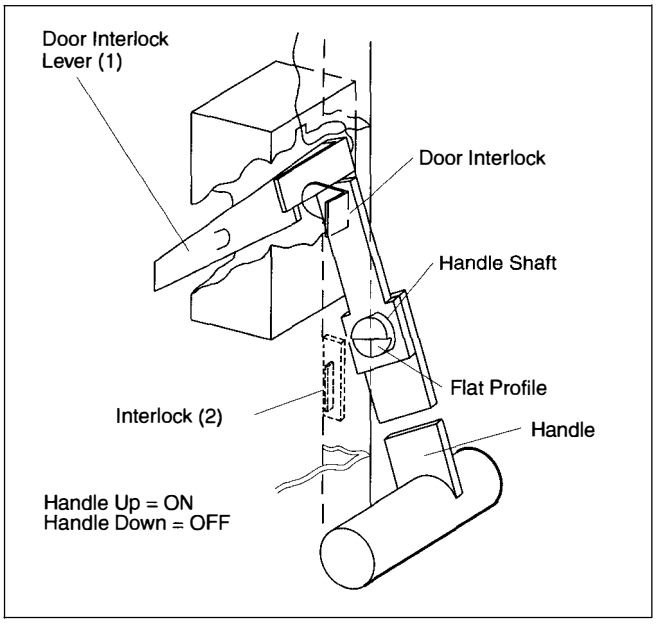
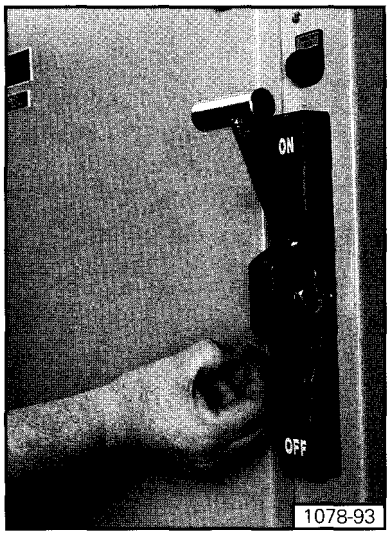
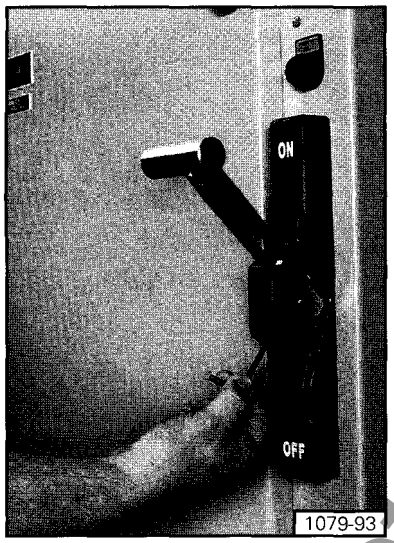


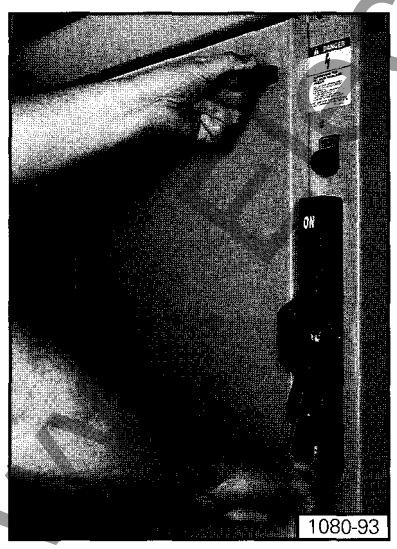
Figure 2. Door Interlock and Door-Handle Interlock



Step 1: Remove plastic cap from handle housing.



Step 2: Rotate handle approximately 23° from the fully upward (ON) position, to align the Allen-head set screw with the access opening. Remove Allen-head set screw.



Step 3: Rotate handle to fully downward (OFF) position to allow door to be opened.

Figure 3. Procedure for defeating the door-handle interlock

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Hazardous voltages.

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The door-handle interlock should be defeated only by authorized and qualified personnel. Disconnect, ground, and lockout incoming power and control voltage sources before attempting to defeat the interlock.

Do not defeat the interlock if the red carriage engagement light is on.

The door-handle interlock may be defeated only by authorized and qualified personnel requiring access to the unit in case of emergency. Disconnect, ground, and lockout incoming power and control voltage sources before attempting to defeat the interlock. Do not defeat the interlock if the red carriage engagement light is on.

The defeater can be reached by removing a plastic cap from the lower part of the handle housing, then by removing the Allen-head set screw. The racking handle must be rotated approximately 23 degrees from the fully upward (ON) position of the handle in order to align the Allen-head set screw with the access opening. When the Allen-head set screw is removed, the handle can then be moved to the OFF position, allowing the door to be opened. Refer to **Figure 3**.

After the malfunction has been corrected, the controller should be restored to normal operation by reversing the procedure used to defeat the interlock.

Contactor Interlock

To prevent accidental insertion or withdrawal of the fuse carriage when the contactor is closed, a contactor interlock is provided. This is important as the stab fingers on the fuse carriage are not rated to make or break any current other than the very low magnetizing current of the control power transformer. Refer to **Figure 4**.

An interlock lever moves to engage the notches in the racking cam when the vacuum contactor is closed. This lever is driven by a cable which is, in turn, driven by the movable armature of the contactor.

Door-to-Door Interlocks

For controllers which include multiple medium voltage compartments, interlocks are provided between the front doors. For example, consider the case of a reduced voltage controller, with a main contactor/fuse carriage compartment as well as compartments for starting contactors and a starting autotransformer. For this example, the interlocks function so that the doors for the starting contactors and the starting autotransformer must be closed before the door for the main contactor/fuse carriage compartment can be closed. In turn, until this door is closed, the fuse carriage cannot be racked in. Once the door is closed and the fuse carriage is racked in, the contactor may be closed.

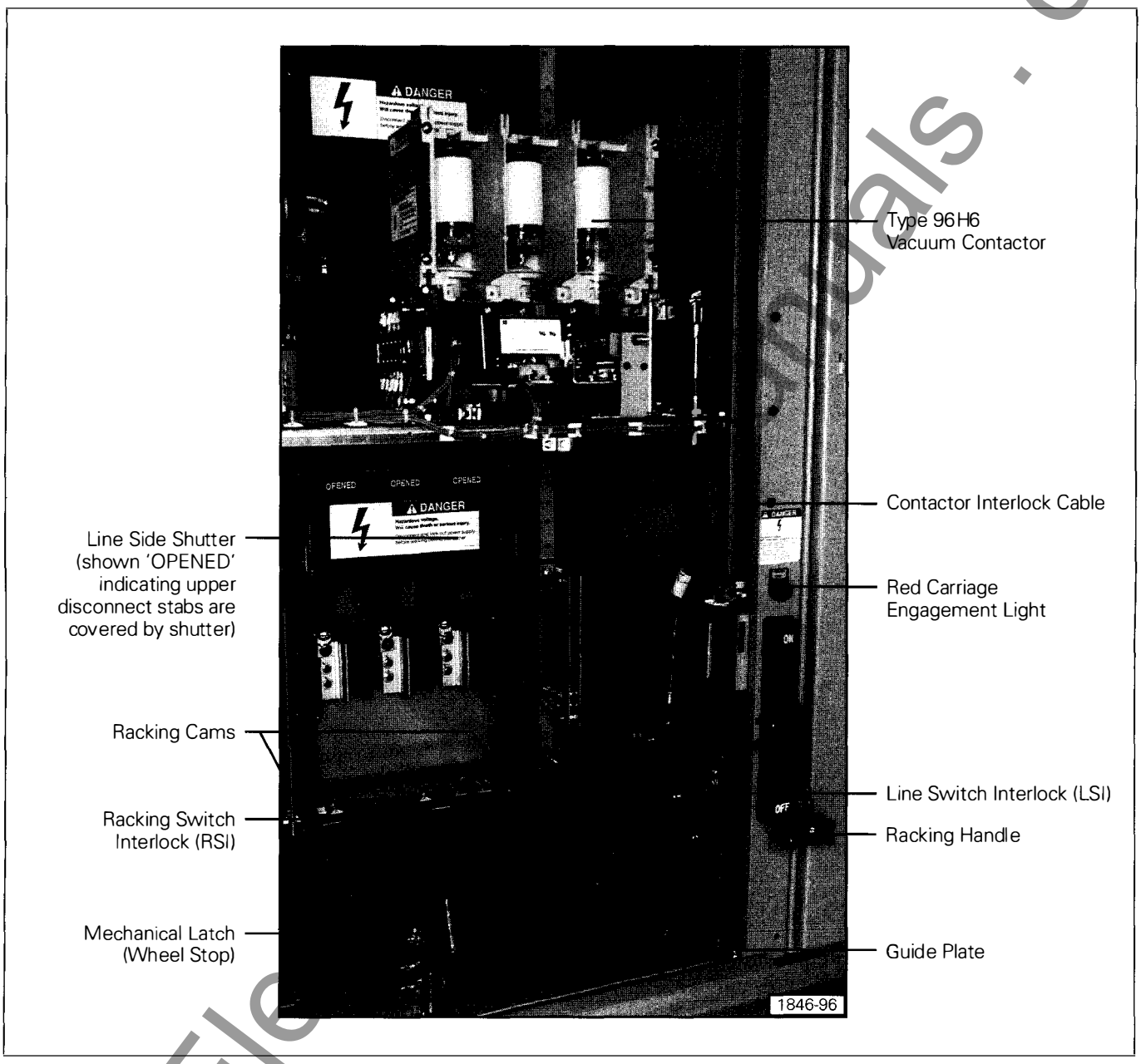

Figure 4. 720A Controller Construction (shown with fuse carriage removed)

The interlocking similarly requires that the contactor be open before the fuse carriage can be racked to the disconnect (OFF) position. Once the fuse carriage is disconnected, the door for the main contactor/fuse carriage can be opened. After this is done, the doors for the starting contactors and the starting autotransformer may be opened.

