NEMA Standards Publication ICS 18-2001

Motor Control Centers

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Foreword

This Standards Publication was prepared by a technical committee of the NEMA Industrial Automation Control Products and Systems Section. It was approved in accordance with the bylaws of NEMA and supersedes the indicated NEMA Standards Publication. This Standards Publication supersedes, Parts 2 & 3 of ICS 3-*1993: Factory Built Assemblies*. ICS 3-1993, Part 1: *Motor Control Centers Rated Not More Than 600 Volts AC* has been published as a separate Standards Publication.

This Standards Publication provides practical information concerning ratings, construction, test, performance and manufacture of industrial control equipment. These standards are used by the electrical industry to provide guidelines for the manufacture and proper application of reliable products and equipment and to promote the benefits of repetitive manufacturing and widespread product availability.

NEMA Standards represent the result of many years of research, investigation and experience by the members of NEMA, its predecessors, its Sections and Committees. They have been developed through continuing consultation among manufacturers, users and national engineering societies and have resulted in improved serviceability of electrical products with economies to manufacturers and users.

One of the primary purposes of this Standards Publication is to encourage the production of reliable control equipment which, in itself, functions in accordance with these accepted standards. Some portions of these standards, such as electrical spacings and interrupting ratings, have a direct bearing on safety; almost all of the items in this publication, when applied properly, contribute to safety in one way or another.

Properly constructed industrial control equipment is, however, only one factor in minimizing the hazards which may be associated with the use of electricity. The reduction of hazard involves the joint efforts of the various equipment manufacturers, the system designer, the installer and the user. Information is provided herein to assist users and others in the proper selection of control equipment.

The industrial control manufacturer has limited or no control over the following factors which are vital to a safe installation:

a. Environmental conditions
b. System design
c. Equipment selection and application
d. Installation
e. Operating practices
f. Maintenance

This publication is not intended to instruct the user of control equipment with regard to these factors except insofar as suitable equipment to meet needs can be recognized in this publication and some application guidance is given.

This Standards Publication is necessarily confined to defining the construction requirements for industrial control equipment and to providing recommendations for proper selection for use under normal or certain specific conditions. Since any piece of industrial control equipment can be installed, operated and maintained in such a manner that hazardous conditions may result,

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conformance with this publication does not by itself assure a safe installation. When, however, equipment conforming with these standards is properly selected and is installed in accordance with the National Electrical Code and properly maintained, the hazards to persons and property will be reduced.

To continue to serve the best interests of users of Industrial Control and Systems equipment, the Industrial Control and Systems Section is actively cooperating with other standardization organizations in the development of simple and more universal metrology practices. In this publication, the U.S. customary units are gradually being supplemented by those of the modernized metric system known as the International Systems of Units (SI). This transition involves no changes in standard dimensions, tolerances, or performance specifications.

NEMA Standards Publications are subject to periodic review. They are revised frequently to reflect user input and to meet changing conditions and technical progress. Proposed revisions to this Standards Publication should be submitted to:

Vice President, Engineering Department
National Electrical Manufacturers Association
1300 North 17th Street, Suite 1847
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 Section was composed of the following members:

ABB Control, Inc.—Wichita Falls, TX
Alstom Power Conversion—Pittsburgh, PA
Automatic Switch Company—Florham Park, NJ
Balluff, Inc.—Florence, KY
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CMC Torque Converters—Billerica, MA
Control Concepts Corp—Beaver, PA
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Motor Control Centers

1 GENERAL

1.1 Referenced Standards

In this NEMA Standards Publication reference is made to the standards listed below. Copies are available from the indicated sources.

