

Specification Number: 26 12 16.30.FL
Product Name: SUBSTATION TRANSFORMERS

SECTION 26 12 16.30.FL
SUBSTATION TRANSFORMERS

Uni-Cast II™ substation transformers are an ideal choice for industries such as pharmaceuticals, food and beverage, and medical, as well as other industrial and commercial installations. The primary windings are completely impregnated with epoxy resin which forms a solid dielectric system. The secondary windings are wrapped in epoxy-impregnated Nomex® and baked to bond the conductor and Nomex and the end cavities are sealed with air-dried epoxy. This combination provides not only high reliability, but also an economical solution for many applications.

Power-Cast II™ substation transformers - three-phase, cast-epoxy units are particularly suited for applications requiring a dry-type transformer with superior performance characteristics. The windings are completely impregnated with epoxy resin forming the solid dielectric system. This system protects the windings from moisture and environmental airborne contaminants and provides exceptional strength to withstand extreme thermal shock and the mechanical forces of short circuit. These transformers meet the more stringent ANSI/IEEE standards for liquid-filled transformers, but have the added advantages of a dry-type, making Power-Cast II transformers an ideal replacement for the PCB-filled or PCB-contaminated units. Power-Cast II units are available in both indoor and outdoor enclosures. If required, special enclosures can be designed to rotate the unit 90° to better fit in space previously occupied by a PCB-filled unit. Combustion byproducts of Power-Cast II transformers have been tested and documented to be environmentally safe and nonflammable. All windings are partial-discharge tested to provide a reliable high voltage dielectric system. All units manufactured receive the standard production tests as prescribed by IEEE C57.12.91 as well as 100% QC impulse testing.

PART 1 PRODUCT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Uni-Cast II substation transformers.
- B. Power-Cast II substation transformers.

1.02 REFERENCES

- A. IEEE C57.12.01 - Standard General Requirements for Dry-Type Distribution and Power Transformers Including Those with Solid Cast and/or Resin-Encapsulated Windings
- B. ANSI C57.12.28 - Switchgear and Transformers, Pad-Mounted Equipment - Enclosure Integrity
- C. ANSI C57.12.50 - Requirements for Ventilated Dry-Type Distribution Transformers, 1-500 kVA Single-Phase and 15-500 kVA Three-Phase, with High Voltage 601-34,500 Volts, Low Voltage 120-600 Volts
- D. ANSI C57.12.51 - Requirements for Ventilated Dry-Type Power Transformers, 501 kVA and Larger Three-Phase, with High Voltage 601-34,500 Volts, Low Voltage 208Y/120-4160 Volts.
- E. ANSI C57.12.55 - Conformance Standard for Transformers - Dry-Type Transformers Used in Unit Installations, Including Unit Substations
- F. IEEE C57.12.56 - Standard Test Procedure for Thermal Evaluation of Insulation Systems for Ventilated Dry-Type Power and Distribution Transformers
- G. IEEE C57.12.58 - Guide for Conducting a Transient Voltage Analysis of a Dry-Type Transformer Coil
- H. IEEE C57.12.59 - Guide for Dry-Type Transformer Through-Fault Current Duration
- I. IEEE C57.12.70 - Terminal Markings and Connections for Distribution and Power Transformers
- J. IEEE C57.12.80 - Standard Terminology for Power and Distribution Transformers
- K. IEEE C57.12.91 - Test Code for Dry-Type Distribution and Power Transformers
- L. IEEE C57.94 - Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type General Purpose Distribution and Power Transformers
- M. IEEE C57.96 - Guide for Loading Dry-Type Distribution and Power Transformers
- N. IEEE C57.105 - Guide for Application of Transformer Connections in Three-Phase Distribution Systems

- O. IEEE C57.124 - Recommended Practice for the Detection of Partial Discharges and the Measurement of Apparent Charge in Dry-Type Transformers
- P. CSA-C88 - Power Transformers and Reactors

1.03 SUBMITTALS

- A. Submit shop drawings indicating outline dimensions, connection and support points, weight, specified ratings and materials.
- B. Submit product data indicating standard model design tests and options.
- C. Submit manufacturer's installation instructions.

