low voltage motor control center

MNS-MCC Non-Arc Resistant / Arc Resistant / Intelligent

ANSI / UL845

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# General Information

This specification defines the requirements for low voltage motor control centers utilizing ABB MNS-MCC Low Voltage Motor Control Centers as shown on the contract drawings shall be furnished and installed by the contractor.

## Standards

Equipment shall be designed, manufactured and tested in accordance with the most current applicable version of the following:

1. UL 845 – Low Voltage Motor Control Centers
2. CSA C22.2 – Canadian Standard Assemblies
3. NOM NMXJ353 – Official Mexican Norms
4. UL 489 – Molded Case Circuit Breakers
5. UL 1066 – Low Voltage AC and DC Power Circuit Breakers used in Enclosures
6. National Electrical Code
7. Canadian Electrical Code
8. NEMA ICS-1 – Industrial Control and Systems General Requirements
9. NEMA ICS-2.2 – Industrial Control and Systems: Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated not more than 600 Volts
10. NEMA ICS-18 - Motor Control Centers
11. [Motor Control Centers rated for arc resistance shall be provided and tested according to the IEEE C37.20.7-2007 “IEEE Guide for Testing Metal Enclosed Switchgear Rated up to 38 kV for Internal Arcing Faults.” MCCs shall be provided with documentation and labeling indicating equipment is rated for these applications. ]

## Submittals

Product Data: Submit manufacturer’s printed product data.  
Submittal Drawings for Approval:

1. Table of Contents for the drawings package
2. Elevations drawings including Front / Top / Bottom / Side Views and General Notes
3. Estimated shipping weights and dimensions
4. One Line Diagram for showing basic electrical power diagram
5. Component / Unit information for tabulating a schedule of unit ratings and options.
6. Elementary for unit control and power schematic
7. Installation and Maintenance Manual

## Qualifications

1. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
2. The manufacturer of this equipment shall be ISO 9001, 14001 and 18001 certified.
3. The manufacturer shall provide Seismic tested equipment that complies with the following standards:
   1. IBC-2018, CBC-2019, IEEE 693-2005: High
   2. AC156, “Shake-Table Testing for Nonstructural Components and Systems”
   3. ASCE / SEI 7-05, “Minimum Design Loads for Buildings and Other Structures”

## Shipment, Storage and Handling

Equipment shall be properly packed for shipment, handled at site and stored in accordance with the manufacturer’s instructions in the MCC Installation and Maintenance Manual. One (1) copy of the MCC Installation and Maintenance Manual shall be provided at time of shipment.

# Product

## Manufacturer

1. The motor control centers shall be ABB, product name MNS-MCC
2. Additions to the existing MCC’s shall be the same as the original manufacturer.

## Ratings

1. Voltage – Unless shown differently on the drawings, the MCC shall be rated for a 480VAC or 600VAC, 3-wire and 4-wire systems.
2. Short Circuit Withstand Rating – 480V MCC shall be rated for [42,000] [65,000] [100,000] RMS symmetrical amperes. [600V MCC shall be rated for [25,000] [42,000] [65,000] [100,000 fusible, non-Arc Resistant] RMS symmetrical amperes]