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

ICS 1-2000	*Industrial Control and Systems General Requirements*
ICS 1.3-1986 (2001)	*Preventive Maintenance of Industrial Control and Systems Equipment*
ICS 2-2000	Industrial Control & Systems: *Controllers, Contactors and Overload Relays*
ICS 2.3-1995	Industrial Control & Systems: *Controllers, Instructions for the Handling Installation, Operation, and Maintenance of Motor Control Centers*
ICS 6-1993 (R2001)	Industrial Control and Systems: *Enclosures*
NEMA 250-1997	*Enclosures for Electrical Equipment (1000 volts maximum)*

Underwriters Laboratories
333 Pfingsten Road
Northbrook, IL 60062

UL 845 (1998)	*Motor Control Centers*

American National Standards Institute
11 West 42nd Street
New York, NY 10036

ANSI C62.2-1987	Guide for Application of Gapped, Silicon-Carbide Lightning Arresters for Alternating Current Systems

Institute of Electrical and Electronics Engineers
345 East 47th Street
New York. NY 10017

IEEE C37.09-1999	Test Procedure For AC High-voltage Circuit Breaker Rated on a Symmetrical Current Basis
IEEE C37.26-1972	Methods of Power-Factor Measurements for Low-Voltage Inductive Test Circuits
IEEE 141-1993	Recommended Practice for Electric Power Distribution for Industrial Plants
IEEE 4-1995	Techniques for High-Voltage Testing
IEEE 100-2000	*Standard Dictionary of Electrical and Electronic Terms*

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1.2 Scope

The standards in this part apply to three phase 50 and 60 hertz motor control centers rated not more than 600 volts AC.

1.3 Normative References

The definitions and standards of NEMA Standards Publication No. 250, ICS 1, ICS 6, and portions of ICS 2 also apply to this part.

1.4 Equipment

A motor control center may contain any combination of equipment such as the following:

a) Full-voltage reversing or non-reversing combination motor-control units

b) Full-voltage multispeed combination motor-control units

c) Reduced-voltage part-winding, wye-delta or auto-transformer combination motor-control units

d) Solid-state industrial controllers such as adjustable-speed drives, programmable controllers, protective relays, etc.

e) Lighting or distribution panelboards

f) Feeder-tap units

g) Incoming-line equipment, such as main lugs, fusible switch, isolation switch, or air circuit breaker

h) Control or lighting transformers

i) Special equipment assemblies

The foregoing equipment may contain such items as pushbuttons, selector switches, indicating lights, control transformers, control circuit fuses, and auxiliary contacts incorporated as an integral part of the above units.

2 DEFINITIONS

For the purposes of this part, the following definitions apply:

blank unit space: Unit space not equipped to accept a future unit.

combination motor-control unit: A control unit that includes an externally operable circuit disconnecting means, motor branch-circuit overcurrent protection and a motor controller with associated auxiliary devices when used.

The disconnecting means and motor branch-circuit overcurrent protection consist of a fusible disconnecting device or circuit breaker. If the latter is used, it is either an inverse time (thermal-magnetic or dual magnetic) or an instantaneous magnetic-trip-only circuit breaker.

The motor controller includes motor overload protection unless equivalent protection is otherwise provided.

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Two sets of externally operable circuit disconnecting means, each with branch-circuit overcurrent protection and magnetic motor controller, may be mounted in a single compartment to form a dual unit.

custom drawings (motor control centers): Manufacturer's drawings made to meet user custom requirements.

feeder-tap unit: A unit that includes an externally operable circuit disconnecting means and branch-circuit overcurrent protection, principally used for nonmotor loads.

Two sets of externally operable circuit means, each with branch-circuit overcurrent protection, may be mounted in a single compartment to form a dual unit.

future unit space: Unit space specified and equipped to accept a future unit.

motor control center: A floor-mounted assembly of one or more enclosed vertical sections typically having a horizontal common power bus and principally containing combination motor-control units.

These units are mounted one above the other in the vertical sections. The sections normally incorporate vertical buses connected to the common power bus, thus extending the common power supply to the individual units. Power may be supplied to the individual units by bus bar connections, by stab connection, or by suitable wiring.

standard drawings (motor control centers): Arrangement drawings and wiring diagrams prepared. using manufacturer's standard drawing sizes, device symbols, and identification and numbering designation.

unusable unit space: Unit space not suitable to accept a future unit.

