STD.NEMA ICS 3.1-ENGL 1998 ■ 6470247 0518428 86T ■

NEMA STANDARDS PUBLICATION

ICS 3.1

HANDLING, STORAGE, AND INSTALLATION GUIDE FOR AC GENERAL-PURPOSE MEDIUM VOLTAGE CONTACTORS AND CLASS E CONTROLLERS, 50 AND 60 HERTZ

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HANDLING, STORAGE, AND INSTALLATION GUIDE FOR AC GENERAL-PURPOSE MEDIUM VOLTAGE CONTACTORS AND CLASS E CONTROLLERS, 50 AND 60 HERTZ

Published by

National Electrical Manufacturers Association
1300 North 17th Street, Suite 1847
Rosslyn, Virginia 22209

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Foreword

This publication is a guide containing practical information to the handling, storage, and installation of AC general-purpose medium voltage contactors and Class E controllers. It was prepared by the Medium Voltage Controllers Technical Subcommittee of the NEMA Industrial Automation Control Products and Systems Section. It was approved in accordance with the bylaws of NEMA.

This guide was developed in response to the many questions from the user public and has been developed from the experience of the member companies working with their customers and users. It provides information that will be useful to architects, electrical engineers, electrical contractors, maintenance engineers, and others who are responsible for the installation of this equipment. It is not intended to replace the manufacturer's instructions and does not purport to cover all possible circumstances arising from the handling, storage, and installation of this equipment. Any problems or questions should be discussed with the manufacturer.

NEMA publications are subject to periodic review. Any comments or proposed revisions to this guide should be submitted to:

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Rosslyn, Virginia 22209

This Standards Publication was developed by the Industrial Automation Control Products and Systems Section. Section approval of the standard does not necessarily imply that all section members voted for its approval or participated in its development. At the time it was approved, the Group/Section was composed of the following members:

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Section 1
GENERAL INFORMATION

1.1 SCOPE

These instructions apply to AC medium-voltage contactors and Class E magnetic controllers rated 1501-7200 volts, which are installed in accordance with the National Electrical Code (NEC), NFPA 70 and the manufacturers' instructions. The requirements in ICS 3, Part 2 apply. These instructions are not considered adequate for industrial control equipment intended for use in locations which are designated as hazardous in the National Electrical Code.

1.2 PRECAUTIONS

There is a hazard of electric shock whenever working on or near electrical equipment. All power supplying the equipment should be turned off before starting work, and disconnecting means should be locked out and/or tagged out in accordance with NFPA 70E, Part II. Where it is not feasible to de-energize the system, the following precautions should be taken:

a. Persons working near exposed parts that are or may be energized should be instructed and should use practices (including appropriate apparel, equipment, and tools) in accordance with NFPA 70E, Part II.

b. Persons working on exposed parts that are or may be energized should be qualified persons who have been trained to work on energized circuits.

1.3 RECOMMENDED PROCEDURE

The operation of controllers is dependent upon handling, installation, operation, and maintenance by qualified personnel. Failure to follow fundamental installation and maintenance recommendations could lead to personal injury and damage to the controller and other property.

1.4 REFERENCES

References to the National Electrical Code, shown as NFPA 70 (NEC), refer to NFPA Publication No. 70. Although not specifically referenced, the National Electrical Safety Code, ANSI C2, is also applicable.

Reference to manufacturer, unless otherwise specified, means the controller manufacturer.

1.5 QUALIFIED PERSON

For the purpose of this guide, 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 should have the following qualifications:

a. Trained and authorized to energize, de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices;

b. 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 practices;

c. Trained in rendering first aid;

d. Knowledgeable in the applicable electrical installation code requirements. For instance, in the United States, this includes NFPA 70 (NEC).

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Section 2
HANDLING

2.1 GENERAL

The manufacturer's handling instructions for the specific equipment should be followed. The controller should be handled with care, to avoid damage to components and to the frame or its finish.

The following guidelines are provided to help during handling:

2.1.1 Upright Position

The controller should be kept in an upright position unless otherwise specifically permitted by the manufacturer. If it is received in the horizontal position, the carrier should be notified of possible damage, and the controller should be restored to the vertical position as soon as practical.

2.1.2 Handling Equipment Capability

Medium voltage controllers can be extremely heavy. Moving equipment used in the handling of controllers should be capable of handling the weight of the controller. This capability should be confirmed prior to starting any handling operations with the controller.

2.2 UNPACKING/PACKING

2.2.1 Initial Inspection

When the controller is received, it should be unpacked sufficiently to inspect for concealed damage and to determine that the shipment is complete and correct.

