

Ambient Air Temperature Test of High Voltage Metering Instrument Transformer

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1. Background

The material specification C043 of the High-Voltage Metering Instrument Transformer (HVMT) published by Taiwan Power Company (TPC) was updated from version 101-06 to 111-04. TPC requested that the previously qualified manufacturers undergo certification of manufacturing capacity for the new version. The C043 applies to HVMT (including potential transformer and current transformer) in TPC’s distribution-level (12kV and 24 kV) power systems. The secondary side of HVMT can be equipped with meters to display energy usage (purchase or sale of electricity).

The 111-04 version of the C043 specification introduces a new test: Ambient Air Temperature Test. This test aims to verify that the appearance and insulation properties of HMVT are unaffected after multiple cycles of extreme temperature changes, thereby ensuring product quality and enhancing the integrity of TPC’s high-voltage metering systems.

2. Study Content

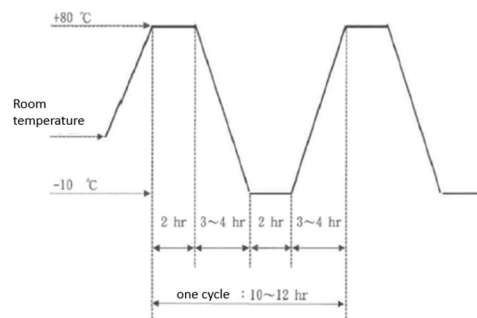
(1) Materials:

External insulation materials of metering transformers commonly include epoxy resin,

polyurethane, thermoplastic rubber, and synthetic rubber. The internal windings are primarily made of silicon steel cores, enameled wires, and insulation paper (or film). Since these materials exhibit varying temperature characteristics, environmental temperature changes could potentially affect transformer performance. After conducting an Ambient Air Temperature Test, the external appearance is examined for abnormalities, followed by additional tests to confirm the transformer remains fully functional.

(2) Testing Procedure:

- A. Increase temperature from ambient (room) temperature to 80°C, maintaining 80°C for 2 hours.
- B. Decrease temperature from 80°C to -10°C within 3-4 hours, maintaining -10°C for 2 hours.
- C. Increase temperature from -10°C back to 80°C within 3-4 hours.
- D. The above steps (1–3) constitute one cycle, lasting 10–12 hours.
- E. Conduct five continuous cycles without interruption. The allowable temperature deviation at all stages is ±5°C.
- F. See Figure 1 for the cycle schematic.



Source: Taiwan Power Company C043(2022-04) Standard

Figure 1 Testing cycle schematic

(3) Testing Outcome Requirements:

- A. The tested transformer must show no visible damage after testing.
- B. Subsequent tests, including a Power Frequency Withstand Voltage Test, an Impulse Test, an Induced Voltage Test, an Inter-turn Overvoltage Test, a Partial Discharge Test, a Wet Withstand Voltage Test, and Ratio Error and phase Angle Measurement Tests, are conducted to verify the transformer's insulation and functional stability.

(4) Test Equipment Specifications:

- A. Power input: 3-phase 220V, 30A
- B. Temperature range: -40°C to 100°C
- C. Refrigerants: R-134a, R-404, R-23

(5) Comparison with Other Tests:

The C043 specifies both the “Temperature Rise Test” and the “Ambient Air Temperature Test,” which have different procedures and purposes.

- A. Temperature Rise Test: This test involves applying a specified voltage/current and burden to measure the transformer’s internal coil

temperature variations.

- B. Ambient Air Temperature Test: Conducted with the transformer powered off, placed in a test chamber, and subjected to external temperature changes to evaluate the durability of the transformer’s external insulation materials.

3. Research Outcomes

After announcing the C043 specification version 111-04, Ambient Air Temperature Test equipment was established and completed in 2023 (figure 2). This equipment will support future testing requirements for HVMT procured by TPC.

4. Conclusion

The HVMT converts the voltage/current on the high-voltage side of the power system into the lower voltage/current at a specific ratio for metering purposes. As a critical component of the electric metering system, the HVMT ensures system accuracy and reliability. The Ambient Air Temperature Test validates the durability of HVMT’s external insulation against temperature fluctuations, enhancing the stability of the power and metering systems.



Source: Photo Taken by TPRI
Figure 2 Ambient Air Temperature Test equipment