3 CLASSIFICATIONS

3.1 Classes and Types

Motor control centers are provided as either Class I or Class II assemblies. Each class may be supplied with standard or custom drawings. Motor control centers are factory wired as either Type A, B, or C.

3.2 Classes of Motor Control Centers

Motor control centers shall be provided as either Class I or Class II assemblies. With either class the user may specify the physical arrangement of units within the motor control center subject to the design parameters of the manufacturer.

Equipment described in 3.2.1 and 3.2.2 shall be supplied with the manufacturer's standard drawings and shall be designated as Class I or Class II, as selected by the user.

Equipment described in paragraph 3.2.3 shall be supplied with the manufacturer's custom drawings and shall be designated as Class I-S or Class II-S, as selected by the purchaser.

3.2.1 Class I-Independent Units

Class I motor control centers shall consist of mechanical groupings of combination motor-control units, feeder-tap units, other units and electrical devices arranged in a convenient assembly. The manufacturer shall famish drawings that include:

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a) Overall dimensions of the motor control center, identification of units and their location in the motor control center, locations of incoming line terminals, mounting dimensions, available conduit entrance areas, and the location of the master terminal board if required (Type C wiring only)

b) Manufacturer's standard diagrams for individual units, and master terminal, boards (Type C wiring only), consisting of drawings that:

1. Identify electrical devices

2. Indicate electrical connections

3. Indicate terminal numbering designations

NOTE-Where a combination schematic or wiring diagram, or both. for a unit is supplied showing optional devices, the manufacturer shall provide information to indicate which devices are actually furnished.

3.2.2 Class II-Interconnected Units

Class II motor control centers shall be the same as Class I motor control centers except with the addition of manufacturer-furnished electrical interlocking and wiring between units as specifically described in overall control system diagrams supplied by the user.

In addition to the drawings furnished for Class I motor control centers, the manufacturer shall furnish drawings that indicate factory interconnections within the motor control center.

3.2.3 Class I-S & II-S-Motor Control Centers with Custom Drawing Requirements

Class I-S and II-S motor control centers shall be the same as Class I and H motor control centers except custom drawings shall be provided in lieu of standard drawings as specified by the user.
Examples of custom drawings are:

a) Special identifications for electrical devices

b) Special terminal numbering designations

c) Special sizes of drawings

The drawings supplied by the manufacturer shall convey the same information as drawings provided with Class I and II motor control centers, additionally modified as specified by the user.

3.3 Circuit Wiring

All circuit components within each unit shall be factory wired.

3.3.1 Types of Wiring

3.3.1.1 Type A Wiring

With Type A wiring user field wiring connects directly to device terminals internal to the unit. Type A wiring shall be provided only on Class I motor control centers.

3.3.1.2 Type B Wiring

Type B user (field) load wiring for combination motor-control units Size 3 and smaller shall be designated as Type B-D or B-T, according to the following:

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a) For Type B-D, the user connects directly to the device terminals, which are located immediately adjacent, and readily accessible, to the vertical wireway.

b) For Type B-T, the user connects to a load terminal block in, or adjacent to, the unit.

With Type B load wiring for combination motor-control units larger than Size 3, and for feeder-tap units, the user connects directly to unit device terminals.

With Type B control wiring the user connects to unit terminal blocks located in or adjacent to each combination motor-control unit.

3.3.1.3 Type C Wiring

With Type C wiring user (field) control wiring connects to master terminal blocks mounted at the top or bottom of those vertical sections that contain combination motor-control units or control assemblies. Combination motor-control units and control assemblies shall be factory wired to their master terminal blocks.

With Type C wiring, load wiring for combination motor-control units Size 3 and smaller connects to master terminal blocks mounted at the top or bottom of vertical sections. Motor-control unit load wiring for these units shall be factory wired to the master terminal blocks.

With Type C wiring, load wiring for combination motor-control units larger than Size 3, and for feeder-tap units, the user connects directly to unit device terminals.

4 CHARACTERISTICS AND RATINGS

4.1 Voltage Ratings

Motor control center voltage ratings shall be in accordance with ICS 1 and ICS 2. The rated voltage is the voltage to which the performance characteristics of motor control centers are related.

4.2 Combination Motor-Control Unit Ratings

The ratings of magnetic motor controllers of the combination motor control units shall be in accordance with Part 2 of ICS 2.

4.3 Continuous-Current Ratings of Buses

The horizontal common power bus shall have a continuous-current rating of 600, 800, 1000, 1200 amperes or higher as required by a particular application. Vertical bus extensions installed in a section shall have a minimum continuous-current rating of 300 amperes.

4.4 Basis for Short-Circuit Current Rating of Motor Control Centers

4.4.1 Available Short-Circuit Current

The available short-circuit current is the short-circuit current available at the motor control center line terminals plus motor contribution. The available short-circuit current shall be expressed in rms symmetrical amperes.

4.4.1.1 Short-Circuit Current Rating

Unless a current limiting means is used in a series combination (as defined in 4.4.3) with a motor control center, the short-circuit current rating shall be the lowest of the following:

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a) The short-circuit current rating of the bus structure

b) The lowest short-circuit current rating of any installed combination motor control unit

c) The short-circuit current rating of any installed feeder tap unit.

4.4.2 Series Combination Rating

A series combination short-circuit rating is a higher short-circuit current rating, obtained by adding an internal or external current-limiting means in series with a lower-rated motor-control center.

Table 1-4-1
SHORT-CIRCUIT CURRENT RATINGS

RMS Symmetrical Amperes	
5,000	30,000
7,500	35,000
10,000	42,000
14,000	50,000
18,000	65,000
22,000	85,000
25,000	100,000

Examples of current-limiting means include current-limiting circuit breakers, current-limiting fuses, and current-limiting reactors.

The series combination rating shall not exceed the rating of the current-limiting device and shall be selected from Table 14-1.

For motor control centers with short-circuit current ratings over 100,000 amperes, a current-limiting means limiting the current to 100,000 amperes or less is recommended.

4.5 Standard Short-Circuit Ratings of Motor Control Centers

4.5.1 Ratings of Combination Motor-Control Unit and Feeder-Tap Units

Each combination motor-control unit and feeder-tap unit of a motor control center shall have a short-circuit current rating. The rating shall be selected from Table 1-4-1.

A combination motor-control unit shall be permitted to have a short-circuit rating greater than the short-circuit current rating of any individual component as determined by design tests.

4.5.2 Units Not Containing a Short-Circuit Protective Device

A unit not containing any short-circuit protective device shall not be connected directly to the power bus (with the exception of lightning and surge arresters) and shall not be assigned a unit short-circuit current rating.

Absence of a short-circuit current rating on such a unit does not affect the short-circuit current rating of the motor control center.

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4.5.3 Separately Derived Systems

Motor control centers short-circuit current rating are not affected by units connected to a separately derived system in a motor control center.

Table 1-4-2
BUS STRUCTURE SHORT-CIRCUIT CURRENT RATINGS

rms Symmetrical Amperes	
22,000	65,000
25,000	85,000
42,000	100,000
50,000	--

The short-circuit current rating for such a unit should be appropriate for the short-circuit current capacity of the separately derived system

4.5.4 Rating of Bus Structure

The bus structure (horizontal and vertical bus) of a motor control center shall have a short-circuit current rating. The rating shall be selected from Table 1-4-2.

All short-circuit current ratings shall be based upon the test procedures, performance, and criteria described in 8.3.

4.6 Range of Operating Voltage

The range of operating voltage of a control center shall be in accordance with Part I of ICS 2.