1.04 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under.
- B. Include procedures for cleaning unit, and replacing components.

1.05 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in distribution transformers with [three] [] years [documented] experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect dry-type transformers from moisture by using appropriate heaters as instructed by the manufacturer.

2.01 SUPPLIER

- A. Square D Company [or approved equal].

2.02 UNI-CAST II SUBSTATION TRANSFORMER

- A. The transformer(s) shall be the substation type with sidewall mounted primary and secondary terminations.
- B. Transformer(s) shall be Uni-Cast II, dry-type construction, mounted in a suitable, ventilated [indoor] [outdoor] enclosure.
- C. The average temperature rise of the transformer windings shall not exceed 100 [80, 115] °C when the transformer is operated at full nameplate AA and FA rating. The transformer(s) shall be capable of carrying 100% of nameplate kVA rating in a 40° C maximum, 30° C average ambient as defined by IEEE C57.12.01 .
- D. Terminations shall be side-wall mounted for: [close-coupling to high and low voltage switchgear sections] [close-coupling to high voltage switchgear on the primary side and terminating in an air-filled terminal chamber for cable connections to the low voltage side] [close-coupling to low voltage switchgear on the secondary side and termination in an air-filled terminal compartment on the primary side for cable entrance] [terminations within air-filled terminal chambers on both high voltage and low voltage side for cable entrance and exit][cover mounted for top entry/exit].
- E. Primary and secondary locations shall be as follows: [primary: ANSI Segment 2, i.e. to observer's left when facing the transformer front; secondary: ANSI Segment 4, i.e. to observer's right when facing the transformer front.] [primary: ANSI Segment 4, i.e. to observer's right when facing the transformer front; secondary: ANSI Segment 2, i.e. to observer's left when facing the transformer front].
- F. The transformer(s) shall be rated [kVA AA] [kVA AA/FFA]; [kVA AA/FA]. Primary voltage delta. Secondary voltage [wye] [delta], [3-wire] [4-wire], 60 Hz with two 2-1/2% full capacity above normal and two 2-1/2% full capacity below normal primary taps. Impedance shall be [%] [manufacturer's standard impedance] $\pm 7-1/2\%$. Sound level shall not exceed [the maximum specified by NEMA TR-1 for the applicable kVA size of dry-type transformer] [dB].
- G. Forced air-cooling shall increase the allowable full-load kVA by 33-1/3%.
- H. The impulse rating of the high voltage windings must be at least equal to the basic impulse level specified by IEEE C57.12.00 for liquid-filled transformers of the same voltage class, without the use of supplemental surge arresters.
- I. The impulse rating of the low voltage winding must be at least 10 kV for low voltage windings rated 1.2 kV and below.

J. Both high voltage and low voltage windings shall be of [aluminum] [copper] conductors. High voltage windings shall each be separately cast as one rigid tubular coil. Each primary coil shall be reinforced with fiberglass mat. The casting process shall provide complete, void-free resin impregnation throughout the entire insulation system. The coil supports shall maintain constant pressure during thermal expansion and contraction of the coils. There shall be no rigid mechanical connection between high voltage and low voltage coils. The secondary windings shall be completely wrapped in epoxy-impregnated Nomex and then oven baked. To seal the end cavities, the coil ends shall be potted with an air-dried epoxy.

K. The transformer core shall be constructed of high grade, grain-oriented silicone steel laminations, with high magnetic permeability. Magnetic flux density is to be kept well below the saturation point. The core shall be cruciform in shape, with mitered joints to keep core losses, excitation current, and noise level at a minimum. The outside surfaces of the core shall be protected against corrosion by painting with a suitable coating after assembly. Core dipping is not acceptable.

L. The enclosure(s) shall be constructed of heavy-gauge sheet steel. All ventilating openings shall be in accordance with NEMA and NEC standards for ventilated enclosures. The cabinet shall have a minimum of four [hinged doors] [removable panels] complete with door handles.

M. The base(s) shall be constructed to permit rolling or skidding in any direction, and shall be equipped with jacking pads designed to be flush with the transformer enclosure.