2.2.2 Storage Before Installation

If the controller is to be stored for any length of time, prior to installation, the packing should be restored for protection during that period. Where conditions permit, the packing should be left intact until the controller is at the final installation position. If the packing is removed, the top and openings of the equipment should be covered during the construction period to protect it against dust and debris. See the *Storage* section below for additional storage guidelines.

2.2.3 Shipping Skids

The controller should remain secured to the shipping skid to prevent distortion of the frame and to minimize tipping during handling.

2.3 MOVING

Extreme care should be exercised during any movement and placement operations to prevent dropping or unintentional rolling or tipping.

2.3.1 Rod and Pipe Rollers

Rod or pipe rollers, with the aid of pinch bars, provide a simple method of moving the controller on a level floor. The load should be steadied to prevent tipping.

2.3.2 Forklift

A forklift truck may offer a more convenient method of handling the controller. A safety strap should be used when handling a controller with a forklift. The forks should be inserted under the shipping skid. The metal transom of the controller enclosure may not be capable of supporting the concentrated load on the forks. The ends of the forks should not enter the bottom of an open-bottom enclosure.

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2.3.3 Overhead Hoisting

Where it is necessary to move the controller between elevations, overhead hoisting may be required. Lifting plates and eye-bolts (Figure 1) or channels, angles or bars with lift holes (Figure 2) may be provided as a permanent or removable part of the controller. The following guidelines apply:

a. Spreaders (Figure 1) should be used to provide the vertical lift on eye-bolts required to avoid eye-bolt failure.

b. The rigging lengths should be selected or adjusted to compensate for any unequal distribution of load, and to maintain the controller in an upright position. Some controller interiors may contain heavy equipment, such as transformers mounted within, that could make the center of gravity be considerably off mechanical center.

c. The angle between the lifting cables and vertical should not be allowed to exceed 45 degrees.

d. Ropes or cables should not pass through the lift holes in bars, angles, or channels. Slings with safety hooks or shackles, of adequate load rating, should be used.

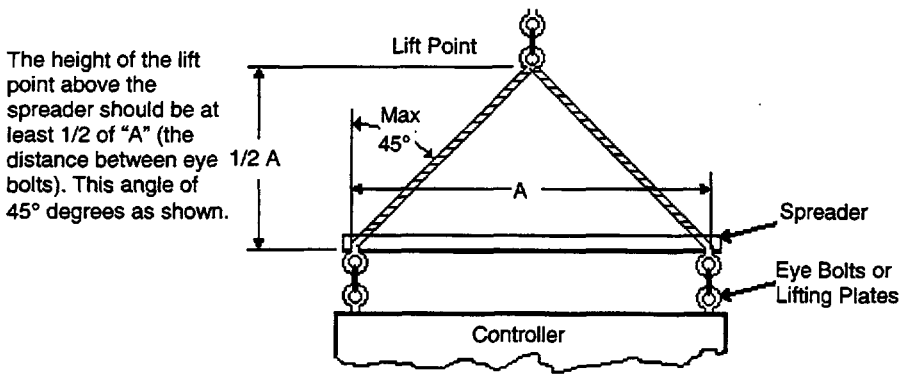


Figure 1
LIFTING WITH EYE-BOLTS OR LIFTING PLATES

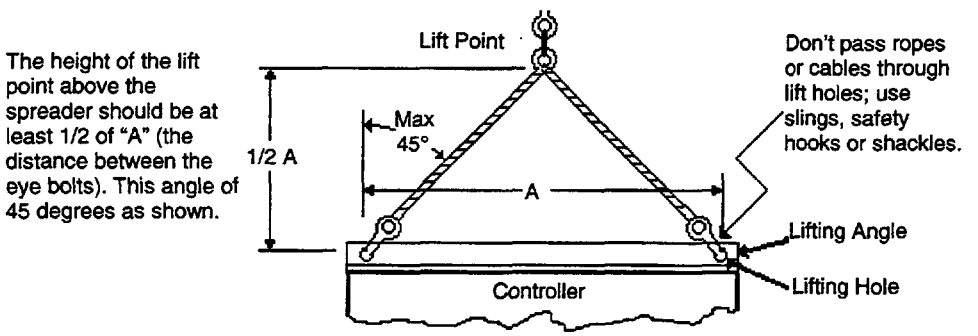


Figure 2
LIFTING WITH INTEGRAL LIFT ANGLE

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Section 3
STORAGE

3.1 CONTROLLERS FOR INDOOR INSTALLATION

A controller intended for indoor installation which is not installed and energized immediately should be stored in a clean dry space where a uniform temperature prevents condensation.

