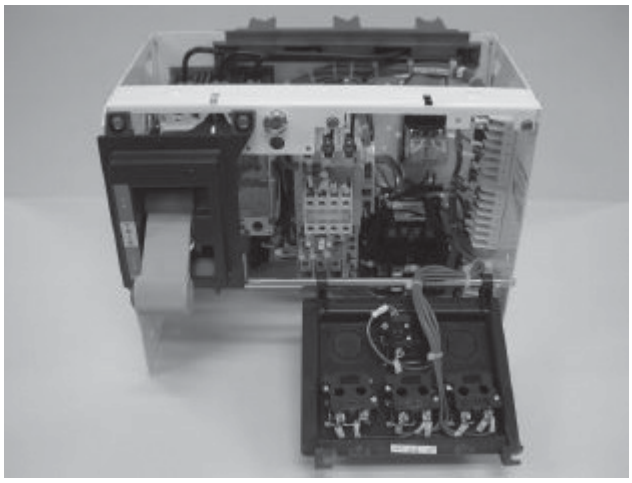

Figure 36. Unit device panel

Installing a new unit

It is recommended that a new unit be installed in a unit space at the top of a vertical compartment or directly below an existing unit. Material provided with the new unit by the factory includes: A divider pan with integral guide rails, a unit door, hinges, catches and hardware. Observe the following sequence of operations for installation.

1. Remove the existing blank door .
2. Position the new unit door over the open space to ensure the hinges and latches are aligned. If the spaces differ, the hinges and latches on the structure must be re-located to match the unit door hinges and latches. Mount the door, using the hinge pins provided.
3. Install the new divider pan in the notches provided in the rear barrier so that it is aligned with the bottom of the new door. Attach the pan to the vertical structure channels with one thread-forming screw on each side.
4. Remove from the vertical bus barrier the flat plate which covers the stab holes that will align with the stabs on the new unit. If an optional labyrinth vertical bus barrier is in place, install an automatic shutter over the stab cutouts. Follow the instruction sheet provided with the shutter kit.

Part 10. Maintenance

Preventive maintenance

Preventive maintenance should be a program, a scheduled periodic action that begins with the installation of the equipment. At that time, specific manufacturer's instruction literature should be consulted, then stored for future reference. Follow-up maintenance should be at regular intervals, as frequently as the severity of duty justifies. Time intervals of one week, or one month, or one year may be appropriate, depending on the duty. It is also desirable to establish specific check lists for each control, as well as a logbook to record the history of incidents. A supply of renewal parts should be obtained and stored.

This control equipment is designed to be installed, operated, and maintained by adequately trained workmen. These instructions do not cover all details, variations, or combinations of the equipment, its storage, delivery, installation, check-out, safe operation, or maintenance. Care must be exercised to comply with local, state, and national regulations, as well as safety practices, for this class of equipment.

Authorized personnel may open a unit door of a motor control center (MCC) while the starter unit is energized. This is accomplished by defeating the mechanical interlock between the operating mechanism and the unit door. A clockwise quarter turn of the slotted head screw located above the operating handle will allow the door to open. See **Figure 37**.

When servicing and adjusting the electrical equipment, refer to the applicable drawings covering the specific motor control center MCC and any other related interconnection drawings. Follow any instructions that may be given for each device. A list of instruction leaflets covering standard components is shown on page 31 of this manual. Any of these leaflets may be obtained by contacting your nearest Eaton representative.

General guidelines—The whole purpose of maintaining electrical equipment can be summarized in two rules:

1. Keep those portions conducting that are intended to be conducting.
2. Keep those portions insulated that are intended to be insulated.

Good conduction requires clean, tight joints, free of contaminants such as dirt and oxides.

Good insulation requires the absence of carbon tracking and the absence of contaminants, such as salt and dust that become hydroscopic and provide an unintended circuit between points of opposite polarity.