Mechanical Latch
The mechanical latch (or wheel stop) is mounted on the left hand side of the guide plate on which the drawout fuse carriage rolls. It serves to locate and hold the fuse carriage in the disengaged (test) position. The latch is released by manually pivoting the latch downward and rolling the carriage out of the enclosure. Refer to **Figure 4**.

If the mechanical latch is not in the proper position, the front door will not close properly. If this occurs, simply rotate the mechanical latch upward, which secures the fuse carriage inside the compartment, and allows the front door to close fully.

Detent Lever
This lever is provided to prohibit relative motion between carriage stab fingers and stationary stab terminals. Refer to **Figure 5**. Slight initial force on the racking handle is required to free the detent lever when moving it from the ON to the OFF position.

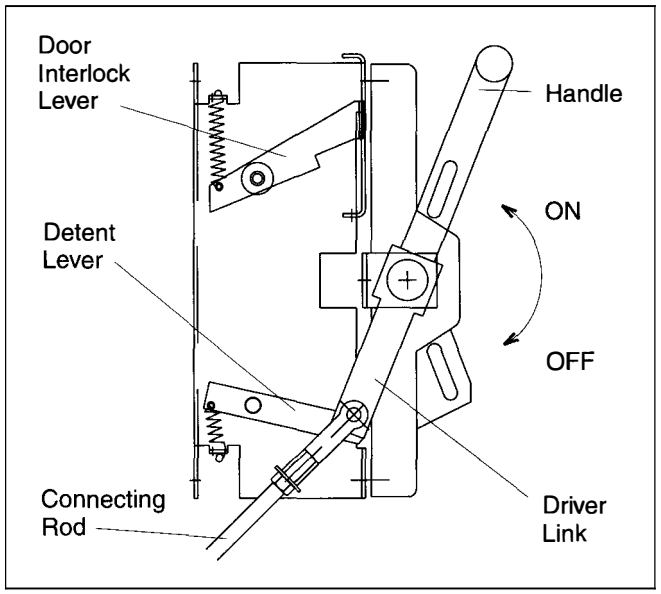

Figure 5. Detent Lever

Carriage Engagement Warning Light
A red warning light, mounted above the racking handle housing, is energized only when the drawout fuse carriage is fully engaged and incoming power is present, independent of the condition of the contactor or door. When the handle is moved to the OFF position, the red warning light should always go out, indicating the fuse carriage is fully disengaged and isolated from the stab assembly. Refer to **Figure 4**.

If the racking handle is moved to OFF and the red light stays on, the racking mechanism is not operating properly and the carriage is still engaged. **Do not attempt to open the medium voltage door.** Disconnect and lockout all incoming power and refer to the section on the door-handle interlock.

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Do not attempt to open the medium voltage door if the red carriage engagement indicating light is on. Do not open medium voltage compartment door until power has been removed.

A push-to-test feature is provided to test the carriage engagement warning light using customer-supplied test power. A routine test of the light should be included in the controller maintenance plan.

Line Switch Interlock (LSI)
All control power derived from the secondary of the control power transformer is carried from the drawout carriage to the low voltage control panel through a set of contact fingers mounted on the rear of the carriage. These contact fingers, along with the mating contact block which is stationary-mounted on the guide plate, make up the Line Switch Interlock (LSI). Refer to **Figure 4**.

The function of this interlock is to break all load on the control power transformer secondary winding prior to disengagement of the main power stabs as the carriage is racked out.

Racking Switch Interlock (RSI)
The Racking Switch Interlock (RSI) is a microswitch mounted on the rear of the guide plate, which functions to prevent operation of the contactor on test power when the fuse carriage is racked in (ON). As the racking handle is moved from OFF to ON, the normally closed RSI contact opens and isolates the test source from the control circuit. Refer to **Figure 4**.

Power Fuses
Current limiting power fuses are mounted on a drawout carriage which may be completely removed from the enclosure for servicing. All fuses used in 720 ampere controllers are bolt-in type.

ANSI "R" or "X" rated fuses are used for motor starting duty and "E" rated fuses are used for transformer feeders.

Minimum melting and total clearing time curves for motor starting fuses are shown in **Figures 6** and **7**. Current limiting characteristics of motor starting fuses are shown in **Figure 8**. Motor fuse selection guide and maximum permissible motor accelerating times are shown in **Figures 9** and **10**.

Do not handle the fuse carriage by means of the fuses.

Overload Relay
For information on Siemens type 3UA thermal overload relays, refer to the Series 81000 Controller Instruction Manual, MVC-9068. For other types of relays, refer to the instruction manual for the overload device furnished.

Type 96H6 Vacuum Contactor
Siemens 720 ampere Type 96H6 vacuum contactors provide the advantage of long mechanical and electrical life with low maintenance and are essentially immune to adverse atmospheric environments. They are suitable for loads of all types including three-phase motors, transformers and capacitors.

The contactor has three main poles, each consisting of a sealed vacuum interrupter. Since arc interruption is accomplished completely within the vacuum interrupter, items required in air magnetic contactors, such as arc chutes, blowout coils and pole plates are not required. Stationary and movable power contacts are located inside the vacuum interrupter. A stainless steel bellows attached to the movable contacts ensures a complete seal and vacuum integrity.

Refer to **Figure 11** for an illustration of the major components of the Type 96H6 contactor.

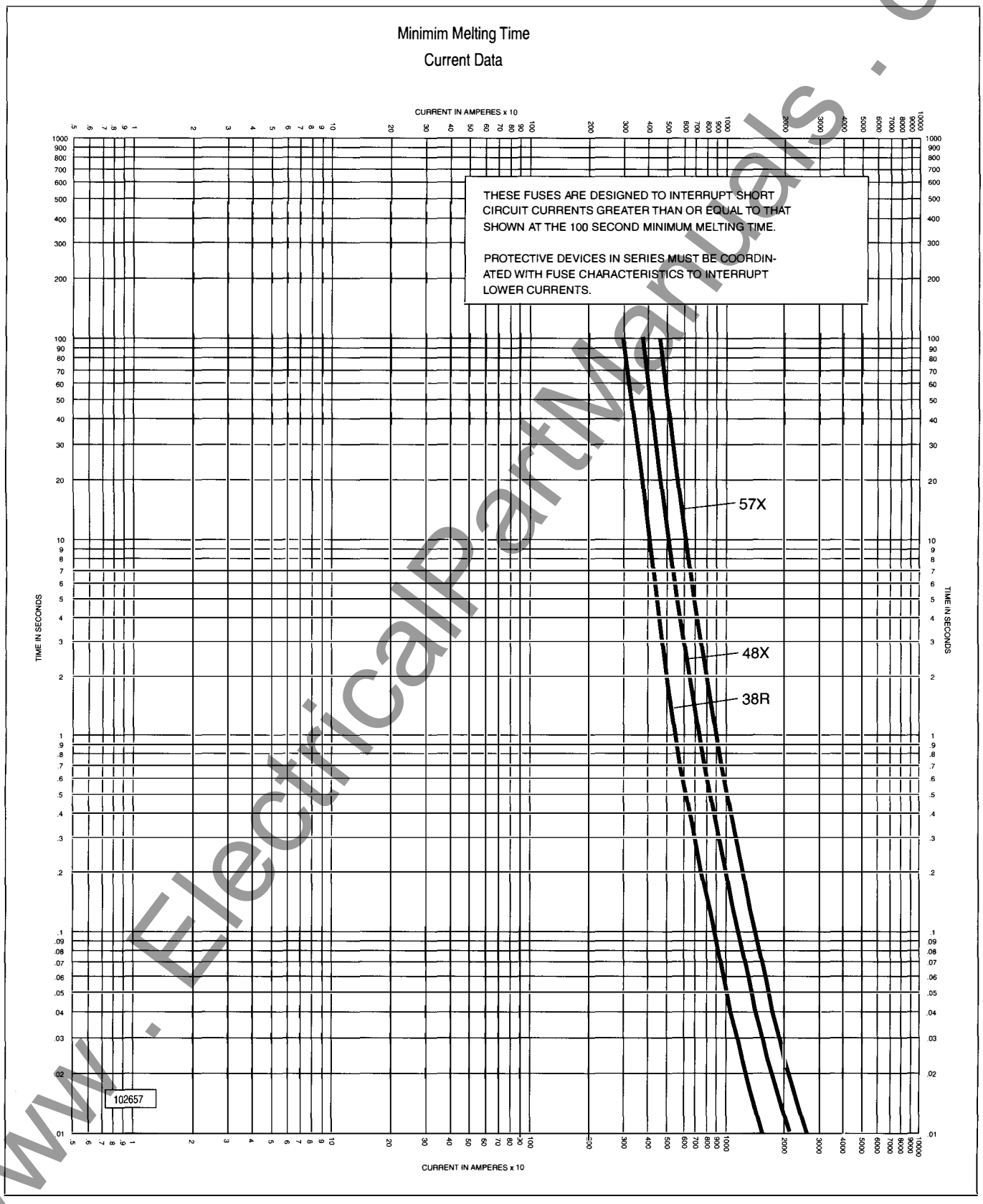


Figure 6. Time-Current Characteristic Curves (Minimum Melting Times) — 38R and 57X Fuses

