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ADJUSTABLE SPEED DRIVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes separately enclosed, pre-assembled, combination ASDs, rated 480 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.3 DEFINITIONS

A. ASD: Adjustable Speed Drive
B. BAS: Building automation system
C. CPT: Control power transformer.
D. EMI: Electromagnetic interference.
E. IGBT: Insulated-gate bipolar transistor.
F. LAN: Local area network.
G. LED: Light-emitting diode.
H. MCP: Motor-circuit protector.
I. NC: Normally closed.
J. NO: Normally open.
K. OCPD: Overcurrent protective device.
L. PCC: Point of common coupling.
M. PID: Control action, proportional plus integral plus derivative.
N. PWM: Pulse-width modulated.
O. RFI: Radio-frequency interference.
P. TDD: Total demand (harmonic current) distortion.
Q. THD(V): Total harmonic voltage demand.

1.4 SUBMITTALS

A. Product Data: For each type and rating of ASD indicated. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, and furnished specialties and accessories.

B. Shop Drawings: For each ASD indicated. Include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.

1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    a. Each installed unit's type and details.

b. Factory-installed devices.
c. Enclosure types and details.
d. Nameplate legends.
e. Short-circuit current (withstand) rating of enclosed unit.
f. Features, characteristics, ratings, and factory settings of each ASD and installed devices.
g. Specified modifications.

2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring.

C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around ASDs. Show ASD layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D. Product Certificates: For each ASD, from manufacturer.

E. Source quality-control reports.

F. Field quality-control reports.

G. Operation and Maintenance Data: For ASDs to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.
2. Manufacturer's written instructions for setting field-adjustable overload relays.
3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

H. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.

I. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.5 QUALITY ASSURANCE

A. The equipment shall be UL or ETL Listed and Labeled, or equivalent NRTL acceptable to the Owner and the AHJ.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

1.7 COORDINATION

A. Coordinate features of motors, load characteristics, installed units, and accessory devices to be compatible with the following:

1. Torque, speed, and horsepower requirements of the load.
2. Ratings and characteristics of supply circuit and required control sequence.
3. Ambient and environmental conditions of installation location.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace ASDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Owner’s Acceptance.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish two spares for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. The ASD shall be solid state AC to AC inverter-controlled device utilizing the latest isolated gate bipolar transistor (IGBT) technology.

B. The drive shall be an Adjustable Speed Drive Motor-Controller AC Drive that is designed to comply with standard IEEE 519-1992 when installed into system that is already in compliance with the standard.

C. Variable-frequency power converter (IGBT rectifier, dc bus, and IGBT-PWM inverter) factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

2.2 MANUFACTURERS

A. ABB

B. Or approved equal.

2.3 HARMONICS

A. The construction of the ASD shall not contribute any significant harmonics at the input terminals of the ASD, and shall maintain harmonics levels at the ASD’s input terminals to levels at or below those listed in “Harmonic Control in Electrical Power Systems, IEEE Std. 519-1992.” in the system that already is in compliance with the said standard.

B. All harmonic management devices must be internal to the ASD enclosure and supplied as a complete solution.

C. The ASD shall have an active line supply unit which controls the waveform of the input current and reduces the low order harmonic current drawn from the power line. Line currents and voltages shall be nearly sinusoidal. IGBTs shall be used in the rectified and inverter circuits.

D. Each input phase of the ASD shall incorporate a symmetrical LCL filter arranged in a T-configuration. The inductors are to be series power components that carry the full current of the ASD.

E. The input current to the ASD shall have a total harmonic content less than 5% of full rated capability at the input terminals of the ASD on power system sized according to IEEE 519-1992 at line voltage unbalance up to 3% and under all motor load conditions.

F. The ASD shall operate at fundamental power factor 1.0 on the supply side under all motor load conditions.

G. The input power factor shall be programmable from 0.8 lagging to 0.8 leading, allowing the ASD to be used as a compensating device for installations that are excessively inductive or excessively capacitive in reactive power. The reactive power required by other loads connected to the same distribution system may be compensated when the ASD has sufficient capacity for reactive and active loads.

H. The ASD's design shall not compensate for existing harmonic content in the distribution system.

2.4 ASD CONSTRUCTION

A. The models shall provide a complete, ready-to-install solution.

B. The latest, most efficient IGBT power technology shall be used for all power and voltage ranges offered by the manufacturer.