## Structure

1. The enclosure shall be a NEMA 1 [1A (gasketed general purpose)] enclosure.
2. The structure shall provide a rigid platform based on a C-channel design comprised of 12- and 14-gauge Aluzinc steel. The components of the framework shall be secured by self-tapping screws which require little or no maintenance.
3. MCC rated for arc resistance shall:
   1. Provide Type 2 Accessibility (front, sides and rear) as defined by IEEE C37.20.7-2007 ‘IEEE Guide for Testing Metal-enclosed Switchgear Rated up to 38 kV for Internal Arcing Faults
   2. Deliver 65,000A at 480V for a full 100msec with no upstream protective device
4. Each section shall be equipped with removable rear and side panels secured with threaded screws.
5. Full height barriers shall be provided to isolate each vertical section.
6. Removable end plates on each end of the MCC shall cover all horizontal bus and horizontal wireway openings.
7. Four roof-mounted lifting eyes shall be provided for each section.
8. Vertical sections shall be 90.5” (2300mm) high excluding lifting eyes, 19.7” (500 mm) wide and 19.7” (500 mm) deep. The widths for incoming main sections shall be either of 19.7”, 23.6”, 27.6”, 31.5”, or 39.4” as required.
9. Structures shall allow a maximum quantity of 6 -12” units or 12 - 6” units per vertical section.
10. Removable 14-gauge top [and bottom] plates shall be provided for top conduit entry/exit. [MCC rated for arc resistance shall have flaps located directly over the section of the bucket compartments only and shall not impede conduit / cable entry into the vertical wireway.]
11. No rear access shall be required to remove any internal control components.
12. MNS finish system is based on the duplex finish system, this finish system consists on powder coat paint over hot dip galvanized protection.  
    Steel parts shall be prepared for painting by a four-stage wash system consisting of:
    1. Degreasing process
    2. Fresh water rinse
    3. Zinc phosphate immersion
    4. Fresh water rinse
13. Following the wash system all steel parts are dried in an oven. After cleaning and drying, the steel parts are coated with a minimum 3.0 mils dry film thickness of light gray Interpon polyester powder, followed by a 15-minute curing process. The paint shall have a salt spray rating according to ASTM B117-07a of 1500 hours. Paint finish color shall be textured ANSI # 61 light gray.
14. Each enclosure shall contain an engraved stainless-steel nameplate with white background and black lettering located on the top of the vertical wireway door.
15. Handling
    1. The lineup shall be divided into shipping splits. The maximum shipping length shall not exceed 60” (1524 mm). Any lineup that is in excess of 60” (1524 mm) shall be divided into shipping splits accordingly.
    2. Each MCC shall be provided with adequate lifting eyes.
    3. A removable shipping base shall be provided with every shipping split.

## Wireways

1. Each 19.7” structure shall contain a 4” wide vertical wireway with an option for an 8” wide wireway. The vertical wireway depth shall be 11.5” providing 40.25 square inches of cross-sectional area for control and load wiring. The wireway shall be isolated from the main bus compartment by use of suitable barriers.
2. Each vertical wireway shall be equipped with a window over the bus splices to allow for visual inspection and ease of routine maintenance.
3. Each wireway shall be equipped with a 14-gauge full height hinged door securely fastened with three steel quarter-turn latches. The vertical wireway doors shall swing open 105 degrees opposite of the unit doors for maximum accessibility.
4. Each vertical wireway shall contain field-wiring terminals for power and control. Terminal block assembly must be finger safe rated and meet IP20.
5. The top horizontal wireway shall be 10” high. The top horizontal wireway shall be covered by a 14-gauge steel hinged door secured by a steel quarter turn latch.
6. The bottom horizontal wireway shall be 7” high. The bottom wireway shall contain the ground bus and be covered by a 14-gauge steel hinged door secured by a steel quarter turn latch.

## Bussing

1. The main horizontal bus shall be rated at [800] [1200] [1600] [2000] [2500] [3200] [4000] amperes; 3200A and 4000A NEMA-1 only.
2. The horizontal bus shall be mounted in the rear portion of the MCC.
3. All power bussing shall be braced to withstand a fault current of [42,000] [65,000] [100,000] RMS symmetrical amperes at 480V or [25,000] [42,000] [65,000] [100,000 fusible, non-arc resistant] RMS symmetrical amperes at 600V
4. [MCCs rated for arc resistance bus shall be braced to withstand a fault current up to 65,000 RMS symmetrical amperes at up to 600V and shall not require the use of upstream protection or an arc sensing device to achieve arc resistance, no exceptions].
5. The horizontal bus shall be [tin] [silver] plated copper; aluminum bussing not acceptable. [MCCs rated for arc resistance shall be provided with an insulated horizontal bus. The horizontal bus joints shall be covered by an insulating cover]
6. The main horizontal bus bar shall be sectionalized, allowing shipping splits to be separated.
7. Horizontal bus splice connections shall be made with grade 5 hardware at each connection point. All connecting hardware shall be designed to be tightened from the front of the MCC without applying any tools to the rear of the connection.
8. The horizontal bus shall be completely isolated from the front of the section using barriers and the vertical distribution bus bar wall (multifunction separator).
9. The horizontal bus shall be connected to the adjacent section by means of shipping split splice bar kits. The splice kits are provided on the left side of each section and front accessible through the front side of the vertical wireway. The bus splice kits shall be secured by grade 5 hardware.
10. The horizontal-to-vertical bus connects shall be maintenance-free by utilizing a liquid thread-lock epoxy.
11. The standard vertical bussing shall be rated 800A minimum, no exceptions; optional 1600 amperes shall be available.
12. Vertical bussing shall be silver plated copper.
13. The standard vertical bus shall be arranged in between the main bus bar and the equipment compartment of the panel. The standard vertical bus bar shall be embedded in an insulated, non-flammable, and no hygroscopic wall known as “multifunction separator.” The multifunction separator shall be used as a barrier between the bus bar and cable compartment, preventing personnel from accidental and unintentional contact with the vertical bus bars offering a touch-proof design (IP20).
    1. Barriers which rely on moving parts (shutters) shall not be acceptable.
14. All bus bar ratings are to be based on a maximum temperature rise of 65°C over a 40°C ambient temperature.
15. A bottom-located bare copper ground bus shall be provided that runs the width of each MCC section and is connected to adjacent sections with bus splice kits. The ground bus shall be 1 3/16” x 3/8” (40mm x 10mm) and be rated for 400 [600] amps. The ground bus shall be provided with several 0.4-inch holes in each section to accept ground lugs. Steel ground bus is not acceptable.

