SECTION 26 22 14 – high efficiency harmonic cancellation transformers

1. GENERAL
	* + 1. RELATED DOCUMENTS
				1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
				2. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.
			2. SUMMARY
				1. This Section specifies the requirements for energy efficient dry-type harmonic cancellation transformers, rated 1000 V and less. All transformers shown on Drawings are single output on the secondary.
				2. Transformers shall be designed to treat all major harmonics produced by phase-neutral, phase-phase, and 3-phase six-pulse electronic equipment: 3rd, 5th, 7th, and 9th in addition to other zero sequence currents.
				3. 3rd harmonic and other zero sequence currents shall be treated in the secondary windings the transformer through flux cancellation, and shall not be coupled into the primary winding. Trapping these currents in the primary delta winding, as is the case for the delta-wye transformer configuration, is not acceptable.
				4. 5th and 7th harmonics for single output transformers are treated by introducing the appropriate primary-to-secondary phase-shift in the transformer such that these currents subtract at the common bus with 5th and 7th harmonic currents produced by other similar harmonic current sources fed from the same bus. See Drawings for phase shift of each transformer. Fundamental current imbalance shall be reduced on the primary side of the transformer compared to the secondary side.
				5. Harmonic cancellation performance guarantee shall be provided by the manufacturer.
			3. REFERENCE STANDARDS
				1. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
				2. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
				3. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within all references.
			4. QUALITY ASSURANCE
				1. Listing and Labeling: Provide transformers specified in this Section that are listed by Underwriters Laboratories (UL), certified by CSA, bear the EPA ENERGY STAR logo. Transformers shall meet relevant NEMA, UL, CSA, NFPA, EPA Energy Star Program.
				2. Transformer, with characteristics and options specified, must deliver the energy savings required under the EPA ENERGY STAR program and bear the EPA ENERGY STAR logo.
				3. Minimum Linear Load Efficiency: NEMA TP-1 and EPA ENERGY STAR compliant; 97.5 percent for 30 kVA, 97.7 percent for 45kVA, 98.0 percent for 75 kVA, 98.2 percent for 112.5kVA, 98.3 percent for 150 kVA, 98.5 percent for 225 kVA, 98.6 percent for 300 kVA, 98.7 percent for 500 kVA.
				4. Non-linear Load Efficiency: Greater than 98 percent for all transformers 45kVA and above, greater than 97 percent for transformers 30kVA and smaller. Load per section “Factory Test Reports” above.
			5. SUBMITTALS
				1. Product Data:

Include data on features, components, ratings and performance for each type of transformer specified. Include dimensioned plans, sections, and elevation views. Show minimum clearances and installed devices and features.

Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics.

No load core loss, full load winding conductor loss, full load losses, efficiency at 25 percent, 50 percent, 75 percent and 100 percent rated loads, percent regulation with 80 percent and 100 percent power factor loads, sound level, tap configurations, insulation system type and rated temperature rise.

* + - * 1. Record Documents:

Wiring Diagrams: Detail wiring and identify terminals for tap changing and connecting field-installed wiring.

Product Certificates: Signed by manufacturer of transformers certifying that the products furnished comply with requirements, including harmonic performance guarantee.

Factory Test Reports: Base data for electrical characteristics on actual laboratory tests of typical transformers for harmonic performance and energy efficiency. Testing to be conducted using three (3) single-phase 120V nonlinear load banks with personal computer harmonic profile (100 percent current THD) at 35 percent or more of transformer nameplate load level. Test results to be submitted at time of quotation to include transformer efficiency, change in voltage THD between transformer primary and secondary terminals, ratio of 3rd harmonic current in primary delta current profile compared to that in secondary phase current.

Copies of manufacturer’s design and routine factory tests required by referenced standards, including results of zero sequence impedance and reactance tests.