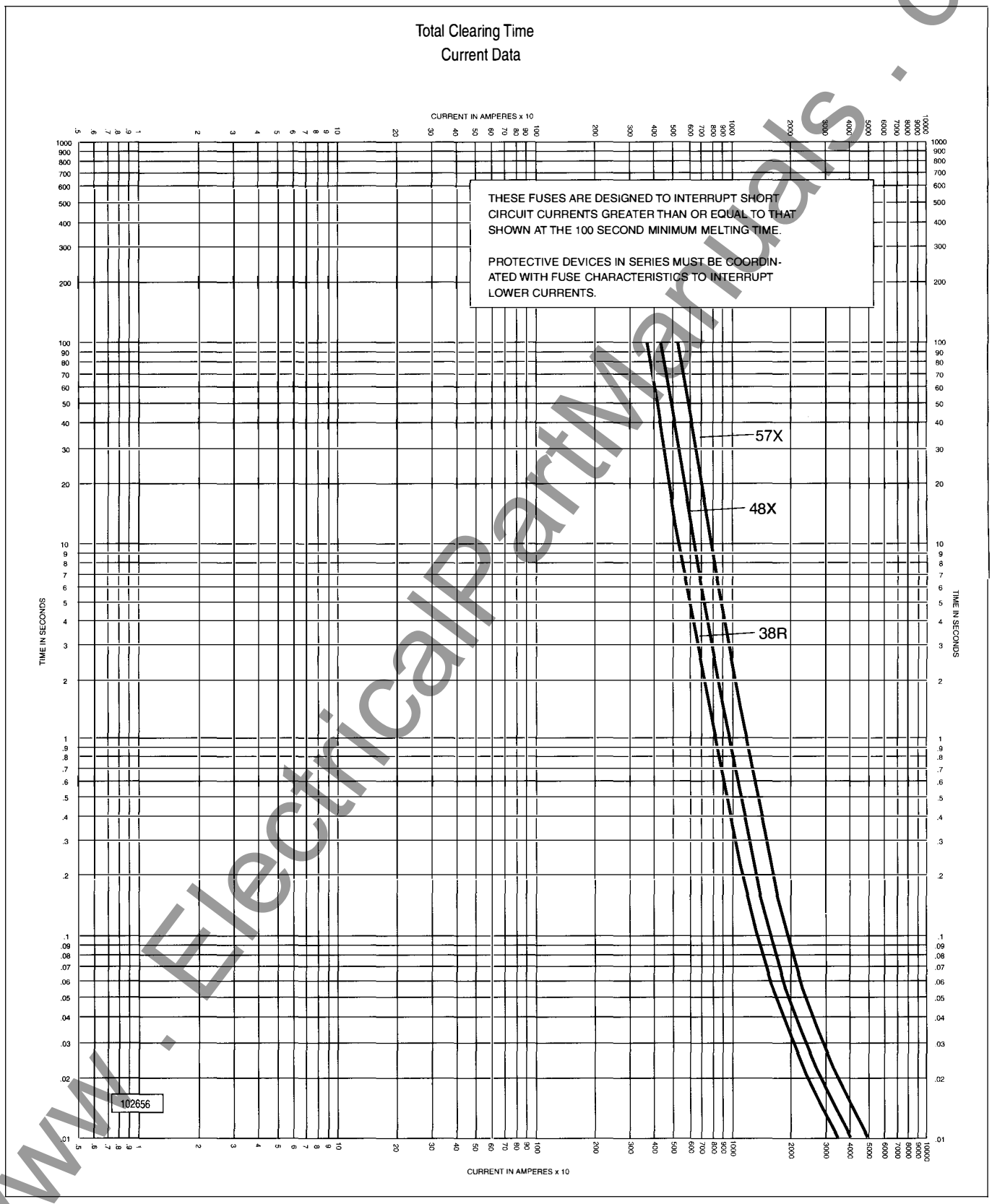


Figure 7. Time-Current Characteristic Curves (Total Clearing Times) — 38R and 57X Fuses