## Removable ‘SafeT Connect’ MCC Units

1. Removable MCC units shall be use for NEMA Size 00 to NEMA Size 5 starters; for 6” high (480V only) to 48” high units.
2. Removable units shall be 14-gauge sheet steel.
3. Removable units provided in MCCs rated for arc resistance shall have reinforced door locks and have been tested to provide additional rigidity and support in the event of an internal arc fault.
4. Removable units shall be provided with an integral front hinged door securely fastened by a steel quarter-turn key latch. Unit doors attached to the structure are not acceptable. The door shall be provided with two lifting handles for removal and installation.
5. Removable units 24” and larger shall be equipped with hinged side handles for ease of installation and removal.
6. Removable units, sized from NEMA Size 00 to NEMA Size 5, shall consist of a bottom plate, guide rails, and the sheet metal sidewall with outgoing control circuit connections.
7. The front door shall be designed to allow mounting of pilot devices and measuring/indicating instruments as specified.
8. Removable units shall be equipped with a five-position rotary handle mechanism for breaker units that is used for electrical as well as mechanical interlocking. The following positions shall be available as follows:
   1. ON: The unit is inserted, main is closed, main and control circuit is connected
   2. OFF: The unit is inserted, main is open, main and control circuit is disconnected, padlocking is possible
   3. TRIP (breaker only): The unit is inserted, the main has tripped, and main circuit and control circuit are disconnected.
   4. MOVE: The unit may be completely withdrawn from the motor control center.
   5. TEST: The unit disconnect is open but a remote-control power source may be connected to externally power the control circuit for test purposes.
9. Removable units to be equipped with a physically ISOLATED position where all power and control circuits are disconnected. ISOLATED position shall have padlock to prevent the unit from being inserted or fully withdrawn from structure when padlock is installed. Unit to provide physical indication when in ISOLATED position.
10. Removable unit shall be equipped with a guiding wheel on the bottom of each unit used for mechanical interlocking.
11. Removable units shall contain 300Vac/10A control terminal pull-apart connections. Standard 12-point terminal blocks shall be used. Optional 24 and 28 terminal blocks shall be available. Terminal block connections must be finger safe rated and meet IP20.
12. No tools shall be required to remove the unit
13. Steel wheels shall be provided on the shelf located beneath the unit. These wheels shall allow ease of installation and removal of the unit.
14. Unit guide rails shall be provided on the lower left side of each unit in the structure. This guiderail shall ensure proper stab alignment between the unit power stabs that insert into the multifunction separator.
15. Power stabs from the unit to the multifunction separator vertical bus shall be shrouded between phases.
16. All motor and control wiring shall be terminated in the vertical wireway allowing removal of the unit from the structure without the use of any tools. All wiring shall remain intact for insertion or removal of the unit.
17. Standard unit grounding shall be provided by means of the structure frame.
18. Opening of the unit door to remove the unit shall not be necessary.
19. A unit identification nameplate shall be provided for each unit.
20. Each removable unit shall be identified with a location numbering nameplate on either of the two handles in front of the unit or on both. The location numbering nameplate shall identify what section the unit corresponds to followed by a sequential number and then by a letter identifying the position in the vertical structure. All letter identifiers shall run from top to bottom.