3.1.1 Indoor Storage

Preferably, a controller intended for indoor installation should be stored in a heated building with adequate air circulation and protection from dirt and water. The controller should be stored where it is not subject to mechanical damage, especially during building construction.

3.1.2 Outdoor Storage

A controller intended for indoor installation that is to be stored outdoors should be securely covered for protection from weather conditions and dirt. Temporary electrical heating should be installed to prevent condensation; approximately 150 watts per enclosure is adequate for the average controller size and environment. All loose packing or flammable materials should be removed before energizing space heaters.

3.2 CONTROLLERS FOR OUTDOOR INSTALLATION

An unenergized outdoor controller should be kept dry internally by installing temporary heating, or by energizing self-contained space heaters provided by the manufacturer, if ordered. If conduit or throat connections are not installed promptly, their openings (and any other openings) should be covered to prevent direct entry of rain, etc.

3.3 ROUTINE INSPECTION

Routine scheduled inspections should be performed if the controller is stored for an extended period. This is to check for condensation, dampness, corrosion, vermin, and adequacy of space heating.

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Section 4
INSTALLATION

4.1 GENERAL

The manufacturer's instructions for the specific controller should be located and followed.

The fault capability of the power system at the point of installation should not exceed the short-circuit rating of the controller.

Refer to the *Handling* section above for handling guidelines during moving and installation.

4.2 SITE PREPARATION

It is recommended that site preparation be completed before the controller is unpacked, so that possible problems—such as headroom, conduit location, cable tray locations, ventilation, etc.—can be solved, assuring a safe installation, in compliance with the building plans and codes.

The intended mounting surface should be level so that the controller is not distorted when bolted into place. The overhead should be checked for plumbing condensation, sprinklers, or similar possible sources of trouble, and corrective steps should be taken where necessary.

Adequate grounding connections should be established in accordance with the manufacturer's recommendations and applicable code requirements.

4.3 PHYSICAL CLEARANCE CONSIDERATIONS

The following items are offered for guidance only. Additional clearances may be required by the applicable installation codes.

4.3.1 Rear Access Required

If rear access is required to work on deenergized parts, a minimum 30 inch clearance (77 cm), or as specified by the manufacturer, should be provided.

4.3.2 Rear Access Not Required

Where rear access is not required, the clearance between the rear of the controller and a wall should be at least 0.5 inch (1.3 cm) for indoor equipment and 6 inches (16 cm) for outdoor equipment.

4.3.3 Front Access Working Space

A minimum working space should be allowed in front of the controller of 36 inches (92 cm) for 2500 volts to ground maximum and 48 inches (122 cm) for maximum 7200 volts to ground. These minimums should be increased if it is necessary to accommodate movement around open enclosure doors or to comply with applicable codes.

4.4 NORMAL SERVICE CONDITIONS

See clause 6 of ICS 1 for normal service conditions.

4.5 UNUSUAL SERVICE CONDITIONS

Unless the controller has been specified and designed for unusual service conditions, it should not be exposed to abnormal ambient temperatures, abnormal altitudes, corrosive or explosive fumes, dust, vapors, dripping or standing water, abnormal vibration or seismic conditions, shock, tilting, or other unusual operating conditions.

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4.5.1 Heat Generation

If the controller includes or is located near significant heat-generating components, such as large power resistors, sufficient ventilation should be provided to maintain an ambient air temperature around the enclosure no higher than the rating of the equipment.

4.5.2 Damp Locations

If the location for installation is damp, space heaters may be required. If provided by the manufacturer, they should be connected as specified by the manufacturer.

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Section 5
CONDUCTORS

5.1 PHYSICAL CONSIDERATIONS

Cable and wire bundles that enter the control enclosure should be routed to avoid interference with moving parts of the controller.

Minimum recommended bending radius for each particular cable should be observed.

Power cables should be braced and laced to withstand short-circuit forces, particularly when such cables span over 18 inches (46 cm) between supports.

5.2 ELECTRICAL CONSIDERATIONS

Power cables should be adequate to carry the load current shown on the ratings nameplate and should have an adequate voltage rating.

Cables should be dressed and terminated as appropriate for the voltage class and manufacturer's recommendations.

Adequate electrical clearance between energized parts and to ground should be allowed.

5.3 BUS INTERCONNECTION LINKS

If power buses or ground buses are supplied with links for interconnection between sections, they should be installed as specified by the manufacturer. All access covers that are temporarily removed during installation should be replaced.

NOTE—Covers that may be supplied only for protection during shipment should not be replaced.