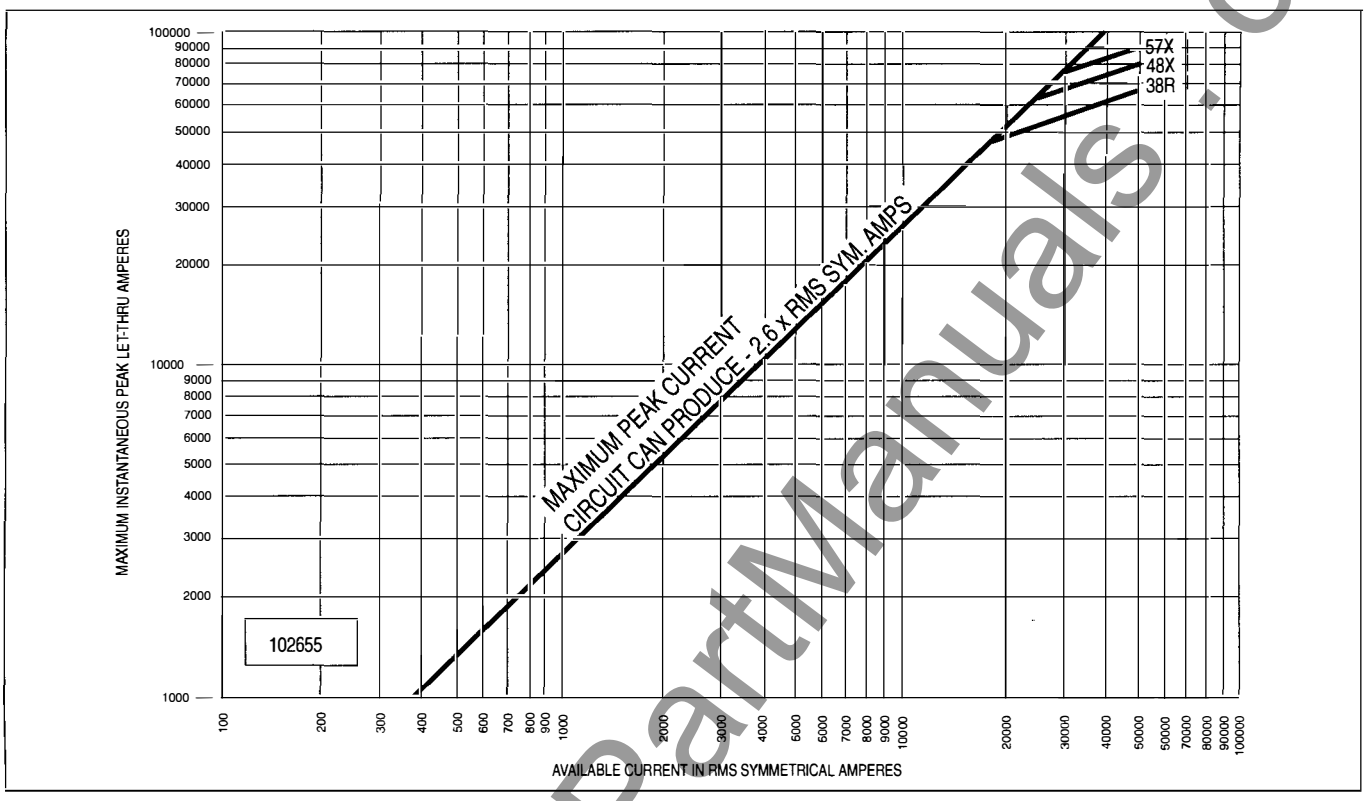


Figure 8. Current-Limiting Characteristic Curves — 38R and 57X Fuses

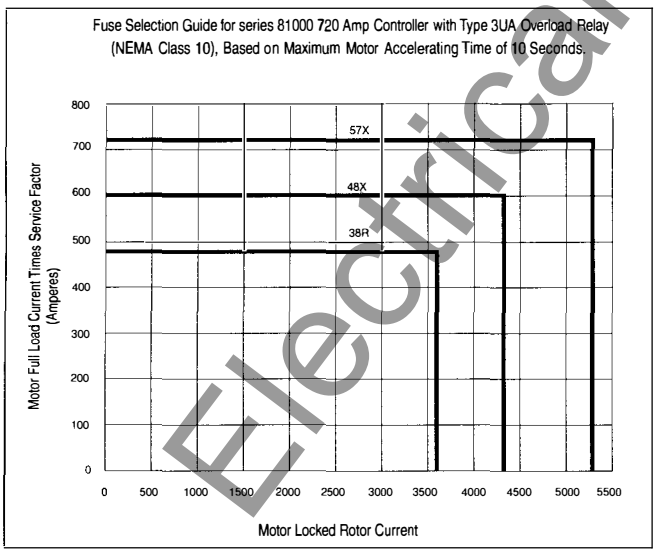


Figure 9. Fuse Selection Guide

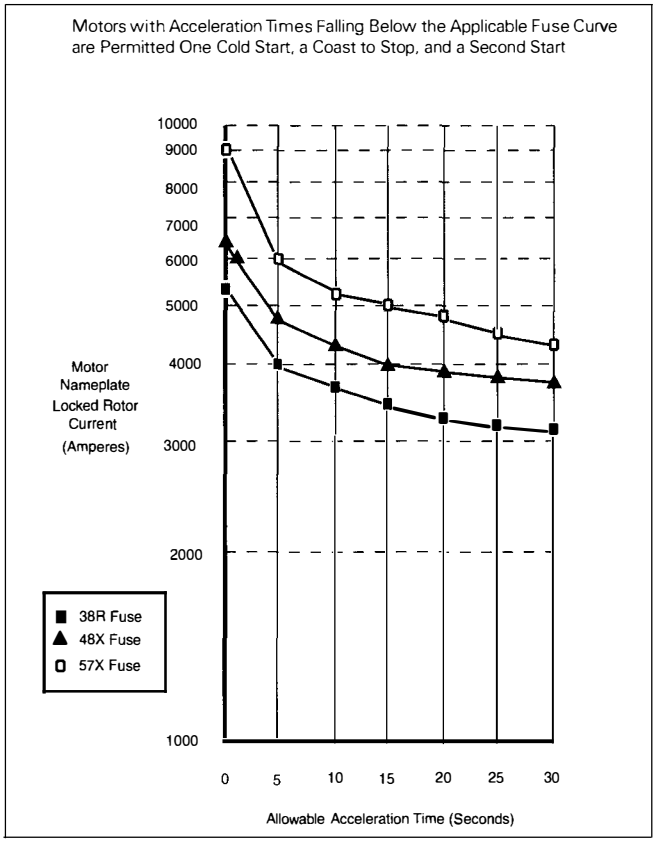


Figure 10. Maximum Allowable Acceleration Times

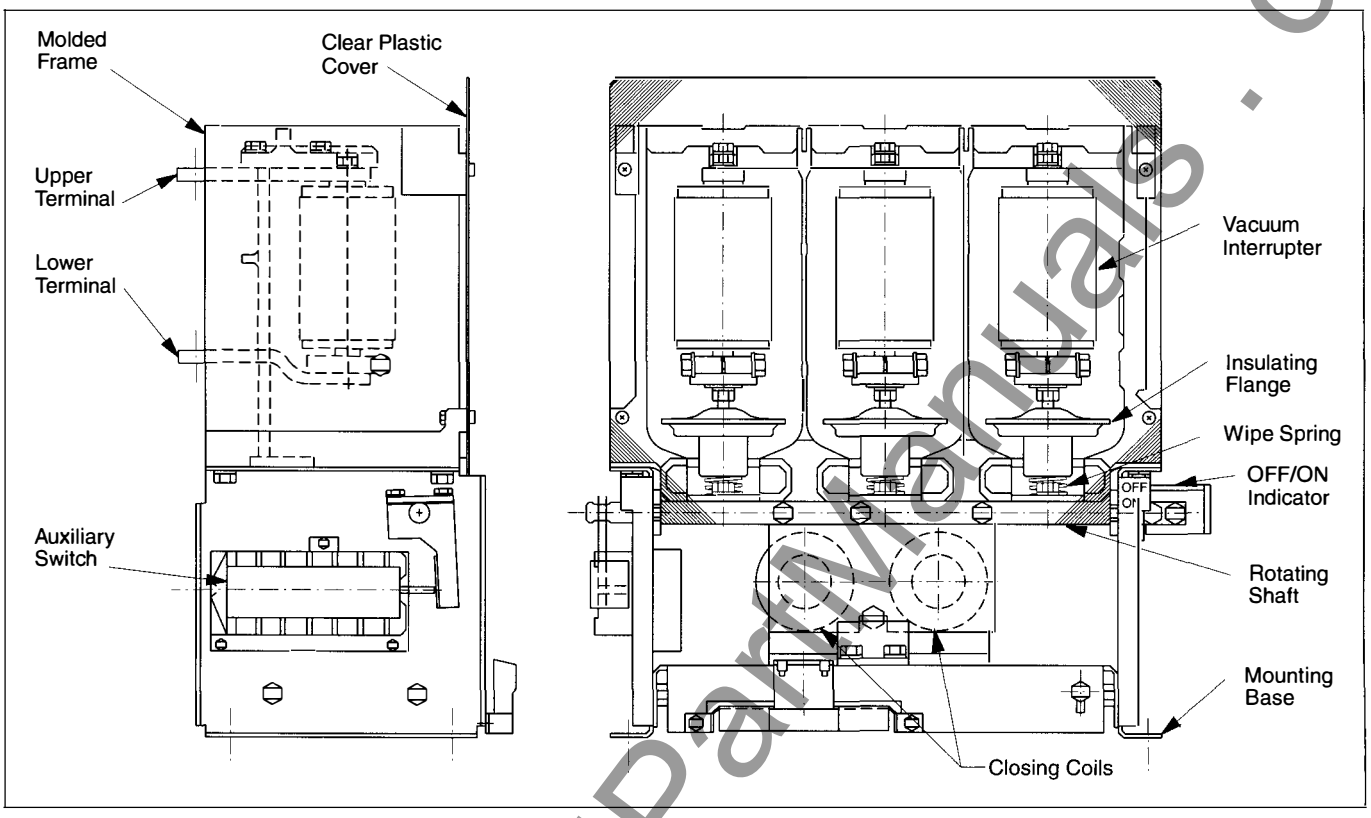


Figure 11. Major Components of 96H6 Contactor

Catalog Numbers
Fuse carriages can be identified through the catalog number system illustrated in **Table 7**.

Table 7: Fuse Carriage Catalog Number System

96 H6 5 3 3 38 4 A 2 F

For use with NEMA Size H6 (720A) Contactor

Insulation Voltage

5 = 5kV

Number of Poles

2 = 2 Poles
3 = 3 Poles

Interrupting Capacity

2 = 200MVA
3 = 350MVA
4 = 400MVA

Main Fuse Type and Rating

00 = None
38 = 38R
45 = 450E
48 = 48X
50 = 500E
57 = 57X
60 = 600E

F = Fuse Carriage

CPT Capacity

1 = 0.75kVA
2 = 1.5kVA
3 = 2.0kVA
4 = 2.5kVA
5 = 3.0kVA
6 = 3.25kVA
7 = Other (See Nameplate)

CPT Secondary Voltage

A = 115VAC
B = 230VAC
E = Other (See Nameplate)
N = None

CPT Primary Voltage

0 = No CPT
2 = 2300V 60Hz
4 = 4000V 60Hz
5 = 4600V 60Hz
9 = Other (See Nameplate)

Example:
Carriage Cat. No. 96H6533384A2F is a three pole fuse carriage designed for use with a Series 81000 720 ampere, 5kV vacuum controller. It has an interrupting capacity of 350MVA at 4000 volts using motor starting fuses rated 38R. It is equipped with a 1.5kVA control power transformer with a 4000VAC 60Hz primary and 115VAC secondary.

Receiving, Handling and Storage - General
Refer to the instruction manual for Series 81000 Controllers, MVC-9068, for instructions regarding receiving, handling and storage of 720 ampere Series 81000 vacuum controllers.

The fuse carriage is normally shipped installed in its associated compartment. The fuse carriage is secured in the compartment with a retainer bolted to the left rear of the guide plate (see **Figure 4**), positively securing the wheel of the fuse carriage. Remove the retainer and associated hardware prior to operation.

Operating Environment
The Series 81000 controller conforms with the provisions of NEMA standard ICS1, clause 6, Altitude Class 1 Km, which defines the usual service conditions. It is designed for indoor use where the temperature inside the controller is higher than the ambient temperature. The controller is capable of carrying its rated load when the ambient temperature does not exceed 40°C (104°F) and the altitude does not exceed 3300ft (1000m) above sea level. Where unusual service conditions exist, or where temperature or altitude limitations are exceeded, the controller construction, ratings, or protection may require alteration. Some examples of unusual service conditions are excessive moisture, vibration, or dust.

Site Preparation and Mounting
Installation shall be in accordance with the National Electrical Code, NEMA, ANSI, and NFPA 70 Standards. Unless the controller has been designed for unusual service conditions, it should not be located where it will be exposed to ambient temperatures above 40°C (104°F), corrosive or explosive fumes, dust, vapors, dripping or standing water, abnormal vibration, shock, tilting, or other unusual operating conditions.

The controller should be installed in a clean, dry, heated place with good ventilation. It should be readily accessible for cleaning and inspection and should be carefully set up and leveled on its supporting foundation and secured in place. If the mounting site is not flat and level, the controller must be shimmed where necessary to prevent distortion of the frame. If shimming is necessary, use correct lifting means (refer to the instruction manual for Series 81000 Controllers, MVC-9068). Do not use prybars or similar devices.

The controller can be mounted by many different fastening systems including true drop in, cast in place, power actuated, or threaded insert fasteners. See **Figure 12** for anchor bolt locations. The bolt pattern is dependent on frame width and depth, location in the lineup, and whether or not sill channels are furnished.

The group arrangement drawing for each controller details the anchor bolt locations. The coordination between the bolts and the controller should be verified prior to attempting installation. Expandable inserts in pre-drilled holes or imbedded "L" bolts are recommended. Wooden plugs driven into holes in masonry or concrete are not recommended for anchoring inserts and should never be used. The bolt size must be 1/2".

Welding the steel base or sill channels to a steel floor plate is an alternate mounting method especially recommended in areas subject to seismic activity.

Grouting the sill channels (refer to **Figure 13**) is another method of fastening the controller to the foundation. This method requires the foundation to be grooved to accept the sill channels. The actual groove dimensions must be coordinated with the floor plan layout on the group arrangement drawing included in the controller information packet.