## Full Height Units

1. Full section units shall accommodate large main units, variable frequency drives (VFD), soft starters and NEMA Size 6 and 7 starters. Each full height unit shall be provided with a full height hinged door securely fastened by minimum (3) quarter-turn fastener latches.
2. Full height units shall connect directly to the horizontal distribution bars by means of bus bars. Cabled connections are not acceptable.
3. All components within a full height unit shall be mounted on steel plates securely fastened by self-tapping screws to the frame.

## Disconnects

1. Main Disconnects
   1. If no overcurrent protection is indicated, a main incoming lug compartment shall be provided.
   2. Main circuit breaker disconnects (if specified in drawings)
      1. The circuit breaker shall be sized as shown on the drawings.
      2. For circuit breakers less than 1200A an ABB electronic trip molded case circuit breaker may be used.
      3. Air circuit breakers type ABB Emax 2 shall be used for amperages 1200A and above.
2. Feeders
   1. Feeder disconnects shall be ABB thermal-magnetic circuit breakers
   2. The minimum frame size shall be 100 Amps
3. Across the line NEMA starters and soft starters
   1. The disconnecting means for the across the line starters shall be an ABB magnetic only circuit breaker or [thermal-magnetic] circuit breaker. All disconnects shall include finger safe isolation to prevent exposure to primary voltage when the disconnect is in the OFF position.
   2. The short circuit withstand rating shall be rated 100kA.
   3. All disconnects shall include finger safe isolation to prevent exposure to primary voltage when the disconnect is in the OFF position.
4. Variable Frequency Drives
   1. The disconnecting means for the variable frequency drives shall be an ABB [thermal-magnetic] motor circuit protector.
   2. The short circuit withstand rating shall be rated 100kA.
   3. All disconnects shall include finger safe isolation to prevent exposure to primary voltage when the disconnect is in the OFF position.

## Combination NEMA rated across the line starters

1. Starters shall be provided with a NEMA rated ABB AF series contactor; application rated starters are not acceptable.
2. Overload Protection – Electronic
   1. The overload protection shall be ABB type EF (electronic overload), trip class 10, 20, 30.
   2. Overload reset buttons from the front of the unit door shall be available via a cable-actuated plunger.
   3. Electronic overloads shall be able to be close coupled with the AF series contactor. The overload shall have a selectable reset (manual or automatic), trip indication, stop button, current setting dial, isolated alarm contact.
3. Overload Protection – Solid State Universal Motor Controller
   1. The overload protection shall be ABB type UMC100.3, trip classes 5, 10, 20, 30, and 40 and provide comprehensive motor protection including phase failure detection, adjustable motor protection for stalled motors during startup or normal operation, configurable current limits to generate trips and warnings.
   2. The solid-state overload shall;
      1. Provide integrated thermistor motor protection (PTC)
      2. Provide integrated Ground Fault detection with an optional zero sequence CT.
      3. Provide a minimum of 6 digital input and 3 relay outputs (24VDC) up to 14 digital inputs and 9 outputs with expansion modules
      4. Provide power (power factor and energy) and voltage-based protection functions with voltage measuring expansion module
      5. Supervise network quality (Total Harmonic Distortion) with voltage measuring expansion module
      6. Offer one-part number to cover the current range from 0.24 up to 850 A, with currents greater than 63A measured using external current transformers
      7. Supports standard configurations for direct starter, reversing starter, star-delta starter, actuator and inching mode.
      8. Allow function blocks for signal adjustment, Boolean logic, timers, and counters.
      9. Provide metering, monitoring and diagnosis
      10. Fully graphic multi-language LCD panel to allow configuration and control and monitoring.
      11. Provide support for multiple communication standards;
          1. Modbus TCP / IP EtherNet
          2. Modbus RTU
          3. ProfiNet
          4. Profibus DP
          5. EtherNet / IP
          6. DeviceNet
4. Starters shall be provided with a minimum of one N.O. and one N.C. auxiliary contact in addition to the hold in contact and auxiliary contacts shown on the drawings.
5. Control Power
   1. If required, the control power transformer shall include two primary fuses and one secondary fuse.
   2. If required, each starter unit shall be provided with an encapsulated 120VAC control power transformer of enough size to accommodate the contactor coil burden plus all specified auxiliary devices.
6. 30mm metal bezel pilot devices shall be provided as standard, 22mm pilot are available as an option. All pilot devices shall be part of the unit mounted directly to the unit door. Pilot lights shall use LED lights.

