Instructions For The Storage, Handling, Installation, And Maintenance Of Industrial Controllers

STORAGE

Electrical control equipment which is to be stored prior to its installation, should be checked before being placed in storage for possible damage during transit. It should then be repacked and stored in a location which is clean and dry.

When storage is in or near buildings under construction, provide covers to protect the equipment against dust, moisture and falling objects.

Apparatus, stored for long periods may corrode. Damage, while stored, will be minimized by maintaining the best possible storage conditions, and by periodically inspecting the equipment and arresting the progress of corrosion and other forms of deterioration which may be found. A small amount of heat will stop corrosion that occurs from moisture due to condensation.

HANDLING

Industrial control equipment often includes instruments, relays, and similar devices which are readily damaged when roughly handled. Because of this, it is important that control equipment be handled with care.

Lift unpacked controllers by lifting angles when provided, and by the frame or enclosure when special lifting devices are not included. Never attempt to lift a control by means of panel mounted switches, contacters, etc.

If practical, the controller should not be unpacked until it is delivered to the plant location where it is to be installed.

Unpacked controllers are more readily damaged while being moved from one point to another than controllers still in the carton.

LOCATION

Motor controllers should be located within plain view of the motor and as close to it as conditions will permit. If possible, locate the controller in a direct line between the power supply and the motor to save cable and to minimize line losses.

INSTALLATION

Industrial controllers are 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.

1. The nameplate ratings of the controller must agree with the power supply and the rating of the load (motor).
2. Controller mounting should be solid to prevent vibration. When the controller is provided with a channel iron base, grout the base in place.
3. Make connections in accordance with the diagrams furnished with the controller. Select 75ºC wire in accordance with the National Electrical Code (NEC) where conductor size is not specified in the instruction material furnished with the controller. For the connections between a DC ammeter shunt and a remotely mounted ammeter, choose a wire size which will give the lead resistance specified on the dial of the ammeter. A remotely mounted ammeter may have a calibrating resistor to compensate for insufficient lead resistance. In this case choose an oversize wire and adjust the calibrating resistor to obtain the correct lead resistance.
4. Before making any connections, be certain that all leads to be handled are dead.
5. Make connections to power leads last.
6. A disconnecting means and short-circuit protection must be installed ahead of the controller, unless they are included as a part of the controller.
7. Fill oil dashpot relays with dashpot oil, and screw dashpots up to the proper calibration setting.
8. With the power off, operate contactors, relays and interlocks by hand to see that they work freely. Mechanical interlocks should prevent the contacts of one contactor from touching while the other contactor is closed.
9. Turn the handles of rheostats throughout their travel to see that the contact arm does not stub in passing over the contacts.
10. See that all terminals and current carrying joints are clean and tight.
11. Before starting, disconnect the motor and check the operating sequence of the controller. Reconnect the motor.
12. Close the circuit to the power supply. If a motor controller has separate switches for the power circuit and for the control circuit, always close the power circuit switch first and the control circuit switch last; this sequence will prevent picking up the contactors and then starting the motor with the disconnect switch.

If a DC motor has both a shunt field and a series field, their polarities should be the same. To check the relative polarities of these two fields, disconnect the shunt field and jog the motor with the series field alone; then reconnect the shunt field and jog the motor again; if the motor jogs in the same direction both times, the relative polarities of the shunt and series fields are correct.

If the controlled motor rotates in the wrong direction, check its field polarity and the power supply polarity or phase rotation to be sure they agree with the diagram. If so, for a DC motor interchange the armature connections A1 and A2. (Do not change the motor internal connection between the brush holder and the commutating field coil.) For a three-phase AC motor, interchange any two of the power connections to the motor. For other AC motors refer to the instructions on the motor nameplate.

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.

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

a. Keep those portions conducting that are intended to be conducting.

b. 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.

Maintenance of control components requires that all power to these components be turned OFF by opening and locking open the branch circuit disconnect device, usually a switch or circuit breaker located in the same enclosure as the control components or in a panel board or switchboard feeding the control enclosure. Separate control sources of power must also be disconnected. If control power is used during maintenance, caution should be used 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 enclosure, 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, etc. 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, joints 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 overtravel will give the user the information required to get the maximum contact life.

OVERTRAVEL MEASUREMENT

Contact life has ended when the overtravel of the contacts has been reduced to .020 inch.

Overtravel of the contact assembly is that part of the stroke which 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 overtravel is as follows:

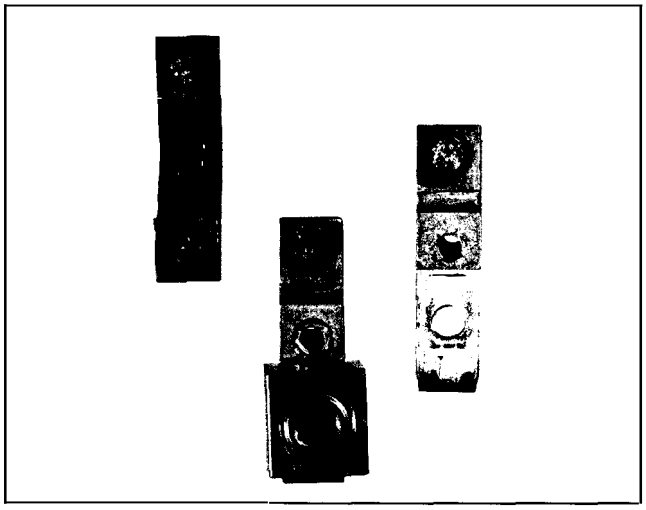

Fig. 1 Normal Service Wear

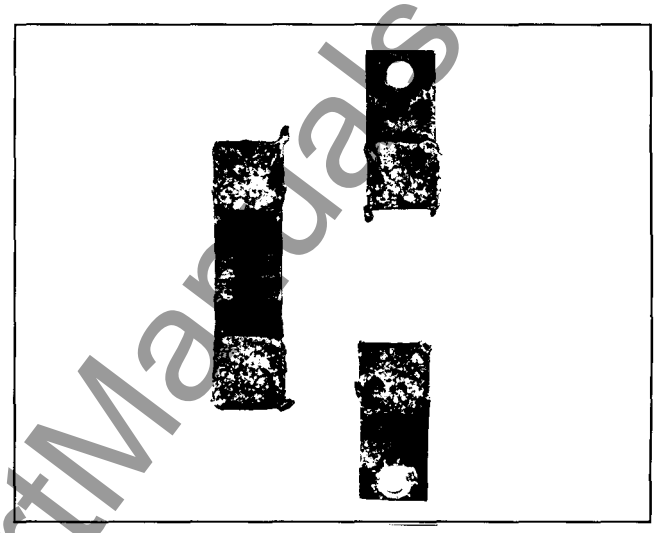

Fig. 2 End of Service Life

CONTACT EVALUATION

Time of Service	Contact Appearance
New	The new contact has a uniform silver color.
Start of Service	The contact surface will have a blue coloring. The geometric form of the contact is unchanged. The sharp outer corners will be rounded with small silver beads. (See Figure 1.)
Intermediate Service to End of Service Life	The coloring changes to brown or black with distributed small silvery white areas. The surface has a finely chiselled appearance. Material transfer causes small peaks and valleys in the contact button surface. (See Figure 2.)

ABNORMAL WEAR CONDITIONS

Contact Appearance	Cause
Curling and Separation of Corner of Contact	Curling is usually a result of service that produces very high heat, as under jogging or inching duty.
Irregular Contour or Slantwise Wear	One corner of a contact may wear more quickly than the other three corners. This wear is normally due to misalignment of the moving and stationary contacts. Contacts should be replaced if it is apparent that one contact is nearly making direct contact with the contact carrier.
Large Beads of Silver on Edges of Contacts	Breaking an excessive current.
Welded Spot (Core of Smooth, Shining Silver Surrounded by a Roughened Halo)	Making an excessive current. High frequency of operation, i.e., jogging.

STORAGE, HANDLING, INSTALLATION, AND MAINTENANCE OF CONTROLLERS

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11-200-6 (1/80)

A. Place a .020 inch feeler gauge between the armature and magnet, with the armature held tightly against the magnet.
B. Check continuity in each phase, i.e., determine if circuit from terminal-to-terminal for each pole is open under these conditions.

CONTACTOR TROUBLESHOOTING CHART

Defect	Cause	Remedy
Overheating	Load current too high	Reduce load. Use larger contactor.
	Loose connections	Clean discolored or dirty connections and retighten. Replace poorly crimped lugs.
	Overtravel and/or contact force too low	Adjust overtravel, replace contacts, and replace contact springs as required to correct defect.
	Collection of copper oxide or foreign matter on copper contact faces	Clean with fine file. Use Type 12 enclosure for dirty atmosphere.
	Load is on in excess of 8 hours on copper contacts	Change operating procedure. Check factory for more suitable contacts.
	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.
Poor arc interruption	Arc box not in place	Install arc box.
	Arc box damaged	Replace broken or eroded insulating parts, arc horns, and grid plates. Clean or replace insulating parts having a heavy coating of foreign conducting material.
	Dirt or paint on arc horns or steel-grid plates	Remove contaminating materials which may have accumulated on arc horns and steel-grid plates.
	Magnetic hardware substituted for non-magnetic hardware in arc box and blowout assemblies	Replace with correct hardware; brass or stainless steel as available.

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

CONTACTOR TROUBLESHOOTING CHART

Defect	Cause	Remedy
Poor Arc Interruption	Blowout coil reversed or shorted	Replace with new blowout coil or correct defect by reversing coil.
	Oil level is low or oil is contaminated (in oil-immersed contactor)	Fill tank to proper level with fresh oil. Test at 28 kV.
Welding of contacts	Overtravel and/or contact force is too low	Adjust overtravel, replace contacts, and replace contact springs as required to correct defect.
	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.
	Contacts rebound to contact-touch position when opening	Correct mechanical defect in in stop assembly. Correct mechanical defect in latch if one is used.
	Poor contact alignment	Adjust contacts to touch simultaneously within 1/32 inch.
	Jogging duty is too severe	Reduce jogging cycle. Check factory for more weld-resistant contact material. Use larger contactor.
	Excessive inrush current	Motor has locked rotor code letter greater than G. Most contactors are designed for motors with code letters A through G. Therefore, use larger contactor. Check factory for more weld-resistant contact material.
	Vibration in starter mounting	Move starter to location having less shock and vibration. Insulate starter from shock and vibration. Provide more rigid support for starter.

CONTACTOR TROUBLESHOOTING CHART

Defect	Cause	Remedy
Short contact life	Low contact force	Adjust overtravel, 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	Use Type 12 enclosure. 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.

MAINTENANCE OF MOTOR CONTROLLERS AFTER A FAULT†

In a motor branch circuit which 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, etc.) indicates a fault condition in excess of operating overload. This fault condition must be corrected and the necessary repairs or replacements made before reenergizing 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 which are deenergized, 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 enclosure such as deformation, displacement of parts or burning, requires replacement of the entire controller.

Circuit breaker. Examine the enclosure 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.

RENEWAL PARTS

When ordering renewal parts, give the complete nameplate reading. Always give the name of the part wanted, also the order or style number of the individual apparatus on which it is to be used, as well as the order or style number of the complete controller.