SECTION 230915

VARIABLE SPEED DRIVES

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**NOTE TO SPECIFIER**

*Use this Specification Section for Mail Processing Facilities.*

***This is a Type 2 Specification with primarily editable text; therefore, most of the text can be edited, but there is some required text which is noted within the Section with a “Note to Specifier.” Do not revise these paragraphs without an approved Deviation from USPS Headquarters, Facilities Program Management, through the USPS Project Manager.***

*For Design/Build projects, do not delete the Notes to Specifier in this Section so that they may be available to Design/Build entity when preparing the Construction Documents.*

*For the Design/Build entity, this specification is intended as a guide for the Architect/Engineer preparing the Construction Documents.*

*The MPF specifications may also be used for Design/Bid/Build projects. In either case, it is the responsibility of the design professional to edit the Specifications Sections as appropriate for the project.*

*Text shown in brackets must be modified as needed for project specific requirements.* *See the “Using the USPS Guide Specifications” document in Folder C for more information.*

*The last date that USPS revised this standard specification section occurs in two places, at the end of this section and in the Table of Contents. If the date in this section matches the date in the Table of Contents, then you are using the latest version. Do not delete or revise the “last revised” date at the end of the section during the development of the Project Manual.*

*The footer in this section should be edited to replace the text, “USPS MPF SPECIFICATION” with the project name, and the blank date in the center should be replaced with the submission date, for interim design reviews, or the issue date of the completed Project Manual.*

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1. GENERAL
	1. SUMMARY
		1. Section Includes:
			1. Variable Speed Drive System.
			2. High efficiency electric motors.
		2. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents.
		3. Related Sections:
			1. Section 250504 – Building Automation System (BAS) General: BAS integration methods.
			2. Section 260500 – Common Work Results for Electrical: Basic electrical methods.
	2. REFERENCES
		1. Institute of Electrical and Electronics Engineers (IEEE):
			1. IEEE 519-1992 - Harmonic Distortion Standard.
		2. National Electrical Contractors Association (NECA):
			1. NECA SI - Standard of Installation.
		3. National Electrical Manufacturers Association (NEMA).
		4. National Fire Protection Association (NFPA).
			1. NFPA 70 - National Electrical Code.
	3. SUBMITTALS
		1. Section 013300 - Submittal Procedures: Procedures for submittals.
			1. Product Data:
				1. Product Specifications.
				2. Descriptive Bulletins
			2. Assurance/Control Submittals:
				1. Certificates: Manufacturer's certificate that Products meet or exceed specified requirements.
				2. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.
		2. Section 017704 – Closeout Procedures and Training: Procedures for closeout submittals.
			1. Project Record Documents: Record actual locations, ratings and sizes of variable speed drives.
	4. QUALITY ASSURANCE
		1. Perform Work in accordance with Manufacturer’s recommendations and as specified herein.
		2. Manufacturer Qualifications: Company specializing in manufacturing Products specified in this Section with minimum five years documented experience.
		3. Regulatory Requirements:
			1. Conform to requirements of NFPA 70.
			2. Products: Listed and classified by Underwriters Laboratories, Incorporated as suitable for purpose specified and indicated.
	5. MAINTENANCE
		1. Section 017704 – Closeout Procedures and Training: Procedures for closeout submittals.
		2. Extra Products: At completion of installation, deliver to Contracting Officer.
			1. Three of each size and type fuse installed.
2. PRODUCTS

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***NOTE TO SPECIFIER***

*Verify manufacturer information, products, and availability at time of Project Manual preparation for Project.*

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* 1. MANUFACTURERS
		1. Variable Speed Drives and Motors: Subject to compliance with project requirements, manufacturers offering Products which may be incorporated in the Work include the following:
			1. ABB, New Berlin WI, (414) 785-8605.
			2. Allen-Bradley, Milwaukee WI, (414) 382-2000.
			3. Cutler-Hammer Eaton Corp., Milwaukee WI, (800) 833-3927.
			4. Square D Company, Schneider Electric; (888) 778-2733.
			5. MagneTek, La Vergne TN, (800) 624-6383.
			6. Reliance Electric, Rockwell Automation, Cleveland OH, (800) 241-2886.
		2. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.
	2. VARIABLE SPEED DRIVE EQUIPMENT (VSD):
		1. Drive System shall be compatible with electrical characteristics of motors furnished and rated for operation with equipment furnished.
		2. Shaft grounding rings shall be incorporated into motors 10HP and higher to prevent electrically induced bearing damage (EIBD) when VFDs are utilized on larger pump and fan motors. Coordinate work with drive and equipment manufacturers.
		3. System shall feature the following minimum operating characteristics:
			1. Input ac voltage tolerance of 480V, plus or minus 10 percent.
			2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
			3. Minimum Efficiency: 96 percent at 60 Hz, full load.
			4. Minimum Displacement Primary-Side Power Factor: 96 percent.
			5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
			6. Starting Torque: 100 percent of rated torque or as indicated.
			7. Speed Regulation: Plus or minus 1 percent.
		4. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.
			1. Electrical Signal: 4 to 20 mA at 24 V.
		5. Internal Adjustability Capabilities:
			1. Minimum Speed: 5 to 25 percent of maximum rpm.
			2. Maximum Speed: 80 to 100 percent of maximum rpm.
			3. Acceleration: 2 to a minimum of 22 seconds.
			4. Deceleration: 2 to a minimum of 22 seconds.
			5. Current Limit: 50 to a minimum of 110 percent of maximum rating.
		6. Self-Protection and Reliability Features:
			1. Input transient protection by means of surge suppressors.
			2. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
			3. Motor Overload Relay: Adjustable and capable of NEMA 250, Class 10 performance.
			4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
			5. Instantaneous line-to-line and line-to-ground overcurrent trips.
			6. Loss-of-phase protection.
			7. Reverse-phase protection.
			8. Short-circuit protection.
			9. Motor overtemperature fault.
			10. Provide with function loss input for interface of a freeze stat to shut down the drive system upon detection of a freeze condition. Manual restart shall be required.
		7. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.
		8. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.
		9. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
		10. Motor Temperature Compensation at Slow Speeds: Adjustable current fallback based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
		11. Minimum 5% line reactor.
		12. The VSD must meet the requirements for Radio Frequency Interference (RFI) above 7 MHz as specified by FCC regulations, part 15, subpart J, Class A devices.
		13. Status Lights: Door-mounted LED indicators shall indicate the following conditions:
			1. Power on.
			2. Run.
			3. Overvoltage.
			4. Line fault.
			5. Overcurrent.
			6. External fault.
		14. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.
		15. Indicating Devices: Digital display and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:
			1. Output frequency (Hz).
			2. Motor speed (rpm).
			3. Motor status (running, stop, fault).
			4. Motor current (amperes).
			5. Motor torque (percent).
			6. Fault or alarming status (code).
			7. PID feedback signal (percent).
			8. DC-link voltage (VDC).
			9. Set-point frequency (Hz).
			10. Motor output voltage (V).
		16. Control Signal Interface:
			1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
			2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:
				1. 0 to 10-V dc.
				2. 0-20 or 4-20 mA.
				3. Potentiometer using up/down digital inputs.
				4. Fixed frequencies using digital inputs.
				5. RS485.
				6. Keypad display for local hand operation.
			3. Output Signal Interface:
				1. A minimum of 2 analog output signal (0/4-20 mA), which can be programmed to any of the following:

Output frequency (Hz).

Output current (load).

DC-link voltage (VDC).

Motor torque (percent).

Motor speed (rpm).

Set-point frequency (Hz).

* + - 1. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
				1. Motor running.
				2. Set-point speed reached.
				3. Fault and warning indication (overtemperature or overcurrent).
				4. PID high- or low-speed limits reached.
		1. Communications Interface: Provide BACnet compliant MS/TCP interface to be used with an external system within a multidrop LAN configuration. Communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, acceleration/deceleration time adjustments, and lock and unlock the keypad. The interface shall allow monitoring of process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature, VSD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the communications interface.

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***NOTE TO SPECIFIER***

***REQUIRED****: The following section must be edited to meet the project requirements for Bypass and approved by the USPS Project Manager.*

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* + 1. Manual bypass shall be provided for each VFD. VFD and bypass components shall be mounted inside a common NEMA 1 enclosure, fully pre-wired and ready for installation as a single UL listed device. Bypass shall include the following:
			1. Input, output, and bypass contactors, to disconnect power to the VFD, when the motor is running in the bypass mode.
			2. 115 V.A.C. control transformer, with fused primary.
			3. Thermal overload relay, to protect the motor while operating in the bypass mode.
			4. Circuit breaker/disconnect switch, with a “through-the-door” handle mechanism.
			5. Control and safety circuit terminal strip.
			6. “Drive-Off-Bypass” selector switch.
			7. Pilot lights for “Power On” and “Fault”.
			8. “Normal/Test” selector switch, to allow testing and adjustment of the VSD while the motor is running in the bypass mode.
	1. ENCLOSURES
		1. NEMA 1 enclosure.

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* 1. ACCESSORIES
		1. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
		2. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
		3. Control Relays: Auxiliary and adjustable time-delay relays.
		4. Historical Logging Information and Displays:
			1. Real-time clock with current time and date.
			2. Running log of total power versus time.
			3. Total run time.
			4. Fault log, maintaining last four faults with time and date stamp for each.
		5. Current-Sensing, Phase-Failure Relays for Bypass Controller: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.
	2. HIGH EFFICIENCY DRIVE EQUIPMENT:
		1. Motors shall conform to the latest applicable requirements of NEMA, IEEE, ANSI, NEC and be U.L. listed. Motors shall be designed for continuous duty. Motors shall feature an engraved, stainless steel nameplate listing horsepower, volts, phase, rated and full load amps, model and serial numbers.
		2. All new motors furnished on this project shall be premium efficiency type rated for [ \_\_\_\_ ] volt, [ \_\_ ] phase.
1. EXECUTION
	1. EXAMINATION
		1. Section 017300 - Execution: Verification of existing conditions before starting work.
		2. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
		3. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.
		4. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.
	2. INSTALLATION
		1. Variable Speed Drives:
			1. Provide a digital, electronic variable speed drive system that is compatible with the equipment to be controlled and suitable for the application.
			2. Provide the services of a factory trained technician to assist in installation, startup and training of Postal Service personnel. Provide filters or other accessories as required to minimize harmonic noise in controlled motors.
			3. Connect new VSD’s to operate equipment and be controlled by BAS or other method as specified. BAS Controller shall operate all VSD’s according to the sequence of operations. VSD control systems requiring operator to make changes at drive unit are not acceptable.
			4. Connect VSD to BAS using either twisted pair or shielded cable as required for system furnished. Check that RPM/HERTZ and other readings at BAS are equal to readings at VSD panel. Insure that system is properly grounded and all connections are properly torqued to manufacturer’s recommendations.
			5. Set minimum speed to allow proper motor cooling and lubrication (normally 20 percent).
			6. Mount VSD (normally on wall) to allow for less than 25 feet of lead length between the drive and motor to prevent voltage reflection. Allow for proper air flow around VSD for cooling and service access. Check for over-voltage by measuring the phase-phase voltage at the motor terminals.
			7. Provide line reactors with 3 to 5 percent impedance or use filter device between drive and motor where required to compensate for power fluctuations (surges and drops).
			8. Mount drive in location to provide adequate ventilation for heat dissipation. Mount drive in interior locations only and provide adequate ventilation.
			9. Coordinate startup and testing with controls contractor. All controls shall be installed and ready to function in accordance with the sequence of operations prior to final testing and training. Adjust controller to update minimum of twice per second.
			10. Where multiple pump or fan systems are designed to operate in parallel, adjust VSD to maintain speeds within 20 revolutions per minute of each other when multiple motors are operating.
		2. High Efficiency Motors:
			1. Provide premium efficiency drive motors that are compatible with digital electronic variable speed drive systems and suitable for the application.
			2. Securely mount and connect new motors to new VSD in accordance with manufacturer’s recommendations, the National Electrical Code and as noted above. Size wiring as specified and per the NEC. All wiring shall be run in conduit suitable for the application.
			3. For three phase motors, verify direction of rotation. Verify proper grounding. Check phase to phase voltage and phase to ground voltage. Report results to the Contracting Officer.
			4. Torque all connections per manufacturer’s recommendations.
			5. Provide thermal overloads in starter sized for the application.
			6. Check operation of system complies with the sequence of operations.
	3. FIELD QUALITY CONTROL
		1. Section 014000 – Quality Requirements: Field testing and inspection.

END OF SECTION

USPS MPF Specification Last Revised: 10/1/2022