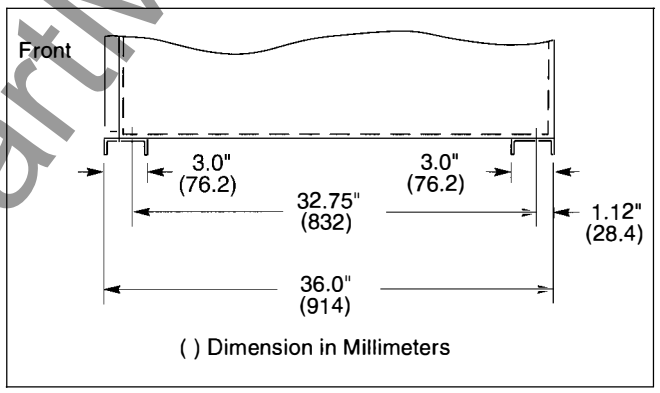


Figure 13. Typical Side View with Optional Sill Channels

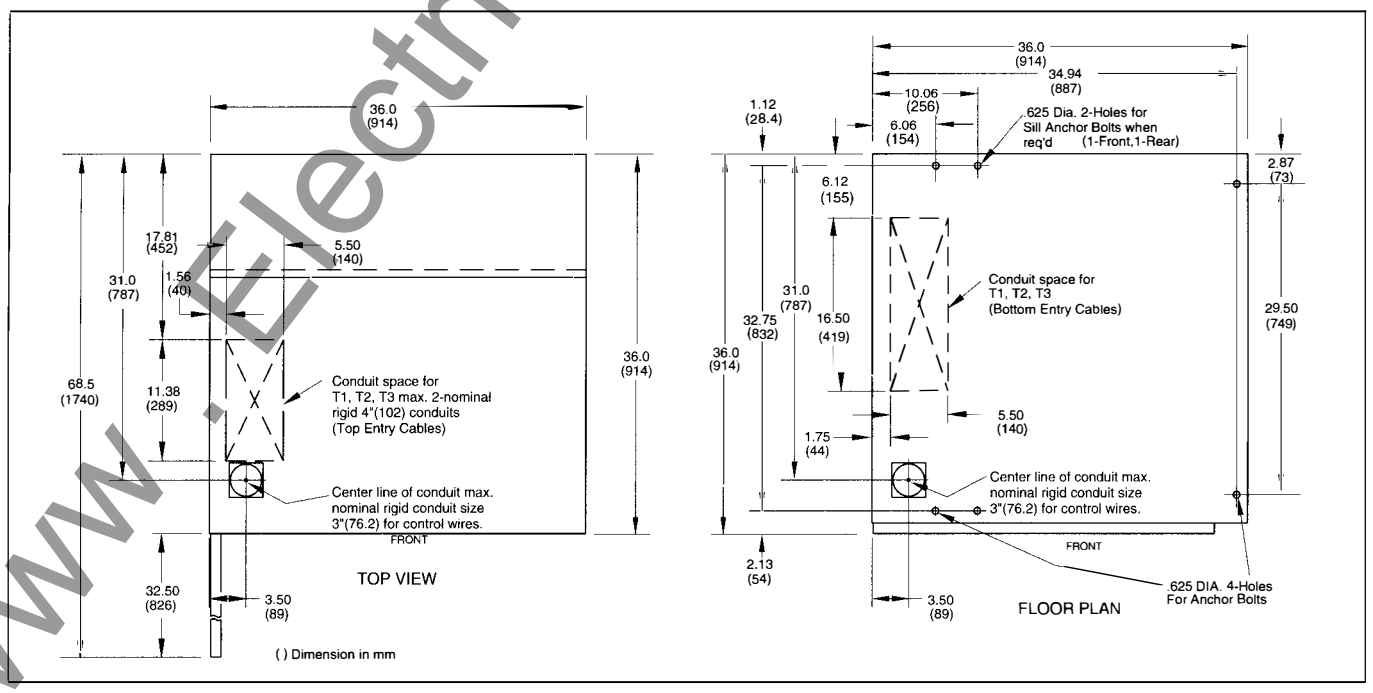
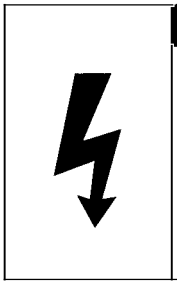


Figure 12. Anchor Bolt and Conduit Entry Locations



⚠DANGER

Hazardous voltages.

Will cause death, serious personal injury or property damage.

Disconnect, lockout, and ground incoming power and control voltage sources before beginning work on this or any other electrical equipment.

General Pre-Installation Inspection

Check all parts for secure mounting and good electrical connections. Inspect visually for good condition.

1. Inspect frame for dents and other damage. Swing doors to make sure they pivot easily.
2. Remove any retainers or bolts used to secure fuse carriage in enclosure during shipment.
3. Operate the racking mechanism to ensure free movement and smooth operation. Inspect the stab assembly and shutter mechanism.
4. Check bolt-in fuses on carriage for tight connections and re-torque per **Table 14**, if needed.
5. Check control circuit plug and receptacle for bent pins and other damage.
6. Make sure that cable clamps and insulators are in good condition.

Grounding

The frame of each controller must be grounded. This connection must be made before making any power connection. If a ground bus is furnished, the ground connection should be made to the ground bus. The control and instrumentation circuits are grounded to the enclosure. This connection can be temporarily removed for test purposes, but it must be reconnected before the controller is returned to operation.

Electrical Connections

To provide additional access for line and load cable connections, the fuse carriage should be removed. Be sure to disconnect the control plug before attempting to remove the carriage.

Line connections should be made first. Refer to Series 81000 Instruction Manual, MVC-9068, for details.

Load cable terminations are made directly to pads located near the current transformers on the left hand enclosure wall. Typical conduit space for top or bottom entry of load cables and control wires is given in **Figure 12**.

Fuse Carriage Installation

Correct installation of the fuse carriage is essential to proper controller operation. Before installing a fuse carriage in any medium voltage compartment, observe the following check list:

A. Check to see that the catalog number and power fuse rating on the carriage rating label match the information given on the medium voltage compartment rating label.
B. Check the following items on the carriage for agreement with the information given on the rating label:
   1. Power fuse type and "R", "X", or "E" rating.
   2. Control power transformer kVA and voltage ratings.
   3. Control power transformer primary fuse "E" rating.
C. Do not attempt to install a drawout contactor from a 360 ampere controller in a 720 ampere controller, or vice-versa.

⚠WARNING

Electrical explosion or fire hazard

Can cause death, serious personal injury, or property damage.

Positively verify that the correct fuse carriage is installed by following the steps outlined.

After it has been verified that the correct fuse carriage has been selected for a given medium voltage compartment, the carriage may be installed as follows:

1. Open the 60 inch high medium voltage compartment door. The racking handle must be in the OFF position and the red carriage engagement warning light must not be lit.
2. Position the carriage in front of the compartment with the stabs pointing into the cubicle in such a way that the rear wheels are lined up with the sides of the guide plate on the bottom of the enclosure. **Do not handle the fuse carriage by means of the fuses.**
3. Roll the carriage onto the guide plate and into the compartment until it stops. When the carriage is fully inserted, the mechanical latch (see **Figure 4**) will rotate to prevent it from rolling back out of the compartment.
4. Connect the control wiring harness plug to the carriage by inserting it in the receptacle located in the lower front.
5. Close and secure the medium voltage compartment door.

Power Cable Termination

For additional instructions on terminating power cables to the 720 ampere controller, refer to the Series 81000 Instruction Manual, MVC-9068.

Site Altitude

When the site altitude exceeds 1000m (3300ft), the electrical ratings of the controller are reduced and special application consideration must be given in accordance with NEMA Standard ICS 1, clause 6. Both the dielectric strength of the insulation and the current ratings are affected. **Table 8** gives derating factors to be applied to the appropriate ratings for application at 1000m and at 2000m. For altitudes between these extremes, interpolate from the values in the table. If the site altitude exceeds 2000m (6600ft), consult the factory for information.

Table 8. Altitude Correction Factors for Contactor (**Note 1**)

Altitude	Interrupting Current	Continuous Current	Dielectric Withstand Voltage	Short Time Current Withstand
Up to 1000m (3300ft)	100%	100%	100%	100%
2000m (6600ft)	95%	90%	90%	85%
Above 2000m (6600ft)	Consult Factory			

Note 1. For altitudes between 1000m and 2000m, interpolate between the values shown in the table.

⚠DANGER

Hazardous voltages.

Will cause death, serious personal injury or property damage.

Disconnect, lockout, and ground incoming power and control voltage sources before beginning work on this or any other electrical equipment.

All pre-energization checks outlined in this instruction manual must be performed before the equipment is energized. This equipment should be energized by qualified personnel only.

Pre-Energization Check

After installation or maintenance, the following checklist should be followed:

1. Retighten all accessible connections in accordance with the torque values provided in **Table 14**.
2. Remove all blocks or other temporary holding means used for shipment from all component devices in the controller interior.
3. Check the integrity of the bus supports.
4. Check the enclosure to see that it has not been damaged and that electrical spacing has not been reduced.
5. Compare all circuits for agreement with the wiring diagrams which accompany the controller.
6. Make certain that external wiring is clear of bus, and all power wiring is physically secured to withstand the effects of the largest fault current which the power system is capable of delivering.
7. Verify that all ground connections have been made properly. If sections of the controller were shipped separately, they must be connected in a manner to assure a continuous ground path.
8. Check all devices for damage. Make necessary repairs or replacement prior to energizing.
9. Be sure that each motor is connected to its intended starter. Ensure that fuse rating is in agreement with the rating specified in the fuse carriage catalog number.
10. Manually exercise all operating mechanisms and devices to make certain that they are properly aligned and operate freely.
11. With all loads disconnected, exercise all electrically operated devices with control test power to verify that they operate properly. Refer to the wiring diagrams supplied for the required control voltage, frequency and test power terminal designations required to test the contactor. For the contactor, this verification should also include tests at the lower limits of pickup voltage as shown in **Table 5**.
12. Test the ground fault protection system, if furnished, in accordance with the manufacturer's instructions.
13. Set all devices with adjustable current and voltage settings, if furnished, to the proper values.
14. Ensure that the overload relay current range and setting is in agreement with the full load current and service factor shown on the motor nameplate, taking into account the current transformer ratio.
15. Check that shorting links on current transformers, if furnished, are in the open position. Check each current transformer's secondary circuit for continuity.
16. To prevent possible damage to equipment or injury to personnel, check that all parts and barriers that may have been removed during installation and wiring have been properly reinstalled.
17. Before closing the enclosure, remove all metal clippings, scrap wire and other debris from the controller interior. Remove any accumulation of dust or dirt, and clean out the controller by using a brush, vacuum cleaner or clean, lint-free rags. Do not use compressed air as it will only redistribute the contaminants on other surfaces.
18. After all power and control connections are made and with incoming power disconnected, conduct an electrical insulation resistance test on the power circuit to ensure that the controller is free from short circuits and grounds.
19. Install covers and close doors, making certain that no wires are pinched and that all enclosure parts are properly aligned and tightened.
20. Make sure that all current-carrying parts outside the contactor have adequate current-carrying capacity and are correctly insulated in accordance with the requirements of the National Electrical Code (NEC). All electrical connections should be made carefully per the wiring diagram furnished with the equipment. Tighten all lugs to recommended torque values (see **Table 14**). Use recommended crimping tools if crimp lugs are supplied.

Dielectric Test

⚠DANGER

High Potential tests employ hazardous voltages.

Will cause death or serious personal injury.

Follow safe procedures. Exclude unnecessary personnel. Use safety barriers. Keep away from the equipment during application of test voltages. Dielectric testing should be conducted only by qualified personnel. Refer to dielectric test equipment instructions for safety instructions.

An AC dielectric test, at 2.25 times the nominal system voltage plus 2000 volts for one minute, should be performed between all phases and from all phases to ground prior to energizing the equipment. Be sure to disconnect any devices (e.g., control power transformers, surge limiters, surge arrestors, etc.) from the circuit which could be damaged by the test voltage.

If a high-potential test set is not available, a megger test at 1000 volts is a suitable second-choice.

Since wide variations can occur in insulation values because of atmospheric conditions, contamination and type of test equipment, discrete values cannot be given. However, making and recording tests on new equipment, and again at regular intervals, will give a comparative indication of insulation change. Maintaining a permanent record of these values should be part of the maintenance program.