Figure 37. Defeater mechanism

⚠ CAUTION

MAINTENANCE OF THE CONTROL COMPONENTS REQUIRES THAT ALL POWER TO THESE COMPONENTS BE TURNED OFF BY OPENING THE BRANCH CIRCUIT DISCONNECT MEANS AND WITHDRAWING THE UNIT TO THE DETENT POSITION (SEE FIGURE 31) OR REMOVING THE UNIT ENTIRELY FROM THE MCC. WHEN UNITS ARE FULLY INSERTED INTO THE MCC, THE LINE SIDE OF EACH DISCONNECT IS ENERGIZED. DO NOT WORK ON FIXED UNITS UNLESS THE MAIN DISCONNECT FOR THE MCC IS OFF.

When working on portions of a branch circuit remote from the MCC, lock the disconnect means for that circuit in the OFF position. To positively lock the operating mechanism in the OFF position, a metal locking bar recessed in the handle may be extended and padlocked with from one to three padlocks. See **Figure 38**.

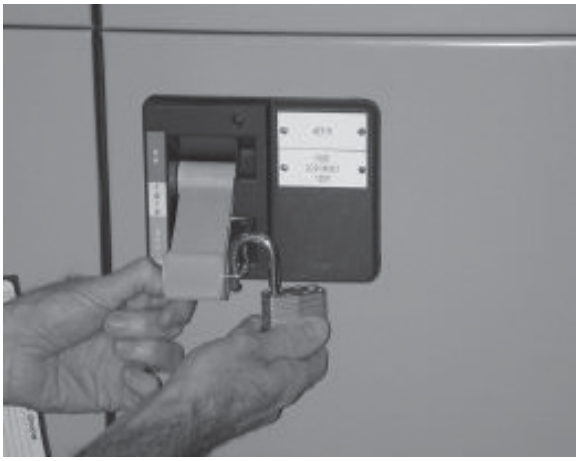

Figure 38. Locking out a disconnect

With the door open and the disconnect device OFF, the operating handle is mechanically interlocked to prevent inadvertently being pushed ON. To defeat this interlock, the bar on the top of the mechanism should be pushed in slightly, allowing the handle to move upward to the ON position.

⚠ WARNING

IF FULLY INSERTED, THE POWER AND CONTROL CIRCUITS WILL BE ENERGIZED. PADLOCKING TO PREVENT THIS HANDLE MOVEMENT MAY BE ACCOMPLISHED BY THE SAME METHOD AS DESCRIBED ABOVE.

Separate control sources of power must also be disconnected. If control power is used during maintenance, take steps to prevent feedback of a hazardous voltage through a control transformer. Be alert to power factor correction capacitors that may be charged. Discharge them before working on any part of the associated power circuit.

Cleaning. Soot, smoke, or stained areas (other than inside arc chutes), or other unusual deposits, should be investigated and the source determined before cleaning is undertaken. Vacuum or wipe clean all exposed surfaces of the control component and the inside of its enclosure. Equipment may be blown clean with compressed air that is dry and free from oil. (Be alert to built-in oilers in factory compressed air lines!) If air blowing techniques are used, remove arc covers from contactors and seal openings to control circuit contacts that are present. It is essential that the foreign debris be removed from the control center, not merely rearranged.

Control equipment should be clean and dry. Remove dust and dirt inside and outside the cabinet without using liquid cleaner. Remove foreign material from the outside top and inside bottom of the enclosure, including hardware and debris, so that future examination will reveal any parts that have fallen off or dropped onto the equipment. If there are liquids spread inside, determine the source and correct by sealing conduit, adding space heaters, or other action as applicable.

Mechanical Checks. Tighten all electrical connections. Look for signs of overheated joints, charred insulation, discolored terminals, and the like. Mechanically clean to a bright finish (don't use emery paper) or replace those terminations that have become discolored. Determine the cause of the loose joint and correct. Be particularly careful with aluminum wire connections. Aluminum wire is best terminated with a crimp type lug that is attached to the control component. When screw type lugs (marked CU/AL) are used with aluminum wire, the joint should be checked for tightness every 200 operations of the device.