* + - 1. DELIVERY, STORAGE and HANDLING
				1. Transport, handle, store and protect products.
				2. Deliver transformers individually wrapped for protection and mounted on shipping skids.
				3. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
				4. Do not stack transformers.
				5. Temporary Heating: Apply temporary heat according to manufacturer’s written instructions within the enclosure of each ventilated-type unit throughout periods during which equipment is not energized and is not in a space that is continuously under normal control of temperature and humidity.
				6. Transformers shall not be used as work tables, scaffolds or ladders.
			2. WARRANTY
				1. Provide ten (10) year pro-rated warranty against defects in materials and workmanship, with limited liability.
1. PRODUCTS
	* + 1. GENERAL
				1. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
			2. MANUFACTURERS
				1. Manufacturer must be a US Environmental Protection Agency (EPA) ENERGY STAR Partner.
				2. Manufacturers:

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Eaton

* + - 1. CONSTRUCTION
				1. Description: Factory-assembled and tested, convection air-cooled units of types specified.
				2. Frequency: 60 Hz.
				3. System Voltage: 480V, 3-phase primary to 208/120V, 3-phase, 4-wire secondary.
				4. Core: Grain-oriented, non-aging silicon steel, 3-leg, common core.
				5. Coils: Continuous copper windings without splices, except for taps.
				6. Internal Coil Connections: Brazed or pressure type.
				7. Primary Winding: One coil per phase and per core leg; 3-phase, 3-wire input.
				8. Secondary Winding: Multiple coils per phase and per leg; one 3-phase, 4-wire output for all transformers.
				9. Insulation class: 220 degree C.
				10. Rated Operating Temperature Rise: 150 degrees C above 40 degrees C ambient for 0 degree phase shift units and 130 degrees C above 40 degrees C ambient for 30 degree phase shift units.
				11. Taps: Full-capacity taps in primary side windings are as follows: 45kV and above: Four 2.5-percent taps, 2 above and 2 below rated voltage.
				12. Impedance – Positive and negative sequence: 2.5 – 4.0 percent (up to 75kVA), 3.0 – 4.8 percent (112.5 – 300 kVA).
				13. Zero sequence impedance and reactance: Less than 0.95 percent and 0.3 percent respectively.
				14. Efficiency: Greater than 98 percent per EPA ENERGY STAR energy savings program requirement.
				15. Enclosure Finish: Epoxy powder coating.
				16. Enclosure Color: Manufacturer’s standard.
				17. Enclosure type: Indoor, ventilated, dripproof, NEMA-1.
				18. Sound Levels: Per NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91. 10-50kVA: 45 dB, 51-150kVA: 50 dB, 151-300 kVA: 55 dB.
				19. Varnishing: The manufacturing process shall incorporate epoxy vacuum impregnation; both primary and secondary windings.
				20. Electrostatic Shielding: Each winding is independently single shielded with a full-width copper electrostatic shield.
				21. Neutral conductor rating shall be 200 percent of phase rating.
				22. Ratings as scheduled, capable of operating at 100 percent load continuously at an ambient temperature of 40 degrees C under full harmonic load profile.
				23. Lugs shall not be provided with the transformer due to the variety of installation scenarios, such as single or multiple conductors per phase.
				24. Terminal strips: Copper, with holes pre-drilled for 3/8 inch hardware.
1. EXECUTION
	* + 1. PREPARATION
				1. Examine the areas and conditions under which dry type transformers are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.
			2. INSTALLATION
				1. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
				2. All installation shall be in accordance with manufacturer’s published recommendations.
				3. Install transformers as indicated, in accordance with the applicable requirements of the NEC and the National Electrical Contractors Association’s “Standard of Installation”.
				4. Install floor-mounted transformers on concrete housekeeping pads with vibration isolating pads suitable for isolating the transformer noise from the building structure in accordance with Section 26 01 00, Basic Electrical Requirements. Maintain a minimum of 6 inches free air space between enclosure and walls.

For floor and trapeze transformer installations, use one pad type Korfund Elasto-Grip waffle at each corner of the transformer, sized for load of 50 pounds per square inch.

For wall hung transformer installations (15kVA and less), use spring type Korfund Series P. Provide sound pads at each corner of the transformer sized for ½ inch deflection. Securely anchor wall-mounting brackets to wall to provide adequate support.

* + - * 1. Suspend transformers (45 kVA and less) from structure by means of trapeze hangers constructed of ½-inch galvanized all-thread rods and metal framing channels. Make double-nut connections between rods and channels. Locate to provide adequate ventilation and accessibility.
				2. Check for damage and tight connections prior to energizing transformer. Verify adjustment of coil shipping anchor bolts prior to energizing.
				3. Measure primary and secondary voltages and make appropriate tap adjustments.
				4. Set transformer plumb and level.
				5. Use flexible conduit, two (2) feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

END OF SECTION 26 22 14