⚠WARNING

Vacuum interrupters may emit X-radiation.

Can cause serious personal injury.

X-rays can be produced when a high voltage is placed across the open contacts of a vacuum interrupter.

Do not exceed 10kV RMS AC when performing dielectric tests across open contacts of the vacuum interrupter.

Keep personnel at least three (3) feet from any vacuum interrupter during dielectric tests.

Note: Do not use DC high potential testers incorporating half-wave rectification. These devices produce high peak voltages.

These high voltages will produce X-ray radiation. These devices also show erroneous readings of leakage current when testing vacuum interrupters.

Energizing Equipment

⚠DANGER

Hazardous voltages.

Will cause death, serious personal injury or property damage.

Disconnect, lockout, and ground incoming power and control voltage sources before beginning work on this or any other electrical equipment.

All pre-energization checks outlined in this instruction manual must be performed before the equipment is energized. This equipment should be energized by qualified personnel only.

1. In order to minimize risk of injury or damage, or both, there should be no load on the controller when it is energized. Turn off all downstream loads including those such as distribution equipment and other devices which are remote from the controller.
2. The equipment should be energized in sequence by starting at the source end of the system and working toward the load end. In other words, energize the incoming power to the controller or group of controllers, then close the incoming line load interrupter switch or circuit breaker (if supplied), and then rack the fuse carriage into the ON position.
3. After all disconnect devices have been closed, loads such as motors may be turned on to verify that the system operates as intended.

⚠DANGER

Hazardous voltages.

Will cause death, serious personal injury, or property damage.

Disconnect, ground, and lockout incoming power and control voltage sources before beginning work on this or any other electrical equipment.

Maintenance should be performed only by qualified personnel.

Introduction

Before performing any maintenance:

- Test all power terminals to verify that incoming power has been disconnected. Use only approved high voltage test equipment to check voltage on power terminals. **Do not attempt to measure high voltage (over 600 volts) with a volt-ohm meter.**
- Check all control and secondary circuit terminals with a voltmeter to make certain that all sources of incoming control and secondary voltage have been disconnected.
- Connect safety grounds to power terminals after the system has been de-energized, and prior to working on the equipment.
- Perform all disconnecting, grounding, and lockout operations in accordance with established safety procedures.
- Follow the procedure outlined in the Pre-Energization Check section of this manual before power is restored.

General

For the safety of maintenance personnel as well as others who might be exposed to hazards associated with maintenance activities, the safety related work practices of NFPA 70E, parts II and III should always be followed when working on electrical equipment. Maintenance personnel should be trained in the safety practices, procedures and requirements that pertain to their respective job assignments. This manual should be reviewed and retained in a location readily accessible for reference during maintenance of this equipment.

The user must establish a periodic maintenance program to ensure trouble-free and safe operation. The frequency of inspection, periodic cleaning and preventive maintenance will depend upon the operating conditions. NFPA Publication 70B "Electrical Equipment Maintenance" may be used as a guide to establish such a program. **A preventive maintenance program is not intended to cover reconditioning or major repair, but should be designed to reveal, if possible, the need for such actions in time to prevent malfunctions during operation.**

⚠WARNING

Use of unauthorized parts in the repair of the equipment, or tampering by unqualified personnel may result in dangerous conditions which may cause death, serious personal injury, or equipment damage.

Follow all safety instructions contained herein.

Recommended Maintenance and Lubrication

Periodic maintenance and lubrication should include all of the tasks shown in **Table 9**. Recommended procedures for each of the listed tasks are provided in this section of the manual, or in the references cited in this manual.

⚠WARNING

Failure to properly maintain the equipment can result in death, serious personal injury, or product failure, and can prevent successful functioning of connected apparatus.

The instructions contained herein should be carefully reviewed, understood, and followed.

The maintenance tasks in **Table 9** must be performed regularly.

Table 9. Maintenance Tasks — Inspection Items

- Vacuum Contactor Inspection
- Vacuum Interrupter Inspection
- Closing Coil
- Latch Mechanism
- Auxiliary Switch
- Pickup Voltage Check
- Mechanical and Electrical Operation
- Shutter Mechanism
- Racking Mechanism
- Mechanical Interlocks
- Blown Fuse Trip Mechanism
- Electrical Interlocks
- Electrical Joints and Terminals
- Periodic Cleaning
- Maintenance Tasks in manual for Series 81000 Controllers, MVC-9068.

The list in **Table 9** does not represent an exhaustive survey of maintenance steps necessary to ensure safe operation of the equipment. Particular applications may require further procedures. Should further information be desired or should particular problems arise which are not covered sufficiently for the user's purposes, the matter should be referred to the local Siemens sales office.

Maintenance of the vacuum contactor should only be performed with the contactor de-energized. Maintenance of the fuse carriage should be performed with the carriage completely withdrawn from the compartment.

Vacuum Contactor Inspection

The inspections listed in **Table 10** are recommended for the vacuum contactor.

Table 10: Vacuum Contactor Inspection Checklist

Parts to be Inspected	Inspection Item	Cracks	Discoloration	Contamination	Rust	Wear	Loose Parts	Incomplete Operation	Vibrating Sound	Inspection Intervals
Main Circuit	Vacuum Interrupter			●	●	●			●	Visual Check Once a Year or Every 20,000 Operations
	Movable Conductor	●	●				●			
	Upper & Lower Terminals		●				●			
Mechanism Section	Molded Frame	●	●	●						
	Insulating Flange	●		●			●			
	Bearing					●	●			
Electromagnet	Closing Coil		●							
	Armature and Core				●		●			
	Auxiliary Switch	●	●				●			
Latch Mechanism	Trip Coil		●							
	Roller	●				●	●	●		
Others	Bolts and Nuts				●		●			
	Insulated Wire	●	●							

NOTE: The life expectancy of the electrical parts (vacuum interrupter, auxiliary switch) is 200,000 operations.

Vacuum Contactor Components — Service Life

The electrical service life of the vacuum interrupter is defined by allowable contact wear, whereas the mechanical service life is defined by the number of close/open operations. When a vacuum interrupter has reached the acceptable limit for electrode (contact) wear, or has reached the mechanical operation limit, it must be replaced. To determine the electrode wear, follow the procedure outlined in "Vacuum Interrupter Inspection".

The maximum number of close/open operations for the vacuum interrupters is 200,000. When the number of operations on the vacuum interrupters reaches 200,000, the interrupters must be replaced, even if the allowable contact wear has not been exceeded.

Capacitor switching duty imposes considerable stress on a contactor, due to high frequency inrush currents, and high interpole recovery voltage during interruption. The life expectancy of the vacuum interrupters under capacitor switching duty is shown in **Figure 14**. The vacuum interrupters should be replaced when the allowable number of capacitor switching operations shown is reached.

Contact your Siemens representative if vacuum interrupters need to be replaced.

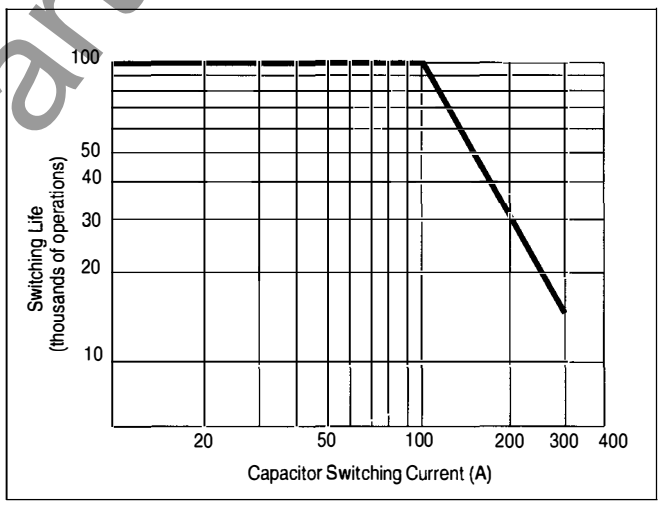


Figure 14. Vacuum Interrupter Life Expectancy — Capacitor Switching Duty

The allowable service life of the auxiliary switches, drive unit, and closing coils is also 200,000 operations. These items should be replaced when they have accumulated 200,000 operations.

The mechanical service life of the magnetically held contactor is 1,000,000 operations. The mechanical service life of the latched contactor is 200,000 operations.

The replacement schedule for various major components of the contactor is as shown in **Table 11**.

Table 11. Vacuum Contactor Component Replacement Schedule

Component	Replacement interval
Vacuum interrupter	200,000 operations
Auxiliary switch	200,000 operations
Latch mechanism	200,000 operations
Movable core	Detailed inspection and cleaning every 200,000 operations
Stationary core	Detailed inspection and cleaning every 200,000 operations
Closing/tripping coils	200,000 operations
Flexible conductor to interrupter stem	200,000 operations
Drive unit	200,000 operations

⚠ DANGER

High Potential tests employ hazardous voltages.

Will cause death or serious personal injury.

Follow safe procedures. Exclude unnecessary personnel. Use safety barriers. Keep away from the equipment during application of test voltages. Dielectric testing should be conducted only by qualified personnel. Refer to dielectric test equipment instructions for safety instructions.

⚠ WARNING

Vacuum interrupters may emit X-radiation.

Can cause serious personal injury.

X-rays can be produced when a high voltage is placed across the open contacts of a vacuum interrupter.

Do not exceed 10kV RMS AC when performing dielectric tests across open contacts of the vacuum interrupter.

Keep personnel at least three (3) feet from any vacuum interrupter during dielectric tests.

Note: Do not use DC high potential testers incorporating half-wave rectification. These devices produce high peak voltages.

These high voltages will produce X-ray radiation. These devices also show erroneous readings of leakage current when testing vacuum interrupters.