5.4 CLEANUP DURING INSTALLATION

All debris and tools should be removed from each compartment as installation of cabling and conductors is completed.

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Section 6
GROUNDING

6.1 GENERAL

Grounding of the controller should be carefully executed to make certain that the actual ground is that which was intended. Special attention should be paid to protection for operating personnel, to protection of equipment itself (e.g., ground-fault relays), and to protection of sensitive transducers or control devices that are electronic in nature. The following may be used as a general guide with regard to metallic grounding:

6.2 CONTROLLER USED AS SERVICE ENTRANCE EQUIPMENT FOR A GROUNDED SYSTEM OR AS A MAIN SECTION FOR A SEPARATELY DERIVED SYSTEM

6.2.1 Grounding Electrode Conductor

A grounding electrode conductor (ground wire), sized in accordance with applicable installation codes, should be run from the grounding electrode to the controller ground bus or ground terminal designated by the manufacturer.

6.2.2 Main Bonding Jumper

Unless installed by the manufacturer, a main bonding jumper, sized in accordance with applicable installation codes, should be installed from the incoming grounded conductor bus (neutral) to the ground bus or at a location designated by the manufacturer.

6.2.3 Ground Interconnection

The steps described in the above two paragraphs should effectively connect together the grounding electrode, the controller frame, all outgoing equipment grounding conductors, and the grounded neutral bus of the system (on the supply side of any disconnecting line).

6.2.4 Ungrounded Sections

No connection should be made to ground on the load side of any neutral disconnecting line or any sensor used for ground fault protection. No connections should be made between outgoing grounding conductors and the neutral.

6.2.5 Dual-Fed with Ground-Fault Protection

Where the controller or system is dual-fed (double-ended) and has ground-fault protection, special precautions are necessary to accomplish proper grounding and bonding. The manufacturer's instructions should be followed.

6.3 CONTROLLER USED AS SERVICE ENTRANCE EQUIPMENT FOR AN UNGROUNDED SYSTEM OR AS A MAIN SECTION FOR A SEPARATELY DERIVED SYSTEM

6.3.1 Grounding Electrode Conductor

A grounding electrode conductor (ground wire), sized in accordance with applicable installation codes, should be run from the grounding electrode to the controller ground bus or ground terminal designated by the manufacturer.

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6.3.2 Ground Ahead of Motor Control

Where the system is grounded at any point ahead of the controller, the grounded conductor, sized in accordance with applicable installation codes, should be run to the controller and connected to the ground bus or to the controller frame and equipment grounding terminal designated by the manufacturer.

6.3.3 Ground Interconnection

The steps described in the above two paragraphs should effectively connect together the grounding electrode, the controller frame, all outgoing equipment grounding conductors and any grounded conductors, and any grounded conductor which runs to the controller.

6.4 CONTROLLER NOT USED AS SERVICE ENTRANCE EQUIPMENT NOR AS A MAIN SECTION FOR A SEPARATELY DERIVED SYSTEM—FOR A GROUNDED OR UNGROUNDED SYSTEM

6.4.1 Grounding Conductors

The controller frame and any ground bus should be grounded by means of equipment grounding conductors, sized in accordance with applicable installation codes, and run with the main supply conductors or by bonding to the raceway enclosing the main supply conductors

6.4.2 Ground Leads

Ground leads should be connected to cable potheads and shields as specified by the manufacturer.

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Section 7
INSPECTION PRIOR TO INITIAL ENERGIZATION

Prior to energizing the controller for the first time, it should be inspected. In all circumstances, the manufacturer's instructions should be the primary guide.

7.1 REMOVE SHORTING BARS

Shorting bars should be removed from the secondary of current transformers once their load is connected. A current transformer should not be operated with its secondary circuit open.

7.2 REMOVE TEMPORARY SHIPPING BLOCKING

All blocks or other temporary holding means used for shipment should be removed from all component devices in the controller.

7.3 BUS MOUNTING INTEGRITY

The integrity of all bus mounting means should be checked to insure they are secure.

7.4 CONNECTIONS

7.4.1 Phase Rotation

Each load should be connected to its intended controller, and, if applicable, and phase rotation should be checked.

7.4.2 Wiring Diagram Agreement

All circuits should be compared for agreement with the wiring diagrams which accompany the controller.

7.4.3 Wiring Clearances

Field wiring should be checked for clearance and, where necessary, physically secured to withstand the effects of fault current.

7.4.4 Ground

All grounding connections should be checked. If there is no ground bus, the sections of the controller which are shipped separately should be connected in such a way as to assure a continuous grounding path.