C. The ASD shall offer microprocessor-based control logic that is isolated from power circuitry.

D. The ASD shall use the same main control board for all ratings.

E. Control connections shall remain consistent for all power ratings.

F. The ASD shall employ an active AC to DC rectifier (commonly referred to as an active supply unit).

G. The ASD shall be offered in UL Type 1 and NEMA Type 12 for indoor use and NEMA 3R for outdoor use.

H. Provide a fully-rated circuit-breaker disconnect.

I. The power modules in the cabinet shall be of a modular construction for quick removal and replacement.

2.5 BYPASS MOTOR STARTER

A. Provide reduced voltage bypass motor starter connected in parallel with the ASD. This starter will allow the corresponding motor to operate while the ASD is taken out of service for maintenance or repairs/.

B. The bypass starter shall be capable of functioning completely independent of the ASD.

2.6 OPERATOR INTERFACE

A. The ASD shall be equipped with a front mounted operator control panel consisting of a four-(4) line by 20-character back-lit alphanumeric LCD display and a keypad with keys for Run/Stop, Local/Remote, Increase/Decrease, Reset, Menu navigation and Parameter select/edit.

B. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple ASDs.

C. The display of the control unit shall have the following features:

1. The LCD display shall have contrast adjustment provisions to optimize viewing at angle.
2. All parameter names, fault messages, warnings and other information shall be displayed in complete American English words or standard American English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table.
3. Additional languages including British English, French, Spanish, Portuguese, German, Italian, Dutch, Danish, Swedish, Finnish, Czech and Polish shall be selectable.
4. During normal operation, one (1) line of the control panel shall display the speed reference and run/stop forward/reverse and local/remote status. The remaining three (3) lines of the display shall be programmable to display the values of any three (3) operating parameters. The selection shall include at least the following values:
   a. Speed/torque in percent (%), RPM or user-scaled units
   b. Output frequency, voltage, current and torque
   c. Input voltage, power and kilowatt hours
   d. Heatsink temperature and DC bus voltage
   e. Status of discrete inputs and outputs
   f. Values of analog input and output signals
   g. Values of PID controller reference, feedback and error signals

D. The keypad shall be used for local control, for setting all parameters, and for stepping through the displays and menus.

E. A copy function to upload and store parameter settings from an ASD and download stored parameter settings to the same ASD or to another ASD shall exist.

F. An intelligent start-up assistant shall be provided as standard. The Start-up routine will guide the user through all necessary adjustments to optimize operation.

1. The Start-Up routine shall include “plug and produce” operation, which automatically recognizes the addition of options and fieldbus adapters and provides the necessary adjustment assistance.
2. The Start-Up routine shall prompt the user for Motor Nameplate Data including power, speed, voltage, frequency and current.

3. An auto-tune function shall identify the optimal motor tuning parameters for typical applications.
4. An auto-tune function shall also be available to tune the PID speed regulator loop. Manual adjustments shall also be allowed.
    a. A selection of at least six (6) preprogrammed application macro parameter sets shall be provided to minimize the number of parameter adjustments required during start-up. Macros offered shall include Factory Default, Hand/Auto, PID Control, and Torque Control. A selection of two (2) user defined macros shall are also be available.
    b. Selection shall be offered for both 2-wire and 3-wire Start/Stop control.

2.7 PROTECTIVE FEATURES

A. For each programmed warning and fault protection function, the ASD shall display a message in complete English words or Standard English abbreviations. The five (5) most recent fault messages and times shall be stored in the ASD's fault history.

B. The ASD shall include internal MOVs for phase to phase and phase to ground line voltage transient protection.

C. Output short circuit and ground fault protection rated for 100,000 amps without relying on line fuses shall be provided per UL508C.

D. Motor phase loss protection shall be provided.

E. The ASD shall provide electronic motor overload protection qualified per UL508C.

F. Protection shall be provided for AC line or DC bus overvoltage at 130% of maximum rated voltage or undervoltage at 65% of min. rated voltage.

G. The ASD shall protect itself against input phase loss.

H. A power loss ride through feature shall allow the ASD to remain fully operational after losing power as long as kinetic energy can be recovered from the rotating mass of the motor and load.

I. Stall protection shall be programmable to provide a warning or stop the ASD after the motor has operated above a programmed torque level for a programmed time limit.

J. Underload protection shall be programmable to provide a warning or stop the ASD after the motor has operated below a selected underload curve for a programmed time limit.

K. Over-temperature protection shall provide a warning if the power module temperature is less than 5°C below the over-temperature trip level.

L. Input terminals shall be provided for connecting a motor thermistor (PTC type) to the ASD's protective monitoring circuitry. An input shall also be programmable to monitor an external relay or switch contact.

2.8 CONTROL INPUTS AND OUTPUTS

A. Discrete Inputs
   1. A minimum of six (6) discrete inputs shall be provided.
   2. A minimum of six (6) of the inputs shall be independently programmable with function selections (run/stop, hand-off-auto, etc.).
   3. Inputs shall be designed for use with either the ASD's internal 24 VDC supply or a customer supplied external 24 VDC supply.

B. Discrete Outputs
   1. Minimum of two (2) form C relay contact outputs shall be provided.
   2. All outputs shall be independently programmable to activate with at least 30 function selections including:
      a. Operating conditions such as drive ready, drive running, reversed and at set speed.
      b. General warning and fault conditions.
      c. Adjustable supervision limit indications based on programmed values of operating speed, speed reference, current, torque and PID feedback.
      d. Relay contacts shall be rated to switch 2 Amps at 24 VDC or 115/230 VAC.

C. Analog Inputs
   1. Minimum of two (2) analog inputs shall be provided:
      a. At least one (1) must support bi-polar voltage input.
      b. Resolution of analog inputs must be at least 11 bit total resolution.
   2. All inputs shall be independently programmable with input function selections.
   3. A differential input isolation amplifier shall be provided for each input.
   4. Analog input signal processing functions shall include scaling adjustments, adjustable filtering and signal inversion.
   5. If the input reference is lost, the ASD shall give the user the option of the following. The ASD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus.
      a. Stopping and displaying a fault
      b. Running at a programmable preset speed
      c. Hold the ASD speed based on the last good reference received
      d. Cause a warning to be issued, as selected by the user
   6. When inputs are used as speed references, reference signal processing shall include increase/decrease floating point control and control of speed and direction using a "joystick" reference signal. Two (2) analog inputs shall be programmable to form a reference by addition, subtraction, multiplication, minimum selection or maximum selection.

D. Analog Outputs
   1. Minimum of two (2) 0 / 4-20 mA analog outputs shall be provided.

2. Outputs shall be independently programmable to provide signals proportional to output function selections including output speed, frequency, voltage, current and power.

2.9 SERIAL COMMUNICATIONS

A. The ASD shall be capable of communicating with other ASDs or controllers via a serial communications link. A variety of communications interface modules for the typical overriding control systems shall be available.

B. Interface modules shall be available for a wide selection of protocols including but not limited to:
   1. Modbus
   2. Ethernet IP
   3. ControlNet
   4. DeviceNet
   5. Profibus
   6. LonWorks

C. Interface modules shall mount directly to the ASD control board or be connected via fiber optic cables to minimize interference and provide maximum throughput.

D. I/O shall be accessible through the serial communications adapter. Serial communication capabilities shall include, but not be limited to:
   1. Run-Stop control
   2. Hand-Off-Auto Control
   3. Speed Adjustment
   4. PID (proportional/integral/derivative) control adjustments
   5. Current Limit
   6. Accel/Decel time adjustments

E. The ASD shall have the capability of allowing the overriding controller to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), relay outputs, and diagnostic warning and fault information.

F. A connection shall also be provided for personal computer interface. Software shall be available for ASD setup, diagnostic analysis, monitoring and control. The software shall provide real time graphical displays of ASD performance.

2.10 CONTROL FUNCTIONS AND ADJUSTMENTS

A. Output frequency shall be adjustable between 0 Hz and 300 Hz. Operation above motor nameplate shall require programming changes to prevent inadvertent high-speed operation.

B. Stop mode selections shall include coast to stop and ramp to stop.

C. The ASD shall be capable of controlling deceleration of a load without generating an overvoltage fault caused by excessive regenerated energy. Overvoltage control on deceleration shall extend the ramp time beyond the programmed value to keep the amount of regenerated energy below the point that causes overvoltage trip.

D. The ASD shall be capable of starting into a rotating load (flying start) regardless of motor direction. It should then accelerate or decelerate to the active reference without tripping on fault or causing component damage. The ASD shall also be capable of flux braking at start to stop a reverse spinning motor prior to ramp.

E. The ASD shall have the ability to automatically restart after an overcurrent, overvoltage, undervoltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.

F. Control functions shall include two (2) sets of acceleration and deceleration ramp time adjustments with linear and an s-curve ramp time selection.

G. Speed control functions shall include:
   1. Adjustable min/max speed limits.
   2. Selection of up to 15 preset speed settings for external speed control.
   3. Three sets of critical speed lockout adjustments.
   4. A built-in PID controller to control a process variable such as pressure, flow or fluid level.

H. Functions shall include flux optimization to limit the audible noise produced by the motor and to maximize efficiency by providing the optimum magnetic flux for any given speed operating point.

I. The ASD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The ASD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay output shall include programmable time delays that will allow for ASD acceleration from zero speed without signaling a false underload condition.

J. Three (3) programmable critical frequency lockout ranges shall be provided to prevent the ASD from operating the load continuously at an unstable speed.

K. The ASD shall offer software to select the ASDs action in the event of a loss of the primary speed reference.

L. The ASD shall have fifteen (15) internal adaptive programming blocks capable of twenty (20) different functions. These blocks shall be connectable to ASD’s actual signals and functions allowing the user to tailor the ASD to the specific application requirements without additional hardware. These blocks shall be programmable through the standard operator panel and through the use of programming software.

2.11 ENCLOSURES

A. ASD Enclosures: NEMA 250, to comply with environmental conditions at installed location.
   1. Dry and Clean Indoor Locations: Type 1 unless otherwise indicated to comply with environmental conditions at installed location.

B. ASD Enclosure: NEMA 3R, to comply with environmental conditions at installed location.
   1. Outdoor Location: Enclosure with electric strips and cooling fan.

C. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying ASD as "Plenum Rated."

2.12 ACCESSORIES

A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in ASD enclosure cover unless otherwise indicated.
   1. Push Buttons, Pilot Lights, and Selector Switches Standard duty type.
      a. Push Buttons: Shielded types; momentary contact unless otherwise indicated.
      b. Pilot Lights: LED types.

B. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

C. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time- delay settings.
   1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

D. Supplemental Digital Meters:
   1. Elapsed-time meter.
   2. Kilowatt meter.
   3. Kilowatt-hour meter.

E. Spare control-wiring terminal blocks; unwired.

2.13 SOURCE QUALITY CONTROL

A. Testing: Test and inspect ASDs according to requirements in NEMA ICS 61800-2.

B. Test each ASD while connected to its specified motor.
   1. Verification of Performance: Rate ASDs according to operation of functions and features specified.
   2. ASDs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive ASDs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.

B. Examine ASD before installation. Reject ASDs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before ASD installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 HARMONIC ANALYSIS STUDY

A. Perform a harmonic analysis study to identify the effects of nonlinear loads and their associated harmonic contributions on the voltages and currents throughout the electrical system. Analyze possible operating scenarios, including recommendations for ASD input filtering to limit TDD and THD(V) at the defined PCC to specified levels.

B. Prepare a harmonic analysis study and report complying with IEEE 399 and NETA Acceptance Testing Specification.

3.3 INSTALLATION

A. Coordinate layout and installation of ASDs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Wall-Mounting Controllers: Install ASDs on walls with tops at uniform height and with disconnect operating handles not higher than 60 inches above finished floor unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in each fusible-switch ASD.

E. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

F. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

G. Comply with NECA 1.

3.4 IDENTIFICATION

A. Identify ASDs, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each ASD with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for ASDs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of ASD units.

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between ASDs and remote device and facility's BAS.

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic control devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic control devices that have no safety functions when switches are in manual-control position.
2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Provide 4 hours for each ASD, for a factory-authorized service representative to provide startup, including inspection, testing, and adjusting components, assemblies, and equipment installations, including connections.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each ASD element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

D. Tests and Inspections:

1. Inspect ASD, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each ASD element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at ASD locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace them with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:
    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each ASD. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each ASD 11 months after date of Substantial Completion.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Prepare test and inspection reports, including a certified report that identifies the ASD and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.7 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full load amperes and attempt to start motors several times, allowing for motor cool down between starts. If tripping occurs on motor in-rush, adjust settings in increments until motor starts without tripping. Do not exceed eight the motor full load amperes or 11 times for NEMA Premium Efficient motors if required. Where the maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.

D. Set field-adjustable circuit-breaker trip ranges as specified in Division 26.

E. Set field adjustable pressure switches.

F. Adjust overload relay heaters or setting if power factor correction capacitors are connected to load side of overload relays.

3.8 PROTECTION

A. Temporary Heating if required: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace ASDs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.9 STARTUP & COMMISSIONING

A. Commissioning: The Supplier shall provide on-site support for the duration of equipment commissioning. A minimum of 4 work hours for each ASD shall be included in the Bid. Support shall be dedicated to this project and assigned to work continuously until successful commissioning completion.

B. Integrated Systems Testing: Hours listed above shall be inclusive of integrated systems testing. Vendor shall be on call during integrated systems testing.

3.10 DEMONSTRATION

A. A factory-authorized service representative shall train Owner’s maintenance personnel to adjust, operate, and maintain systems.

END OF SECTION

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