Vacuum Interrupter Inspection
The procedure for inspection of the vacuum interrupters is as follows:

1. Check the upper and lower flanges and interrupter shaft for signs of contamination or corrosion. If there is contamination, use a clean cloth and rubbing alcohol to clean. If there is corrosion, replace with a new interrupter. **NOTE:** Avoid touching the ceramic surface. Skin oils may harm the silicone varnish.
2. With the vacuum interrupter closed, check the amount of main contact wear in the vacuum interrupter. Measure the gap between the lever and the washer (dimension A) with the contactor closed, as shown in **Figure 15**. With the vacuum interrupter closed, it should be possible to insert a 1mm thick shim in the gap between the washer and the protrusions on the bottom of the lever. When this shim can no longer be inserted in the gap, the allowable contact wear has been exceeded, and the interrupter must be replaced.
3. Check the vacuum interrupter for integrity of the vacuum. With the contactor open, apply 10kV AC between the upper and lower terminals for one minute. If the interrupter withstands this test, it is acceptable. If voltage breakdown occurs, the interrupter must be replaced. (If there is a loss of vacuum, it can be confirmed manually. First, de-energize the contactor and ground any conductors. Then, push down on the insulating flange below the vacuum interrupter. If the interrupter stem can be easily moved, the interrupter has lost vacuum.)
4. Values for vacuum interrupter contact gap and wipe are listed in **Table 12**.

Table 12. Vacuum Interrupter Contact Gap & Wipe

Contactor Type	Contact Gap	Wipe
Magnetically Held	4.1-4.3mm	2.4-3.0mm
Latched	4.1-4.3mm	2.0mm or more

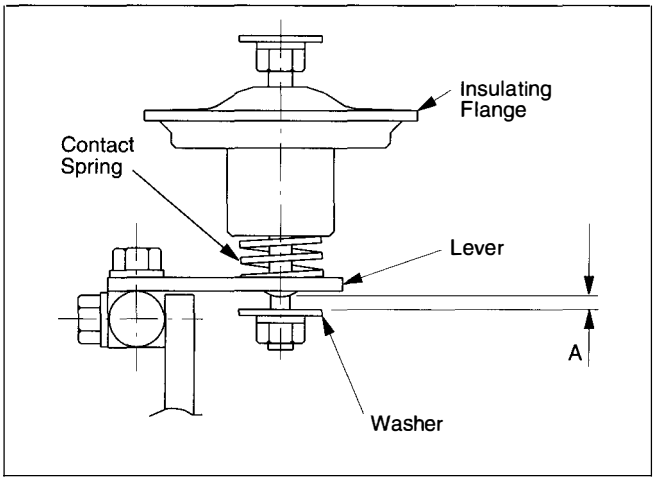


Figure 15. Measurement of Contact Wear

Closing Coil
Check the main closing coils for signs of discoloration. Discoloration and/or burnt insulation indicates that overheating has occurred, and replacement of the coil is necessary.

Latch Mechanism (Latched Contactor Only)
Check that the holding latch reliably engages. (To manually close the contactor, hold the central area of the rotating shaft with a wrench and operate). Check the condition of the latch roller. It should be smooth. Lubricate the rotating parts with a molybdenum disulfide or gear lubricant.

Auxiliary Switch
Once per year, measure the overtravel of the auxiliary switch assembly on the Type 96H6 contactor with the contactor closed as shown in **Figure 16**. If the dimensions are not as shown, adjust by loosening the auxiliary switch mounting plate, moving the plate so the proper adjustment is achieved, and then retighten the mounting hardware. After the hardware is tightened, recheck the auxiliary switch overtravel. Check for excessive accumulation of dirt or other contaminants in the auxiliary contact block and clean if necessary. Verify that there is remaining wipe of the auxiliary contacts. Check for burned or worn contacts, and replace the auxiliary switch if damage is observed. Reference values for auxiliary switch contact gap and wipe are listed in **Table 13**.

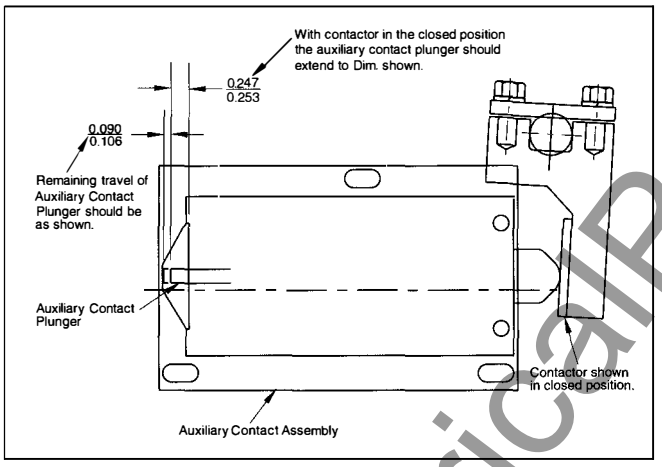


Figure 16. Measurement of Auxiliary Contact Overtravel

Table 13. Auxiliary Switch Contact Gap & Wipe

Auxiliary Switch	Contact Gap	Wipe
NO- Contact	3.6-4.4mm	2.7-3.3mm
NC - Contact	3.6-4.4mm	2.7-3.3mm
Delayed NC contact (for latched contactor only Contacts 16-26)	2.2-2.8mm	4.0-5.0mm

Pickup Voltage Check
Once per year, check to see that the Type 96H6 contactor will pick-up at 85% of rated control voltage. Watch that the contactor picks up in a single motion rather than a two-step motion.

If the pickup voltage is too high, it is possible that the vacuum interrupters may be sticking slightly. In this event, put a small amount of lubricating oil on the moving rod on the lower end of each interrupter.

Mechanical and Electrical Operation of the Controller
Refer to the "Mechanical and Electrical Operation of the Controller" section in the Series 81000 Controller Instruction Manual, MVC-9068.

With regard to the resistance measurements described in MVC-9068, the following maximum values apply to the Type 96H6 contactor and the drawout fuse carriage:
- Across a single contactor pole: 1.0 milliohm
- Across a single pole of the drawout fuse carriage
  - 38R fuse: 1.5 milliohm
  - 57X fuse: 1.3 milliohm

Shutter Mechanism
It is necessary to visually inspect the shutter mechanism components every time the fuse carriage is removed from the compartment. Periodic checks are strongly recommended. Replace broken parts and adjust linkage to provide a bind-free motion.

⚠DANGER

Hazardous voltage.

Energized parts located behind shutter mechanism will cause death, serious personal injury, or property damage.

Disconnect, ground, and lockout incoming power before performing any maintenance on the shutter mechanism.

Racking Mechanism
Information regarding the maintenance and adjustment of the racking mechanism used in 720 ampere Series 81000 controllers can be found in the "Racking Mechanism Adjustment" section of the Series 81000 Controller Instruction Manual, MVC-9068.

Follow the instructions in MVC-9068 which refer to "cell in bottom compartment."

Mechanical Interlocks
All mechanical interlocks are factory adjusted. With normal use, no maintenance should be required except for a light coat of grease at the moving joints.

Periodically check the condition of the cable which connects the contactor to the contactor interlock on the racking mechanism. Inspect the fittings at each end of the cable for mechanical integrity.

If it becomes necessary for any reason to adjust the length of the cable, proceed as follows (refer to **Figure 17**):
1. Move racking handle mid-way between OFF and ON positions.
2. Check the gap between the cam and the interlock lever. The gap should be 0.06" (1.6mm).
3. If adjustment is necessary, remove the pin from the clevis at either end of the cable.
4. Adjust cable length by turning clevis so that a 0.06" (1.6mm) gap exists between the interlock lever and the cam. When making the adjustment, pull the interlock lever up as far as it will go to remove all free play. When the lever is released, it may drag the cam slightly. This is acceptable.

5. Tighten cable locknuts.
6. Reinstall the pin which was removed from the clevis.
7. Return the racking handle to the OFF position.

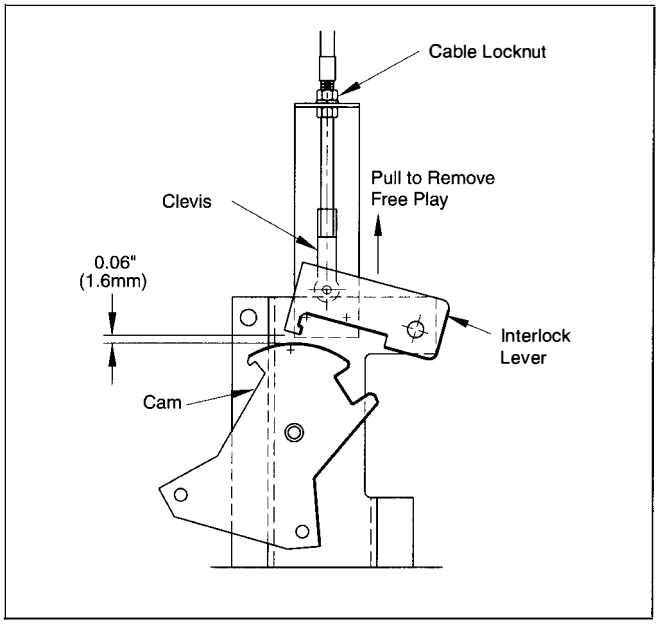


Figure 17. Contactor Interlock Cable Adjustment

Blown Fuse Trip Mechanism (optional)

NOTE: Use of the trip mechanism with fuses other than Gould Shawmut type A051B (38R, 48X or 57X) motor fuses or type A055B (450E) transformer fuses can result in failure of the trip bar to operate.

After the blown fuse trip mechanism has operated, or if any of the power fuses have been removed or replaced, the following checks and adjustments must be performed. Refer to **Figure 18**.