Wires and cables should be examined to eliminate any chafing against metal edges caused by vibration, that could progress to an insulation failure. Any temporary wiring should be removed or permanently secured and diagrams marked accordingly.

The intended movement of mechanical parts, such as the armature and contacts of electromechanical contactors, and mechanical interlocks should be checked for freedom of motion and functional operation.

Wrap-up. Check all indicating lamps, mechanical flags, doors, latches, and similar auxiliaries and repair, if required.

Log changes and observations into record book before returning equipment into service. Do not remove any labels or nameplates. Restore any that are damaged.

Contact wear and replacement

Contactors are subject to both mechanical and electrical wear during their operation. In most cases, mechanical wear is insignificant. The erosion of the contacts is due to electrical wear. During arcing, material from each contact is vaporized and blown away from the useful contacting surface.

A critical examination of the appearance of the contact surfaces and a measurement of the remaining contact over-travel will give the user the information required to get the maximum contact life.

Over-travel measurement

Contact life has ended when the over-travel of the contacts has been reduced to 0.02 inch.

Over-travel of the contact assembly is that part of the stroke that the moving contacts would travel after touching the fixed contacts if they were not blocked from movement by the fixed contacts.

A method of measuring over-travel is as follows:

A. Place a 0.02-inch feeler gauge between the armature and magnet, with the armature held tightly against the magnet.

B. Check continually in each phase, i.e., determine if circuit from terminal-to-terminal for each pole is open under these conditions.

C. If there is continuity through all phases, the remaining over-travel is sufficient. If there is not continuity through all phases, replace all stationary and moving contacts plus moving contact over-travel springs. After replacing parts, manually operate contactor to be sure binding does not occur.

Table 12. Contactor troubleshooting chart

Defect	Cause	Remedy
Short contact life	Low contact force	Adjust over-travel, replace contacts, and replace contact springs as required to correct contact force.
	Contact bounce on opening or closing	Correct improper voltage applied to coil. Correct any mechanical defects or misalignment.
	Abrasive dust on contacts	Do not use emery cloth to dress contacts.
	Load current is too high	Reduce load. Use larger contactor.
	Jogging cycle is too severe	Reduce jogging cycle. Check factory for more durable contact material. Use larger contactor.
Overheating	Load current too high	Install arc box.
	Loose connections	Replace broken or eroded insulating parts, arc horns, and grid plates. Clean or replace insulating parts having a heavy coating of foreign conducting material.
	Over-travel and/or contact force too low	Remove contaminating materials that may have accumulated on arc horns and steel-grid plates.
	Ambient temperature is too high	Reduce load. Provide better ventilation. Relocate starter. Use larger contactor.
	Line and/or load cables are too small	Install terminal block and run larger conductors between contactor and terminal block.
Welding of contacts	Over-travel and/or contact force is too low	Adjust over-travel, replace contacts, and replace contact springs as required to correct contact force.
	Magnet armature stalls or hesitates at contact touch point	Correct low voltage at coil terminals as coil draws inrush current.
	Contactor drops open to contact-touch position because of voltage dip	Maintain voltage at coil terminals. Install low voltage protective device, sometimes called "Brownout Protector."
	Excessive contact bounce on closing	Correct coil overvoltage condition.

Maintenance of motor controllers after a fault

Note: Reproduced by permission of the National Electrical Manufacturers Association from NEMA Standards Publication No. ICS2-2000 (R2005), Industrial Control Devices, Controllers and Assemblies, copyright 2000 by NEMA.

In a motor branch circuit that has been properly installed, coordinated, and in service prior to the fault, opening of the branch-circuit short-circuit protective device (fuse, circuit breaker, motor short-circuit protector, and so on) indicates a fault condition in excess of operating overload. This fault condition must be corrected and the necessary repair or replacements made before re-energizing the branch circuit.

It is recommended that the following general procedures be observed by qualified personnel in the inspection and repair of the motor controller involved in the fault.

Procedure

⚠ CAUTION

ALL INSPECTIONS AND TESTS ARE TO BE MADE ON CONTROLLERS AND EQUIPMENT THAT ARE DE-ENERGIZED, DISCONNECTED, AND ISOLATED SO THAT ACCIDENTAL CONTACT CANNOT BE MADE WITH LIVE PARTS AND SO THAT ALL PLANT SAFETY PROCEDURES WILL BE OBSERVED.

Enclosure. Substantial damage to the unit door or frame, such as deformation, displacement of parts, or burning, requires replacement of the entire unit.

Circuit breaker. Examine the unit interior and the circuit breaker for evidence of possible damage. If evidence of damage is not apparent, the breaker may be reset and turned ON. If it is suspected that the circuit breaker has opened several short-circuit faults or if signs of circuit breaker deterioration appear within the enclosure, the circuit breaker should be replaced.

Disconnect switch. The external operating handle of the disconnect switch must be capable of opening the switch. If the handle fails to open the switch or if visual inspection after opening indicates deterioration beyond normal wear and tear, such as overheating, contact blade, or jaw pitting, insulation breakage or charring, the switch must be replaced.

Fuse holders. Deterioration of fuse holders or their insulating mounts requires their replacement.

Terminals and internal conductors. Indications of arcing damage and/or overheating, such as discoloration and melting of insulation, require the replacement of damaged parts.

Contactor. Contacts showing heat damage, displacement of metal, or loss of adequate wear allowance require replacement of the contacts and the contact springs. If deterioration extends beyond the contacts, such as binding in the guides or evidence of insulation damage, the damaged parts or the entire contactor must be replaced.

Overload relays. If burnout of the current element of an overload relay has occurred, the complete overload relay must be replaced. Any indication that an arc has struck and/or any indication of burning of the insulation of the overload relay also requires replacement of the overload relay.

If there is no visual indication of damage that would require replacement of the overload relay, the relay must be electrically or mechanically tripped to verify the proper functioning of the overload relay contact(s).

Return to service. Before returning the controller to service, checks must be made for the tightness of electrical connections and for the absence of short circuits, grounds, and leakage.

All equipment enclosures must be closed and secured before the branch circuit is energized.

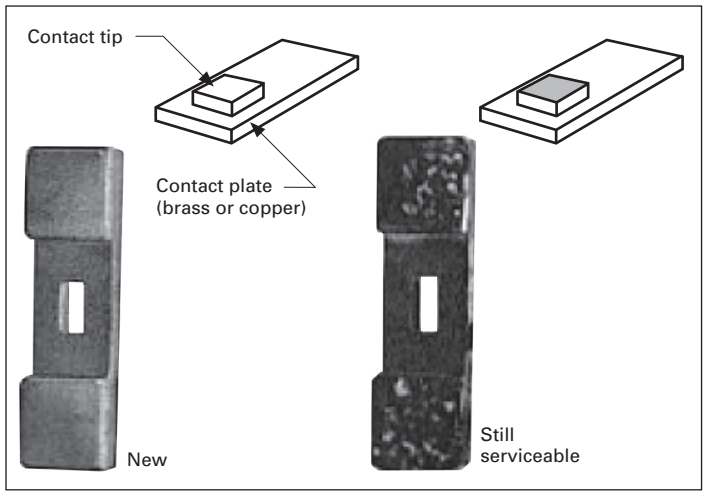

Figure 39. Normal service wear

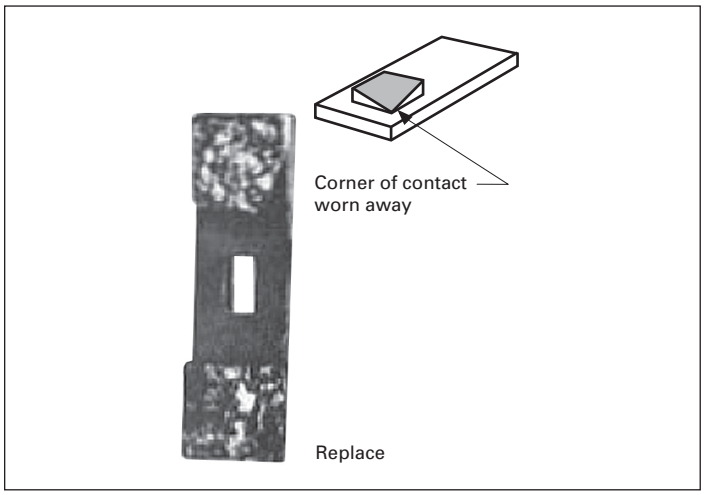

Figure 40. End of service life

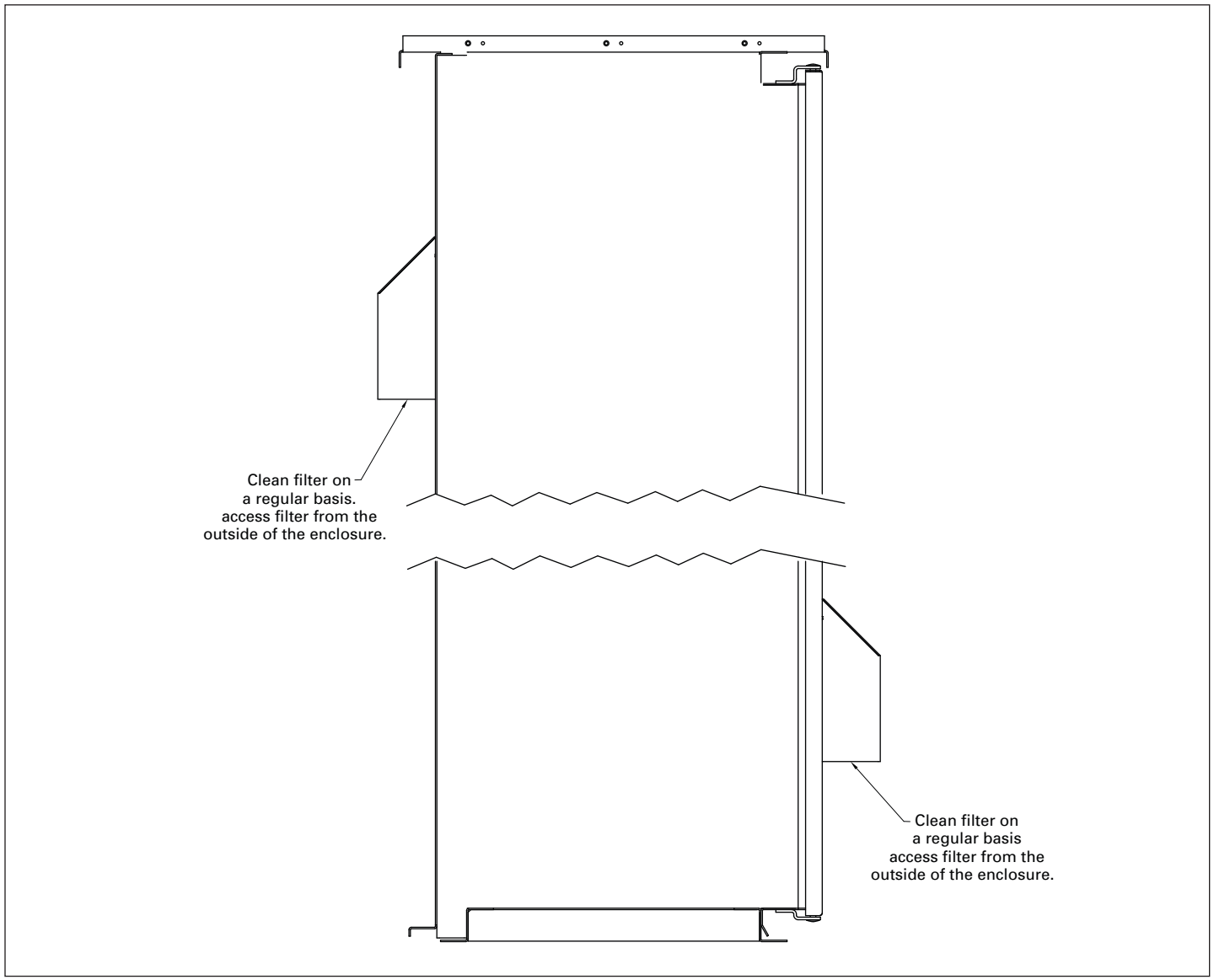

Figure 41. NEMA 3R MCC—all filters require cleaning on regular basis

Table 13. Renewal contact kits, coils, and overload relays

		Part number				
Description	**Coil suffix**	**NEMA Size 1 Series B1**	**NEMA Size 2 Series B1**	**NEMA Size 3**	**NEMA Size 4**	**NEMA Size 5 Series B1**
Renewal parts publication		22177	22177	20426	20428	20429
Contact kits						
Two-pole		6-65	6-65-7	6-43-5	6-44	6-45
Three-pole		6-65-2	6-65-8	6-43-6	6-44-2	6-45-2
Four-pole		6-65-9	6-65-15	—	—	—
Five-pole		6-65-10	6-65-16	—	—	—
Magnet coils						
120 V, 60 Hz or 110 V, 50 Hz	A	9-2703-1	9-2703-1	9-2756-1	9-1891-1	9-1891-1
240 V, 60 Hz or 220 V, 50 Hz	B	9-2703-2	9-2703-2	9-2756-2	9-1891-2	9-1891-2
480 V, 60 Hz or 440 V, 50 Hz	C	9-2703-3	9-2703-3	9-2756-3	9-1891-3	9-1891-3
600 V, 60 Hz or 550 V, 50 Hz	D	9-2703-4	9-2703-4	9-2756-4	9-1891-4	9-1891-4
208 V, 60 Hz	E	9-2703-9	9-2703-9	9-2756-5	9-1891-13	9-1891-13