7.5 POSSIBLE DAMAGE

7.5.1 Internal Devices

All internal devices should be checked for damage. All necessary repairs or replacements should be made.

7.5.2 Enclosure

The enclosure should be checked to see that it has not been damaged so as to reduce electrical spacings.

7.5.3 Warning signs

Any warning signs should not be removed, covered over, or obscured by paint.

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7.6 OPERATING MECHANISMS

7.6.1 Manually Operated Mechanisms

All switches and other operating mechanisms should be manually exercised to make certain that they are properly aligned and operate freely. Operating mechanisms, such as interlocks, key switches, etc., should be checked for function as intended for protection of personnel and equipment.

7.6.2 Electrically Operated Mechanisms

With all loads disconnected from power, all electrically operated switches, contactors, and other mechanisms should be exercised to determine that the devices operate properly. An auxiliary source of control power may be necessary to provide power to the electrical operators. If so, caution is required.

7.7 GROUND-FAULT PROTECTION SYSTEM

The ground-fault protection system (if furnished) should be tested in accordance with the manufacturer's instructions.

7.8 ADJUSTABLE CURRENT AND VOLTAGE TRIP MECHANISMS

The setting of any adjustable current and voltage trip mechanisms should be verified to the proper values. Damage from faults can be reduced if the devices used for short-circuit and ground-fault protection are set or chosen to operate at values as close to normal as feasible, while allowing for expected transients.

7.9 OVERLOAD RELAYS

Overload relays should be installed, selected, and adjusted for the full-load current shown on the nameplate of each motor or load rating and the control manufacturer's instructions. Power circuit fuses should be in accordance with the application requirements. Make sure that fuses are completely inserted in their holders.

7.10 REMOVABLE PERMANENT PARTS AND BARRIERS

To prevent possible damage to equipment or injury to personnel, all parts and barriers that may have been removed during wiring and installation should be checked that they have been properly reinstalled.

7.11 CLEANING

Before closing the enclosure, all metal chips, scrap wire, and other debris from the controller should be removed. If there is appreciable accumulation of dust or dirt, the controller should be cleaned by using a brush, vacuum cleaner, or clean, lint-free rags. *Compressed air should not be used because it will redistribute contaminant on other surfaces.*

7.12 ELECTRICAL INSULATION TEST

An electrical insulation test should be performed to make sure that the controller and field wiring are free from short-circuits and grounds. This should be done phase-to-ground, phase-to-phase, and phase-to-neutral with the switches or contactors opened. Disconnect any devices which have limited dielectric strength and are not designed for this test. A transformer, coil, or similar device normally connected between lines of opposite polarity shall be disconnected from one side of the line during tests between terminals of opposite polarity.

7.13 ENCLOSURE

Care should be exercised that when covers are installed, doors closed, etc., no wires are pinched and all enclosure parts are properly aligned and tightened.

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Section 8
INITIAL ENERGIZATION OF EQUIPMENT

8.1 GENERAL

Energizing a controller for the first time is potentially dangerous. Therefore, only qualified personnel should energize the equipment. If faults caused by damage or poor installation practices have not been detected in the inspection procedure described above, serious damage or personal injury can result when the power is turned on.

8.2 DANGER

Initial start up of medium voltage equipment presents a high risk of electrical burns or electrocution if any part of the equipment is improperly installed or the equipment is operated outside the specified limits. Safety procedures prescribed by the manufacturer, local and national safety codes, and practices typically taught and followed by professionals trained in medium voltage equipment must be followed.

8.3 CONTACTORS AND SWITCHES

All contactors and switches should be in the off position before energizing the bus.

8.4 LOADS

In order to minimize risk of injury or damage, or both, there should be no load on the controller when it is energized, unless the manufacturer specifies otherwise. All of the downstream loads, including those such as distribution equipment and other devices which are remote from the controller, should be turned off.

8.5 ENERGIZATION SEQUENCE

The equipment should be energized in sequence by starting at the source end of the system and working towards the load end: first the main devices, then the feeder devices, and then the branch circuit devices. With barriers (if applicable) in place and unit doors closed and latched, the devices should be turned on with firm positive motion. Protective devices and switches that are not quick-acting should not be "teased" into the closed or open position.

8.6 INDIVIDUAL LOADS AFTER DISCONNECT DEVICE CLOSURE

After all disconnect devices have been closed, loads may be energized.

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Section 9
MAINTENANCE AND USE

9.1 RECORDS

Instruction leaflets and diagrams should be collected and filed for future use. Any changes made to the circuit diagrams should be recorded.

9.2 SPARE PARTS

A supply of spare parts, fuses, etc. should be established.

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