## Softstarters

The Softstarter unit shall be provided with an ABB type softstarter model PSE featuring::

1. Graphical display with keypad
2. Current limit
3. Electronic motor overload protection
4. Underload Protection
5. Locked rotor protection
6. Built-in bypass for energy saving and easy installation
7. Analog Output for display of motor current
8. Fieldbus communication
9. Voltage ramp and Torque control for both start and stop
10. Coated PCBA
11. Kick start
12. Two-phase controlled
13. PSE applications shall incorporate an internal bypass for energy savings once the motor is up to full voltage. The softstarter shall also include an internal electronic overload protection.
14. Reversing softstarter units shall have two additional ABB contactors.
15. If specified, provide door mounted pushbuttons for start-stop control.
16. If specified, provide a door mounted human interface module for programming and display.
17. 30mm metal bezel pilot devices shall be provided as standard, 22mm pilot are available as an option. All pilot devices shall be part of the unit mounted directly to the unit door. Pilot lights shall use LED lights.

## Variable Frequency Drives

1. Variable frequency drives mounted in MCC units shall be ABB ACS880-01, no equal.
2. The variable frequency drive unit shall be provided with a 120V control power transformer. All remote-control wiring shall be in the 120V circuit. The control power transformer shall be provided with primary and secondary fusing.
3. Provide a door mounted human interface module for programming, control and display.
4. If required provide 30mm metal bezel pilot devices shall be provided as standard, 22mm pilot are available as an option. All pilot devices shall be part of the unit mounted directly to the unit door. Pilot lights shall use LED lights.

## Wiring

1. The wiring shall be NEMA Class [1] [2], Type [B] [C].

## Quality Control

1. The entire MCC shall go through a quality inspection before shipment. This inspection will include:
2. Physical Inspection
   1. Structure
   2. Electrical conductors, including:
      1. Bussing
      2. General wiring
      3. Units
3. Electrical Test
   1. General electrical test shall include power circuit phasing, control circuit wiring, instrument transformers and device electrical operation.
   2. AC dielectric tests shall be performed on the power circuit prior to shipment.
4. Markings / Labels
   1. Instructional Type
   2. Underwriters Laboratory (UL)/Canadian Standards Association (CSA).
5. The manufacturer shall use integral quality control checks throughout the manufacturing process to ensure that the MCC meets operating specifications.

# Intelligent Motor Control Centers

## Fieldbus Network Wiring

1. Intelligent motor control centers shall be furnished with a factory installed and tested network providing a communications link with each intelligent starter, soft starter, variable frequency drive, main circuit breaker trip unit, and feeder (if required).
2. Connections for network cable between shipping splits shall be made with quick disconnect screw-type connectors. The use of screw-clamp terminals to join network cables between shipping splits shall not be permitted.
3. Where possible, metal barriers inside MCC wireways shall be installed to provide separation between power conductors and network cables.
4. For Ethernet communication protocols, the use of daisy chain/redundant ring or star topologies shall be supported.
5. Each motor control center shall have at least one connection point available for connecting the MCC network to network scanner outside the MCC. If the network scanner is provided in the MCC, this external connection point is not required.
6. When required, terminating resistors for MCC networks shall be provided.
7. Withdrawal of an MCC unit using a daisy chain network topology shall not cause an interruption in or break in network communication to other units.

## Power Supplies

1. Location in MCC:
   1. Intelligent motor control center network and network component power is to be derived from 24VDC power supplies that are mounted in the motor control center in a removable unit.
   2. Alternatively, the 24VDC power supplies may be mounted in a MCC automation component section, provided disconnect from MCC bus power and control power transformer are located in a removable MCC unit.
   3. DC power supplies that are mounted in main incomer sections shall be in a compartment that is isolated from busbars and incoming cables with insulating barriers.
   4. DC power for intelligent overload relays may be derived from dedicated power supplies located in individual starter units.
2. DC power supplies for network or network component power shall be ABB series CP-E or approved equal.
3. DC power buses for network or intelligent MCC component power shall be redundant and use a diode blocking/redundancy module to prevent backfeed. Redundancy module shall be ABB series CP-E or approved equal.
4. Protection of 24VDC power supply branch circuits shall be provided using miniature circuit breakers or fuses.