277 V, 60 Hz	H	9-2703-7	9-2703-7	9-2756-9	9-1891-26	9-1891-26
208/240 V, 60 Hz	J	—	—	—	—	—
240 V, 50 Hz	K	9-2703-14	9-2703-14	9-2756-13	9-1891-20	9-1891-20
380–415 V, 50 Hz	L	9-2703-8	9-2703-8	—	—	—
380 V, 50 Hz	L	—	—	9-2756-12	9-1891-14	9-1891-14
415 V, 50 Hz	M	—	—	9-2756-8	9-1891-21	9-1891-21
550 V, 50 Hz	N	—	—	9-2756-14	9-1891-8	9-1891-8
Overload relays For replacement on existing starters three-pole—ambient-compensated bimetallic		C306GN3B	C306GN3B	C306KN3	C306NN3	C306DN3B

Table 14. Starter type

	Unit catalog number designation (class)		
	Disconnect means		
Description	**Fusible**	**Circuit breaker**	**Circuit breaker with current limiter**
Full voltage, non-reversing	F204	F206	F207
Full voltage, reversing	F214	F216	F217
Reduced voltage, autotransformer type	F604	F606	F607
Reduced voltage, part-winding type	F704	F706	F707
Reduced voltage, closed transition star-delta	F894	F896	F897
Full voltage, non-reversing, two-speed, two windings	F954	F956	F957
Full voltage, non-reversing, two-speed, one winding	F944	F946	F947