5 PRODUCT MARKING, INSTALLATION, AND MAINTENANCE INFORMATION

5.1 Preventative Maintenance

See NEMA Standards Publication ICS 1.3 for general preventative maintenance instructions.

5.2 Handling, Installation, Operation and Maintenance

See NEMA Standard Publication ICS 2.3 for recommended procedures in handling, installing, operating and maintaining motor control centers.

5.3 Marking and Labeling

5.3.1 Units

A motor-control unit shall be marked with the following information, as applicable:
a) Manufacturer's identity

b) Required power supply (voltage, phase, frequency)

c) Load (any of- HP, Amps, kW, kVA, kvar)

d) Short-circuit current rating expressed in rms symmetrical amperes. A unit subject to the conditions in 4.5.2 a) shall be marked N/A

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e) Wiring diagrams or tables, or their location in the motor control center

f) Service disconnect

5.3.2 Section(s)

A motor control center (when all sections are of similar construction) or each motor, control center section (when the sections are not of similar construction) shall be marked with the following information, if applicable:

a) Manufacturer's identity

b) Required power supply (voltage, phase, frequency)

c) Horizontal and vertical bus ampacity

d) Short-circuit current rating expressed in rms symmetrical amperes

e) Enclosure type

f) Suitability to serve as service equipment

5.3.3 Marking Exception

Motor control center sections not containing power bus or power cabling shall be marked with a short-circuit rating of N/A.

6 SERVICE AND STORAGE CONDITIONS

Clause 6 of ICS 1 applies.

7 CONSTRUCTION

7.1 Vertical Section

The function of a vertical section is to support the vertical and horizontal buses, the units, the doors and covers. Nominal installed height is 90 inches (2.29 m), excluding floor sills or mounting channels.

A vertical section is self-supporting when properly bolted to the floor or otherwise secured. These sections may be assembled into a group to which additional sections may be readily added.

7.2 Wiring Space

Within each section there shall be space for horizontal wiring between vertical sections at the top or bottom, or both. There shall be vertical wiring space within each section for wiring to the units.

7.3 Unit Mounting

Provision shall be made so that each combination motor-control unit and feeder-tap unit may be readily removed as a unit for rearrangement, replacement or repair. Exceptions are permitted where the size or weight of the unit makes its removal impracticable.

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Unit doors shall be hinged and attached either to the vertical section or to the unit. Where the door is mounted on the unit, removal of the unit shall not leave the bus so exposed that accidental contact with it is likely.

7.4 Interlocking of Doors

Access to each combination motor-control unit or feeder tap unit shall be provided by a single separate hinged door, interlocked with its associated disconnecting device so that the door cannot be opened without first opening the disconnecting device.

Where two sets of circuit disconnecting means are mounted in a single compartment to form a dual feeder tap unit, each disconnecting device shall be interlocked with its associated door. Provision shall be made for locking the disconnecting device in the open position when the door is closed.

Where required by the particular application, a deactivating means (defeater) shall be provided to permit entry into the enclosure when the disconnecting device is closed.

7.5 Spacings

Spacings of bare bus bars of the horizontal common power bus and of the bus extensions in the vertical sections, including stabs or bolted connectors, shall provide the following minimum clearances:

a) To parts of opposite polarity through air–1 inch (25.4 mm)

b) Between live parts and ground through air or across surfaces –1 inch (25.4 mm)

c) To parts of opposite polarity across surfaces–2 inches (50.8 mm)

Spacings within units shall be in accordance with the basic requirements for industrial control equipment for the rated voltage. (See Clause 7 of ICS 1.)

7.6 Control Circuit Protection

a) Control circuits shall be protected in accordance with Clause 7 of ICS 1.

b) A control circuit supplied by a source separate from the unit shall be considered to be an external source for purposes of overcurrent protection.

7.7 Lighting Panel and Auxiliary Control Panel Protection

Lighting panels and auxiliary control panels, where connected directly to the common power bus, shall include, or be protected by, protective devices having interrupting ratings not less than the available short-circuit current at the protective device location in the circuit.