N. Fan cooling equipment shall include 3-phase electronic winding temperature monitor controlled automatically by a Type K thermocouples placed in the low voltage air ducts. The temperature monitor must contain yellow and red indicating lights. The yellow lamp indicates fan power, while the red lamp signal that alarm and trip contacts have been activated. A 0-1 milliampere output is required for remote indication. Alarm contacts shall be provided for fans, alarm, and trip function. An audible alarm must sound when the highest phase temperature exceeds a preset point. The fans must be able to operate in either manual or automatic mode. Minimum six fans shall be provided. Fan controller must be POWERLOGIC ® system compatible. Forced air cooling system shall include: fans, control wiring, controller with test switch, current limiting fused in the power supply to the controller, indications lights, alarm silencing relay, auto/manual switch, and necessary accessories to properly control the system.

O. The transformer shall be pre-wired for TRANSPARENT READY web enabled communication [non-TRANSPARENT READY]

P. Provision for future forced air cooling equipment shall include mounting provision for fans, bussing sized to the fan-cooled rating, and provisions for mounting the fan control system.

Q. The transformer shall comply with all applicable portions of NEMA TR 1 and IEEE C57.12.01 .

R. The transformer shall be UL listed and labeled [non-UL labeled]

S. Low voltage bus shall be silver flash plated copper [aluminum] throughout.

T. Testing shall be done in accordance with IEEE C57.12.91 and shall included, as the minimum, the following tests:

1. Ratio
2. Polarity
3. Phase Rotation
4. No-Load Loss
5. Excitation Current
6. Impedance Voltage
7. Load Loss
8. Applied Potential
9. Induced Potential
10. The transformer primary windings must be free of partial discharge up to at least 1.2 times the rated line-to-ground voltage. Each primary coil shall be subjected to a partial discharge test to verify its partial discharge.
11. QC Impulse Test
12. Temperature Test (typical data from previous unit is acceptable)
13. Sound Test (typical data from previous unit is acceptable)

2.03 POWER-CAST II SUBSTATION TRANSFORMER

A. The transformer(s) shall be the substation type with sidewall mounted primary and secondary terminations.

B. Transformer(s) shall be of solid-cast, dry-type construction, mounted in a suitable, ventilated [indoor] [outdoor] enclosure.

C. The average temperature rise of the transformer windings shall not exceed 80 [115] °C when the transformer is operated at full nameplate AA and FA rating. The transformer(s) shall be capable of carrying 100% of nameplate kVA rating in a 40° C maximum, 30° C average ambient as defined by IEEE C57.12.01 .

D. Terminations shall be side-wall mounted for: [close-coupling to high and low voltage switchgear sections] [close-coupling to high voltage switchgear on the primary side and terminating in an air-filled terminal chamber for cable connections to the low voltage side] [close-coupling to low voltage switchgear on the secondary side and termination in an air-filled terminal compartment on the primary side for cable entrance] [terminations within air-filled terminal chambers on both high voltage and low voltage side for cable entrance and exit][cover mounted for top entry/exit].

E. Primary and secondary locations shall be as follows: [primary: ANSI Segment 2, i.e. to observer's left when facing the transformer front; secondary: ANSI Segment 4, i.e. to observer's right when facing the transformer front] [primary: ANSI Segment 4, i.e. to observer's right when facing the transformer front; secondary: ANSI Segment 2, i.e. to observer's left when facing the transformer front].

F. The transformer(s) shall be rated [kVA AA] [kVA AA/FFA] [kVA AA/FA]. Primary voltage volts delta. Secondary voltage volts [wye] [delta], [3-wire] [4-wire], 60 Hz with two 2-1/2% full capacity above normal and two 2-1/2% full capacity below normal primary taps. Impedance shall be [%] [manufacturer's standard impedance], ±7-1/2%. Sound level shall not exceed [the maximum specified by NEMA TR-1, for the applicable kVA size of dry-type transformer] [dB].

G. Forced air-cooling shall increase the allowable full-load kVA by [33-1/3%] [50%]. NOTE: 50% increase is not available for transformers rated 500 kVA and 750 kVA or above 5000 kVA while also maintaining an 80° C rise.

