

10/22/21

**Proposed Changes to IEEE Std. C57.12.90-2015 to support proposed changes for PD Testing of Class I power transformers.**

**10.7 Induced-voltage tests for distribution and Class I power transformers without partial discharge testing**

**10.8 Induced-voltage test for Class II power transformers and Class I power transformers, when specified**

**10.8.1 General**

Each Class II power transformer, and Class I power transformers when specified, shall receive an induced-voltage test with the required test levels induced in the high-voltage winding. The tap connections shall be chosen, when possible, so that test levels developed in the other windings during the 1 h test are x times their maximum operating voltages, as specified in ANSI C84.1, where x is the ratio of the test voltage on the high-voltage winding to the maximum operating voltage.

**10.8.2 Test procedure**

The voltage shall first be raised to the 1 h level and held for a minimum of 1 min or until a stable partial discharge level is obtained to verify that there are no partial discharge problems. The level of partial discharges shall be recorded just before raising the voltage to the enhancement level. The voltage shall then be raised to the enhancement level and held for 7200 cycles. The voltage shall then be reduced directly to the 1 h level and held for 1 h.

During this 1 h period, partial discharge measurements shall be made at 5 min intervals. Partial discharge acceptance criteria shall be based on each line terminal rated 115 kV and above. These measurements shall be made in accordance with 10.9.

**10.8.3 Connections**

The transformer shall be excited exactly as it will be in service. The voltage may be induced from any winding or from special windings or taps provided for test purposes. Single-phase transformers shall be excited from single-phase sources. Three-phase transformers shall be excited from three-phase sources. The neutral terminals and other terminals that are normally grounded in service shall be solidly grounded. This will stress all of the insulation at the same per unit of overstress.

**10.8.4 Frequency**

The test frequency shall be increased, relative to operating frequency, as required to avoid core saturation. The requirements in 10.7.2 are also applicable in the case of this induced test.

### **10.8.5 Failure detection**

Failure may be indicated by the presence of smoke and bubbles rising in the insulating liquid, an audible sound such as a thump, or a sudden increase in the test current. Any such indication shall be carefully investigated by observation, by repeating the test, and by other diagnostic tests to determine whether a failure has occurred. In terms of interpretation of partial discharge measurements, the results shall be considered acceptable and no further partial discharge tests required under the following conditions:

#### **10.8.5.1 Class II Power Transformer**

- a) The magnitude of the partial discharge level does not exceed 500 pC during the 1-h test period.
- b) The increase in partial discharge levels during the 1-h period does not exceed 150 pC.
- c) The partial discharge levels during the 1-h period do not exhibit any steadily rising trend, and no sudden sustained increase in the levels occurs during the last 20 min of the test.

#### **10.8.5.2 Class I Power Transformer**

- a) The magnitude of the partial discharge level does not exceed 500 pC during the 1-h test period.
- b) The increase in partial discharge levels during the 1-h period does not exceed 150 pC.
- c) The partial discharge levels during the 1-h period do not exhibit any steadily rising trend, and no sudden sustained increase in the levels occurs during the last 20 min of the test.

#### **10.8.5.3 General**

Judgment should be used on the 5-min readings so that momentary excursions of the partial discharge readings caused by cranes or other ambient sources are not recorded. Also, the test may be extended or repeated until acceptable results are obtained.

A failure to meet the partial discharge acceptance criterion shall not warrant immediate rejection, but it shall lead to consultation between purchaser and manufacturer about further investigations.

### **10.9 Partial discharge measurement**

#### **10.9.1 Internal partial discharges**

Apparent internal partial discharges (apparent charge) shall be measured at the terminals of the transformer windings under test and reported in units of picocoulombs (pC).

Where agreed to by both the purchaser and the manufacturer, radio influence voltage (RIV) measurements may be used in lieu of, or in conjunction with, apparent charge measurements.

The procedure for RIV measurements is included in Annex A.

### **10.9.2 Instrumentation**

A partial discharge meter shall be used to measure the apparent charge generated by any internal partial discharges. The partial discharge detector, based on IEEE Std C57.113, is used to measure the partial discharge levels at the terminals. The partial discharge meter shall be coupled to the line terminal(s) of the winding(s) under test through the voltage tap of the bushing(s) or through a suitable coupling capacitor connected in parallel with the bushing. General principles and circuits are described in IEEE Std C57.113.

External shielding may be used to avoid air corona, such as may occur at the bushing terminals or grounded projections. Radio-frequency chokes or tuned filters may be used to isolate the transformer under test and the partial-discharge-measuring circuit from the remainder of the test circuit, including its energy source.