Where these panels are supplied from transformers in the motor control center, the transformer primaries shall be protected for not less than the short-circuit rating of the motor control center. Those panels connected to the secondary of such transformers shall be protected for not less than the maximum available short-circuit current of the transformer.

8 PERFORMANCE REQUIREMENTS AND TESTS

8.1 Design Test Concept

Design tests are those tests made to determine the adequacy of the design of a particular type, style, or model of motor control center to meet its assigned ratings and to operate satisfactorily under normal

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service application conditions or under special conditions, if specified. Design tests are made only on representative motor control centers to substantiate the ratings assigned and are not contemplated in normal production.

8.2 Test Methods

All design tests shall be made by the manufacturer using a three-phase power supply for the tests specified in 8.3 and 8.4.

8.3 Horizontal Common Power Bus and Vertical Bus Extension Short-Circuit Withstand Test

8.3.1 Tests

Short-circuit current tests shall be conducted in accordance with the procedures and requirements of UL 845, on both the horizontal bus structure and vertical bus structure.

Each motor control center section shall have a short-circuit rating expressed in maximum rms symmetrical amperes and maximum voltage.

8.3.2 Performance Criteria

Performance shall be acceptable if the motor control center complies with the requirements in UL 845.

Criteria for acceptable performance may be summarized as follows.

a) There is no permanent dislocation of the bus bars or cable that would affect the normal functioning of the assembly.

b) There is no distortion of the vertical buses that would impair normal insertion of a unit.

c) There is no cracking or breaking of an insulating base that would impair the support of live parts.

d) The ground fuse is not opened.

e) There is no damage due to arcing.

f) Stab-in assemblies (if used) and vertical buses at the point of contact are in essentially the same mechanical and electrical condition as before the test.

g) The enclosure or a part of the enclosure has not been damaged or displaced to the extent that a live part is accessible.

h) There is no dielectric breakdown between live parts of opposite polarity and between live parts and the enclosure.

8.4 Combination Motor-Control Units and Feeder-Tap Units Short-Circuit Interrupting Tests

8.4.1 Tests

Short-circuit current tests shall be conducted to verify the compatibility of the overcurrent devices and other involved components such as stab-in assembly line-side wiring, enclosure, door or cover and load-side terminals. The short-circuit tests shall be conducted in accordance with the procedures and requirements of UL 845.

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Each combination motor-control unit and each feeder-tap unit shall have a short-circuit rating expressed in maximum rms symmetrical amperes and maximum voltage.

8.4.2 Performance Criteria

Performance shall be acceptable if the combination motor-control unit or feeder-tap unit complies with the requirements of UL 845.

Criteria for acceptable performance may be summarized as follows.

a) There is no dielectric breakdown at the unit disconnect and the fault current is interrupted by the branch-circuit protective device.

b) There is no discharge of parts outside the unit.

There is no damage to a conductor or terminal connector and the conductor has not pulled out of the terminal connector.

The unit door or cover has not blown open and the operating mechanism for the disconnect and the door interlocks shall permit the opening of the door.

The disconnecting means is capable of being opened manually with normal operation of the operating handle.

Stab-in assemblies (if used) and vertical buses at the point of contact are in essentially the same mechanical and electrical condition as before the test.

8.4.3 Location of Units

Units shall be tested while installed in a motor control center section in a location as close as practicable to the motor control center incoming line terminals.

8.4.4 Unit Fault Connection

The fault connection shall be made at the load terminals of the unit. It shall consist of three insulated conductors, each not more than 4 feet (1.22 meters) long and with ampacity appropriate for the maximum horsepower or maximum current rating of the unit.

8.4.5 Enclosure Ground Circuit

The unit enclosure shall be solidly connected to the test circuit conductor which supplies the center pole (L2) of the unit.