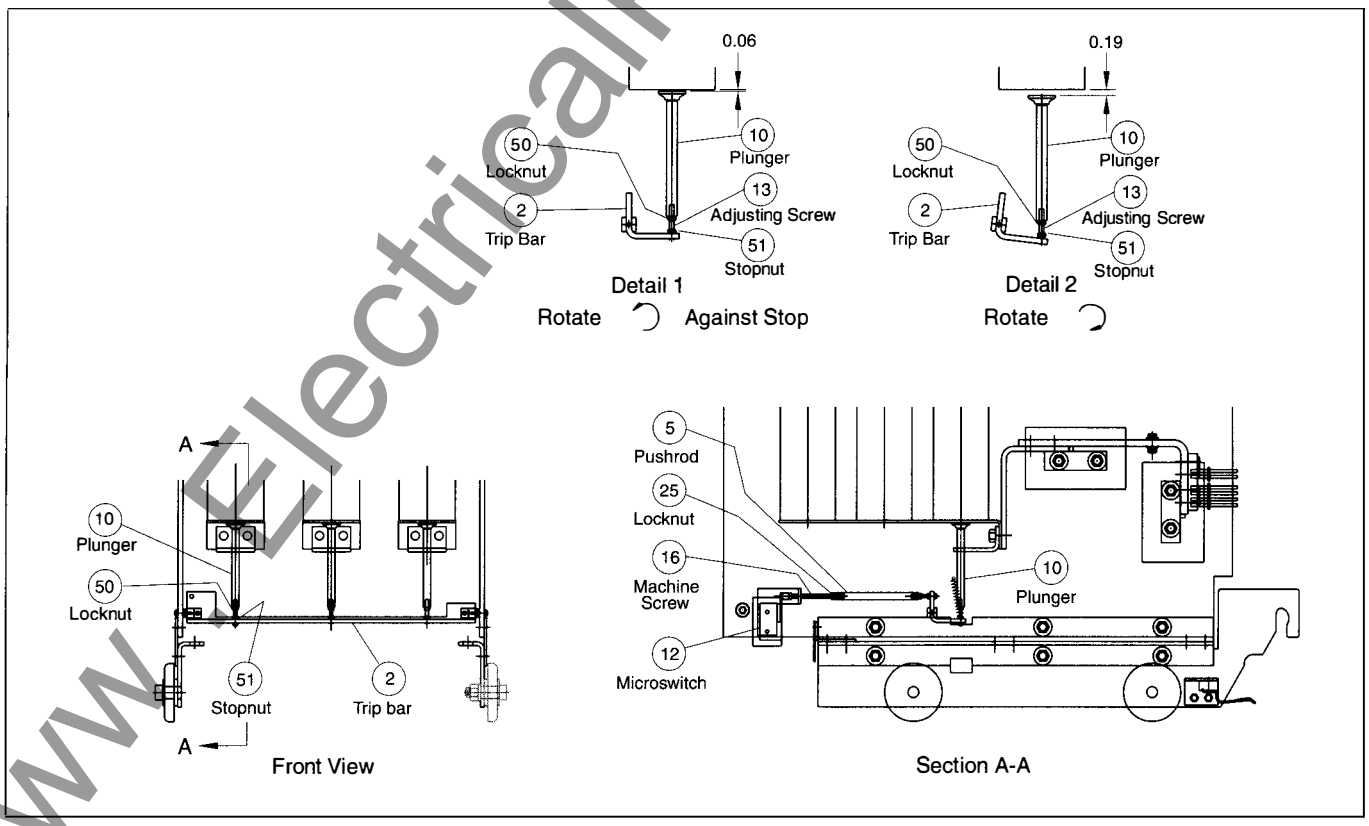


Figure 18. Adjustment of Blown Fuse Trip Mechanism

1. All fuses must be installed on the fuse carriage so that the end of the fuse which has the blown fuse indicator is on the bottom. The plunger end of the fuse must be facing downward.
2. With the trip bar in its normal spring return (deactivated position), the trip bar should rest against the stop screw on the right hand fuse carriage side plate. The trip bar must be held in this position while performing adjustments 3 and 4.
3. Adjust each of the three plunger assemblies shown in detail 1 of **Figure 18** to obtain a 0.06" (1.6mm) gap between the plunger (10) and the end of the corresponding fuse as follows: Insert a 0.06" (1.6mm) shim between the end of the fuse and the plunger (10). Loosen locknut (50) and turn adjusting screw (13) until there is no gap between stop nut (51) and trip bar (2). Retighten locknut (50).
4. Loosen the machine screw (16) which threads into the pushrod (5) and adjust outward (lengthen) until the microswitch (12) contacts just close. Then adjust outward (lengthen) one additional full turn and tighten the locknut (25).
5. Referring to detail 2 of **Figure 18**, insert a 0.19" (4.8mm) thick shim between one of the three plungers and its fuse, rotating the trip bar in the direction shown. The microswitch contacts should open at this point. If they do not, loosen the locknut and adjust the machine screw until the switch contacts open, then retighten the locknut (25).

Electrical Interlocks
Refer to the "Electrical Interlocks" section in the Series 81000 Controller Instruction Manual, MVC-9068.

⚠DANGER

Hazardous voltages.

Will cause death, serious personal injury, or property damage.

Disconnect, ground, and lockout incoming power and control voltage sources before beginning work on this or any other electrical equipment.

Maintenance should be performed only by qualified personnel.

Electrical Joints and Terminals
Carefully inspect all visible accessible electrical joints and terminals in the bus and wiring system.

1. Retighten bolts and nuts at bus joints if there is any sign of overheating or looseness. Refer to "Recommended Torque Values", **Table 14**.
2. If joints or terminations appear to be badly discolored, corroded or pitted, or show evidence of having been subjected to high temperatures, the parts should be disassembled and cleaned or replaced.
3. Examine all wire or cable connections for evidence of looseness or overheating. Retighten, if necessary. If major discoloration of cable insulation or if cable damage is apparent, replace the damaged portion of the cable.
4. Check torque of the fuse mounting hardware.
5. Examine all joints for plating wear. Replace affected components if the plating is worn through (showing bare copper). Special attention should be paid to the stab fingers under adverse environmental conditions, such as where sulfur dioxide, chlorine, some hydrocarbons or saltwater exist in the atmosphere. Replace if evidence of copper oxide or other films are formed. Use Siemens electrical contact lubricant (part no. 15-171-370-001) to protect the stab finger joint from deterioration. Worn plating on the stabs can result in overheating and may lead to flashover. Plating wear-through can be expected after approximately 1500 racking operations in mild environments, with proper lubrication. If lubrication has been neglected, plating life will be shortened significantly.
6. Examine insulation on conductors for signs of overheating, or indications of chafing against metal edges. These can progress into an insulation failure. Replace any damaged conductors, ensure replacement conductors are braced or shielded if needed to avoid similar damage in future operation.
7. Be sure that any conditions that caused overheating have been corrected.

Periodic Cleaning
Accumulation of dust and foreign material such as coal dust, cement dust, or lamp black must be removed from the controller and all surfaces must be wiped clean at regular intervals. Dust can collect moisture, causing insulation breakdown. Do not use compressed air as it will only redistribute contaminants on other surfaces.

Table 14. Recommended Torque Values

Thread Size	Standard Torque Metal-to-Metal (in-lbs/Nm)	2/3 Standard Torque Metal-to-Insert (in-lbs/Nm)	1/2 Standard Torque Compound-to-Insert (in-lbs/Nm)	1/2 Standard Torque Compound-to-Compound (in-lbs/Nm)
8-32	14-20/1.6-2.3	10-14/1.0-1.6	7-10/0.8-1.2	7-10/0.8-1.2
10-32	20-30/2.3-3.4	13-20/1.6-2.3	10-15/1.2-1.8	10-15/1.2-1.8
1/4-20	40-60/4.5-6.8	26-40/3.2-4.5	20-30/2.3-3.4	20-30/2.3-3.4
5/16-18	168-228/19-25.8	110-150/12.4-17	84-114/9.5-13	84-114/9.5-13
3/8-16	240-360/27-41	160-240/18-27	120-180/13.5-20.5	120-180/13.5-20.5
1/2-13	480-600/54-68	320-400/36-45	240-300/27-34	240-300/27-34

Recommended Torque Values
When making bolted assemblies, the following considerations should be generally followed. The recommended torque is determined by the size of hardware used. Refer to **Table 14**.

1. Metal-to-Metal-Apply standard torque.
2. Metal-to-Insert Molded in Compound Part-Apply approximately 2/3 of standard torque.
3. Compound-to-insert Molded in Compound Part-Apply approximately 1/2 of standard torque.
4. Compound-to-Compound-Apply approximately 1/2 of standard torque.

Vacuum Interrupter Replacement
Contact your Siemens representative if vacuum interrupters need to be replaced.

Maintenance after a Fault has Occurred
Refer to the "Maintenance After a Fault has Occurred" section in the Series 81000 Controller Instruction Manual, MVC-9068.

Troubleshooting
If operating problems are encountered, refer to the "Troubleshooting" section in the Series 81000 Controller Instruction Manual, MVC-9068.

Spare Parts
Representative spare parts are listed in **Table 15**.

Table 15. Spare Parts

Description	Qty Per Controller	Part Number
Magnet Coil Kit-115/230VAC, 125/250VDC	1	25-154-504-013
Auxiliary Contact Block-2NO-3NC-1DNC	1	25-154-504-014
Shunt Lead Kit	3	25-154-504-017
Drive Unit Control Board	1	25-154-504-016
Auxiliary Contact Block (latched contactor only)	1	25-154-504-015
Power Fuse 38R 5kV	3	25-154-275-001
Power Fuse 48X 5kV	3	25-154-275-009
Power Fuse 57X 5kV	3	25-154-275-002
Power Fuse 450E 5kV (for use with blown fuse option)	3	25-154-275-008
Power Fuse 450E 5kV (not for use with blown fuse option)	3	25-154-585-001
Power Fuse 500E 5kV (not for use with blown fuse option)	3	25-154-585-002
Power Fuse 600E 5kV (not for use with blown fuse option)	3	25-154-585-003
CPT Primary Fuse 0.5E 5kV	2	25-131-635-005
CPT Primary Fuse 1E 5kV	2	25-131-635-004
CPT Primary Fuse 2E 5kV	2	25-131-635-001
CPT Primary Fuse 3E 5kV	2	25-131-635-002
CPT Primary Fuse 4E 5kV	2	25-131-635-003
Control Power Transformer 0.75kVA 2300-115V	1	25-213-133-001
Control Power Transformer 0.75kVA 4000-115V	1	25-213-133-013

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