H. Both high and low voltage windings shall be of copper [aluminum] conductors. High and low voltage windings shall each be separately cast as one rigid tubular coil, and arranged coaxially. Each cast coil shall be reinforced with glass mat. The casting process shall provide complete, void-free resin impregnation throughout the entire insulation system. The coil supports shall maintain constant pressure during thermal expansion and contraction of the coils. There shall be no rigid mechanical connection between high and low voltage coils.

I. The windings must not absorb moisture, and shall be suitable for both storage and operation in adverse environments, including prolonged storage in 100% humidity at temperature from -30° C to 40° C and shall be capable of immediately being switched on after such storage without predrying.

J. The impulse rating of the high voltage windings must be at least equal to the basic impulse level specified by IEEE C57.12.00 for liquid-filled transformers of the same voltage class, without the use of supplemental surge arresters.

K. The impulse rating of the low voltage winding must be at least [30 kV for low voltage windings rated 1.2 kV and below] [45 kV for low voltage windings rated 2.5 kV and below] [60 kV for low voltage windings rated 5 kV and below].

L. The transformer core shall be constructed of high grade, grain-oriented silicone steel laminations, with high magnetic permeability. Magnetic flux density is to be kept well below the saturation point. The core shall be cruciform in shape, with mitered joints to keep core losses, excitation current and noise level at a minimum. The outside surfaces of the core shall be protected against corrosion by painting with a suitable coating after assembly. Core dipping is not acceptable.

M. The enclosure(s) shall be constructed of heavy-gauge sheet steel. All ventilating openings shall be in accordance with NEMA and NEC standards for ventilated enclosures. The cabinet shall have a minimum of four [hinged doors] [removable panels] complete with door handles.

N. The base(s) shall be constructed to permit rolling or skidding in any direction, and shall be equipped with jacking pads designed to be flush with the transformer enclosure.

O. Fan cooling equipment shall include multi-phase electronic temperature monitor controlled automatically by sensors placed in the LV air ducts. The temperature monitor must contain yellow and red indicating lights. The yellow lamp indicates fan power, while the red lamps signal that alarm and trip contacts have been activated. A 0-1 milliampere output is required for remote indication. Alarm contacts shall be provided for fans, alarm, and trip function. An audible alarm must sound when the highest phase temperature exceeds a preset point. The fans must be able to operate in either manual or automatic mode. A fan exerciser circuit must operate the cooling fans for approximately one minute every six days [Minimum six fans shall be provided; each fan must have a 6-inch diameter blade and develop a minimum 350 CFM at 1500 RPM] [Minimum six "squirrel cage" centrifugal blowers shall be required; each blower must develop a minimum 800 CFM at 1500 RPM] and shall be controlled automatically by sensors placed in the LV air ducts. Forced air cooling system shall include: fans, control wiring, controller with test switch, current limiting fuses in the power supply to the controller, indication lights, alarm silencing relay, and necessary push buttons to properly control the system. Fan controller must be POWERLOGIC ® system compatible.

P. The transformer shall be pre-wired for TRANSPARENT READY web enabled communication [non-TRANSPARENT READY]

Q. Provision for future forced air cooling equipment shall include mounting provision for fans, bussing sized to the fan-cooled rating and provisions for mounting the fan control system.

R. Low voltage bus shall be silver flash plated copper [aluminum] throughout.

S. The transformer shall comply with all applicable portions of NEMA TR 1, and IEEE C57.12.01 .

T. The transformer shall be UL listed and labeled [non-UL labeled]

U. Testing - Testing shall be done in accordance with IEEE C57.12.91 and shall include, as the minimum, the following tests:

1. Ratio
2. Polarity
3. Phase Rotation
4. No-Load Loss
5. Excitation Current
6. Impedance Voltage
7. Load Loss
8. Applied Potential
9. Induced Potential
10. The transformer windings must be free of partial discharge up to at least 1.2 times the rated line-to-ground voltage. All coils shall be subjected to a partial discharge test to verify its partial discharge.
11. QC Impulse Test
12. Temperature Test (typical data from previous unit is acceptable)
13. Sound Test (typical data from previous unit is acceptable)