8.4.6 Test Voltage and Frequency

Units shall be tested at the three-phase 60 hertz rated voltage of the motor control center in which they are to be applied. The test voltage shall be determined at the line terminals of the motor control center by measuring the open-circuit line-to-line voltage immediately before the test.

8.4.7 Test Current

The available short-circuit current at the line terminals of the motor control center in which the unit is tested shall be not less than the short-circuit current rating of the motor control center in which the unit is to be applied.

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8.4.8 Test Circuit Calibration

The available rms symmetrical short-circuit current shall be determined by measuring the current with the motor control center line terminals short-circuited. The current shall be determined at an instant one-half cycle at 60 hertz after the short circuit occurs and shall be calculated per ANSI C37.09. The test circuit power factor shall be in accordance with Table 1-8- 1.

Table 1-8-1
TEST CIRCUIT POWER FACTOR

Short-Circuit Current Rating rms Symmetrical Amperes	Maximum Power Factor, Percent
10,000	50
14,000	30
22,000 and above	20

Resistance and reactance components of the test circuits shall not be connected in parallel, except that an air-core reactor in any phase may be shunted by resistance in which the voltampere loss is approximately 0.6 percent of the reactive voltamperes of the air-core reactor in that phase.

8.4.9 Test Duty Cycle

Each combination motor-control unit tested shall have one open (O) test. The unit disconnecting means and controller contactor shall be closed prior to the test. The operating coil of the contactor shall be energized from a separate source.

Each feeder-tap unit shall have one open (O) test. The disconnecting means shall be closed prior to the test.

Short-circuit current shall be initiated by random closing of the test circuit.

8.4.10 Performance Criteria

After completion of the short-circuit test, the condition of the unit shall be as follows:

a) The fault current shall have been interrupted by the unit branch-circuit protective device.

b) Immediately following the short-circuit test, the unit shall withstand a dielectric test of twice rated voltage at 60 hertz for 1 minute on the line side of the disconnecting means from line to line and from each line to ground. In this test, circuit breakers shall be left in the tripped position and fusible disconnect devices shall be left closed with the fuses left in their holders.

c) In a fusible disconnect device, contact welding is acceptable if normal operation of the operating mechanism will break the weld.

d) A combination motor-control unit or feeder-tap unit may require repair or replacement.

e) The operating mechanism for the disconnect device and the door interlocks shall permit opening of the door.

f) Stab-in assemblies (when employed) and vertical buses at the point of contact shall be in essentially the same mechanical and electrical condition as before the test.

g) The unit door must remain closed in its normal position and shall operate normally.

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Table 1-8-2
ALLOWABLE TEMPERATURE RISE

	Degrees of Temperature Rise
a. Horizontal bus	65°C (117°F)
b. Vertical bus, at the location of the first plug-in connector from the horizontal bus	50°C (90°F)
c. Plug-in connector to the vertical bus	50°C (90°F)
d. Unit field terminals unmarked	50°C (90°F)
e. Unit field terminals marked for use with 75°C wire	65°C (117°F)