## Across the line starter units and solid-state Soft Starter

1. Across the line starter units and solid-state soft starters using programmable/intelligent overload relay (UMC100.3) shall support the following network protocols:
   1. Modbus TCP / IP EtherNet
   2. Modbus RTU
   3. ProfiNet
   4. Profibus DP
   5. EtherNet / IP
   6. DeviceNet
2. Fieldbus network communications for intelligent across the line starters and solid-state soft starters shall permit condition monitoring and starter control.
3. Modbus TCP/IP EtherNet or ProfiNet Communications to intelligent overload relays or solid-state soft starters shall employ the use of a multiport tap that permits redundant Ethernet ring topologies and connects to four starters using a single IP address
4. EtherNet IP Communications to intelligent overload relays shall employ the use of a multiport tap that permits redundant EtherNet ring topologies using a single IP address.
5. Profibus DP communications to intelligent overload relays and solid-state soft starters may use either a daisy-chain fieldbus connection topology or use a multiport tap that connects to four starters using a single Profibus address.
6. DeviceNet or Modbus RTU communications to intelligent overload relays and solid-state soft starters shall use a daisy-chain fieldbus connection topology.

## Variable Frequency Drives

1. Variable frequency drives in intelligent motor control centers shall have provisions for communicating using the MCC installed fieldbus network or EtherNet network. ACS880-01 shall support the following network protocols:
   1. Modbus TCP / IP EtherNet
   2. Modbus RTU
   3. ProfiNet
   4. Profibus DP
   5. EtherNet / IP
   6. DeviceNet

## Main Incomer Breakers

1. Main incomer circuit breakers shall have provisions for communicating using the MCC installed fieldbus network. External gateways for establishing the network link shall be permitted.
2. Control of MCC incomer circuit breakers shall be permitted using the MCC installed fieldbus network
3. Fault status and condition monitoring shall be available through the main incomer circuit breaker communications link.
4. [IEC61850 communication protocol on main circuit breaker incomer.]

## Feeders

1. If required, feeder units in intelligent motor control centers shall have the ability to communicate voltage and current conditions and trip status. The use of an electronic trip unit in circuit breaker for monitoring purposes. An intelligent motor overload relay programmed to monitor only mode for this function is acceptable when fuse disconnect option.

## Control and Monitoring Panel

1. When required, a dedicated MCC section shall be provided as an automation cabinet and should contain the following components:
   1. 24VDC network power supplies and redundancy modules
   2. Ethernet switches
   3. Customer/external network connection point
   4. Touch screen display, ABB Panel 800 series or equal for use as monitoring, configuration and control station for MCC lineup, when required.
   5. Diagnostic network port or tap for connection to network with temporary interface

## Programming and Testing

1. When required, a dedicated MCC section shall be provided as an automation cabinet and should contain the following components:
   1. Assignment of unique addresses for intelligent components (overload relays, trip units, drives)
   2. Configuration of intelligent devices to support control wiring and permit network-issued commands, when required
   3. Archiving factory settings for intelligent devices in software form or as a table of factory-set parameters
2. Factory testing of intelligent MCC shall consist of:
   1. Establishing and demonstrating communication with each intelligent device using unique assigned addresses
   2. Issuing control commands over the network in accordance with the unit design
   3. Monitoring feedback data from the intelligent device over the MCC network
3. If touch screen display is programmed by the manufacturer, functional testing of touch screen control and monitoring functions.

# Execution

## Installation

1. Install motor control center in accordance with manufacturer’s written guidelines and all applicable national and local codes.
2. All necessary hardware required to secure the electrical equipment in place shall be provided by Contractor.

## Field Quality Control

1. Adjustments
   1. Adjust all operating mechanisms per manufacturer's requirements.
   2. Adjust circuit breaker trip and time settings per values required per site engineer
   3. Tighten all bolted bus connections per manufacturer's written guidelines.
2. Cleaning
   1. Touch up damaged or scarred surfaces to match original finish.

## Testing

1. Perform installation test in accordance with applicable NEC, NEMA, and UL requirements.

## Warranty

1. Equipment manufacturer warrants that all goods supplied are free of non-conformities in workmanship and materials for one year from date of initial operation, but not more than eighteen months from date of shipment.

## Field Test

1. Check tightness of all accessible mechanical and electrical connections to assure they are torqued per manufacturer’s recommendations.

# Additional Information

## List of related documents

| Ref # | Document Kind, Title | Document No. |
| --- | --- | --- |
|  | Technical Application Guide | 2TDC190003 |
|  | Installation, Operations and Maintenance Manual | 2TDA090000P0001 |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |