

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIFICATION
FOR
PAD-MOUNTED TRANSFORMER

MET:RDM

1 of 4

APPR:EG:MS:04-22-21

a. Description. This work consists of furnishing, installing and testing a new pad-mounted step-up transformer, dry-type, single phase, rated between the range of 20 up to 50 kilovolt-ampere (kVA), 120/240 volt (V) to 480V at 60 hertz (Hz).

b. Materials. Provide a single-phase pad mounted dry-type transformer of the two-winding type, self-cooled, with ratings and voltages as indicated on the plans.

1. General.

A. Ensure the transformer is designed, manufactured, and tested in accordance with all applicable *ANSI*, *NEMA* and *IEEE* standards. All transformers must be *UL* listed and bear the *UL* label (in accordance with *NEC article 450.11*) or be listed and labeled by a nationally recognized testing laboratory (NRTL), as recognized by the *MIOSHA*.

B. Ensure the transformer is designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in *ANSI C57.96*.

2. Insulation Systems.

A. Ensure the transformer is provided with Class F insulation for 365 °F total temperature, based on 239 °F rise.

B. Ensure the required performance is obtained without exceeding the above indicated temperature rise in a 104 °F maximum ambient temperature, with an 86 °F average ambient temperature over 24 hours.

C. Ensure all insulation materials are flame-retardant and do not support combustion as defined in *ASTM D635*.

3. Winding Taps. Provide a transformer that conforms to *NEMA ST 20* requirements. A minimum of two 5 percent taps below and two 5 percent taps above rated voltage, at full capacity rating.

4. Core and Coil Assemblies. Ensure the transformer core is constructed with high grade, non-aging, grain-oriented silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Ensure the transformer core volume allows efficient transformer operation at 10 percent above the highest tap voltage. The core laminations must be tightly clamped and compressed. Ensure the coils are wound of electrical grade aluminum or copper with continuously wound construction.

A. On units rated below 30kVA, provide a core and coil assembly that is completely encapsulated in a proportioned mixture of resin and aggregate to provide a moisture-proof, shock resistant seal.

B. On units rated 30kVA and above, provide a core and coil assembly that is impregnated with a non-hygroscopic, thermo-setting varnish and cured to reduce hot spots and seal out moisture. Install the assembly on vibration-absorbing pads and securely bolted to the base to minimize sound transmission.

5. Enclosures.

A. Provide an enclosure made of heavy gauge steel that is degreased, cleaned, primed, and finished with *ANSI 61* grey weather-resistant enamel. Equip all transformers with a wiring compartment suitable for conduit entry and large enough to accommodate all conductor bending radii. The maximum temperature of the enclosure must not exceed 194 °F. Ensure the core of the transformer is visibly grounded to the enclosure.

B. On units rated below 30kVA, provide an enclosure construction that is totally enclosed, non-ventilated, meets *NEMA enclosure Type 3R* requirements and has lifting eyes.

C. On units rated 30kVA and above, provide an enclosure construction that is ventilated and has lifting holes. Protect all ventilation openings against falling dirt. Ensure all units are outdoor rated, meet *NEMA enclosure Type 3R* requirements, with suitable weather shields and factory installed rodent guards over ventilation openings.

6. Provide a transformer with sound levels not exceeding the *ANSI* and *NEMA* levels for self-cooled ratings in Table 1.

Table 1: Transformer Sound Levels

| Transformer Size | Maximum Decibels |
|------------------|------------------|
| Up to 9kVA | 40 |
| 10 to 50kVA | 45 |

7. Terminations.

A. Provide each dry-type transformer with a suitable terminal compartment to accommodate the required primary and secondary wiring connections and side or bottom three inch conduit entrance. Ensure transformers rated below 25kVA are equipped with terminal leads that end with Contractor installed connectors arranged and supported in a workmanlike manner, as per *ANSI/National Electrical Contractors Association (NECA)* installment 1. Ensure transformers rated 25kVA and above are equipped with terminal boards with Contractor installed clamp type connectors.

B. Ensure the terminal compartment temperature does not exceed 167 °F when the transformer is operating continuously at rated load with an ambient temperature of 104 °F. Transformers having ratings not exceeding 10kVA must be *UL*-listed for operation with connecting cables rated for use at 167 °F.

8. Provide grounding in accordance with subsection 918.02 of the Standard

Specifications for Construction and 20SP-826A - Grounding, Bonding, Lightning Protection and Surge Protection for Intelligent Transportation System Equipment.

9. Equipment/System Identification. Provide equipment/system identification nameplates in accordance with section 818 of the Standard Specifications for Construction.

c. Construction.

1. Submittals. Submit shop drawings detailing the complete transformer and all other components to be supplied and constructed, including pad design, to the Engineer for approval as required in the Special Provision for Basic Methods and Material for Intelligent Transportation Systems Work. Detail the exact location and placement of system components and include installation details for the required cables. Install all cabling in accordance with the *NEC* and manufacturer recommendations.

2. Furnish and install a dry-type transformer on the pad-type foundation recommended by the manufacturer. Install the transformer with all materials and hardware required to complete the installation.

A. Examine the area and conditions under which the transformer, foundation, and conduit are to be installed. Notify the Engineer in writing of any conditions detrimental to the proper installation of the transformer. Do not proceed with installation of the transformer until the detrimental conditions have been corrected and approved by the Engineer.

B. Ensure the pad-type foundation is constructed in accordance with subsection 820.03.A of the Standard Specifications for Construction and in a manner that will not pond water.

C. Install the transformer, utilizing vibration mounts, on the pad-type foundation.

D. Connect the transformer to the line and load conductors (conductors paid for separately) in accordance with the *NEC*, applicable local electrical codes and manufacturer recommendations.

E. Provide equipment grounding connections for the transformer in accordance with the current version of the *NEC*, applicable local electrical codes and manufacturer recommendations.

3. Factory Tests.

A. Ensure the following factory tests are performed on all transformers:

(1) Ratio tests on the rated voltage connection and on all tap connections.

(2) Polarity and phase-relation tests on the rated voltage connection.

(3) Applied potential test.

(4) Induced potential test.

B. Provide the Engineer with certified test results for all tests listed above.

4. Field Testing.

A. Prior to energizing the transformer, tighten all accessible connections in accordance with the manufacturer’s torque specifications, the *NEC* and applicable local electrical codes.

B. Prior to energizing the transformer, check circuitry for electrical continuity, short-circuits, and improper grounding. Correct any items that do not meet the requirements in this special provision and the *NEC*.

C. Upon energizing the transformer, test each load for compliance with all requirements in this special provision.

5. Warranty. Provide *UL* listed transformer with a standard manufacturer’s warranty, transferable to MDOT. The transformer must carry a warranty (parts, software, and labor) of 18 months from the date of shipment. Furnish warranty and other applicable documents from the manufacturer, and a copy of the invoice showing the date of shipment, to the Engineer prior to final written acceptance.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

| Pay Item | Pay Unit |
|-------------------------------------|-----------------|
| Pad-Mtd Transformer, __ kV AMP..... | Each |

Pad-Mtd Transformer, __ kV AMP includes all pad mounted step-up transformers, pad foundations, connection to line and load power cables, mounting brackets, conduit, assessing site conditions, providing a plan to mitigate detrimental conditions, and any other items as needed for complete functionality are included.