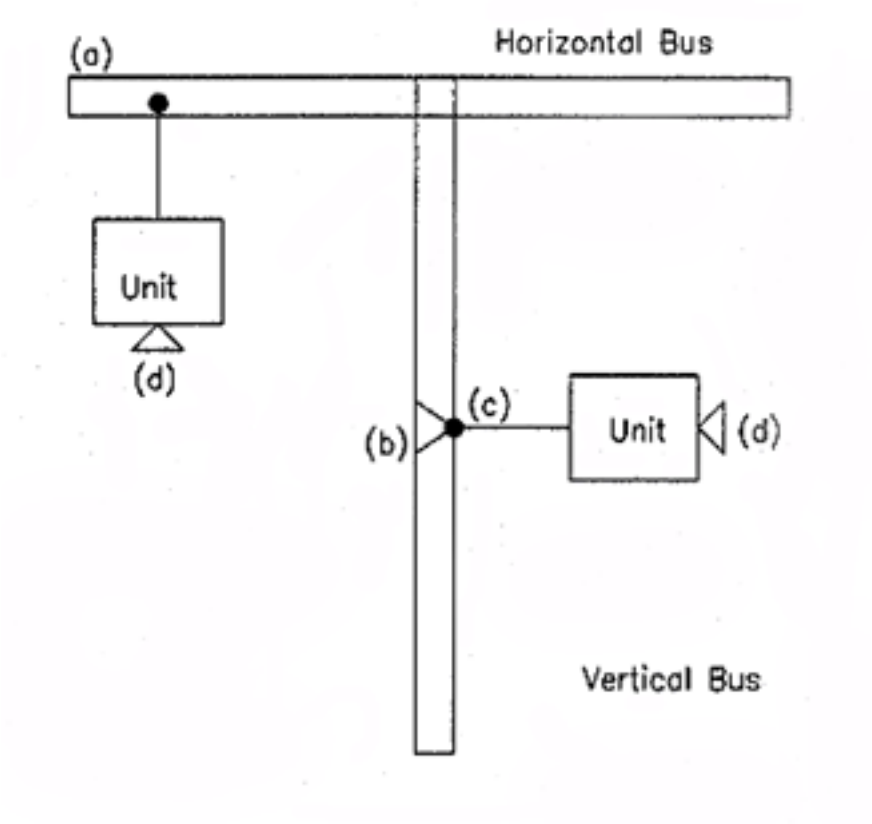


Figure 1-8-1
TEMPERATURE RISE TEST

8.5 Temperature Rise Test

The temperature rise above ambient of current carrying parts shall not exceed the values stated in Table 1-8-2 when tested in accordance with LTL-845, as indicated in Figure 1-8-1.

9 APPLICATION

9.1 Technical Information Needed to Supply a Motor Control Center

The technical information furnished to the motor control center supplier should include the following, as applicable.

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a) Rating of power supply

b) Voltage

c) Frequency

d) Number of Phases

e) Horizontal and vertical bus rating in amperes

f) Available fault current at the line terminals of the control center in rms symmetrical amperes

g) Size, type (aluminum or copper), number and location of incoming cables, or busway

h) Enclosure:

1) Type
2) Accessibility (front or rear, or both)
3) Clearance for door swing
4) Restriction on height
5) Requirements for bottom plates

i) Types of combination motor-control units, feeder-tap units, main disconnect devices, etc., to be coordinated with step a

j) Service entrance requirements per local codes, utilities, etc., for incoming line section

k) Class and type of motor control center

l) Preferred layout of units

m) Special features

9.2 Application of Short-Circuit Current Ratings

The motor control center short-circuit current rating shall be the maximum available rms symmetrical current in amperes permissible at its line terminals. It shall be computed as the sum of the short-circuit current contributions of the motors connected to the motor control center and the maximum available current, including all other short-circuit current contributions of the supply system at the point of connection to the motor control center.

Some simplified methods of determining available short-circuit currents treat all contributions to short-circuit current as due to motors and concentrated at the transformer terminals.

The maximum available current is taken as the sum of the maximum available current of the transformer and a motor contribution based on the transformer continuous-current rating.

Such methods are not consistently applicable for motor control center installations. Under some conditions, as where the installation involves relatively long or high-impedance (possibly current-limiting) feeders, those methods may be unsafe. In such instances, the short-circuit current within the control centers may exceed the predicted value because the short-circuit current contributions of the motors connected to the control center are not diminished by the feeder impedance, as contemplated by the method.

In all circumstances, the maximum available current at the line terminals of the motor control center should be computed as the sum of the maximum available current of the system at the point of connection

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and the short-circuit current contribution of the motors connected to the control center. (In the absence of more precise information, it is usual to assume that the short-circuit contribution of these motors equals four times the continuous current rating of the motor control center.) The current thus determined must not exceed the short-circuit rating of the motor control center.

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