

## Annex L Standards Subcommittee – Unapproved Minutes

October 30, 2019

Hyatt Hotel, Columbus, OH, USA

**Chair: Jerry Murphy**

**Vice Chair: Daniel Sauer**

**Secretary: Marcos Ferreira**

**Standards Coordinator: Jim Graham**

The Chair, Jerry Murphy opened the meeting calling for a show of members to establish quorum which was met based on RFID system verified by e-mail.

### L.1 Meeting Attendance

The Standards Subcommittee met on Wednesday, October 30, 2019, at 4:30 PM EDT. A show of hands indicated **26 of 48** members in attendance the beginning of the meeting which met the quorum requirement. Overall the attendance roll showed according to RFID system: there were **122** attendees: **31** members and **91** guests, which **19** new guests and **4 of 19** requested membership upon tabulation of the circulated rosters and will be reviewed for eligibility. Furthermore, we have the numbers of presence confirmed by the paper rosters. Clair Claiborne moved to approve the agenda with second by Steve Shull; motion was carried with unanimous consent. Jerry then requested a review of the Anaheim minutes; motion was made by Steve Shull and seconded by Clair Claiborne; motion was carried with unanimous consent.

### L.2 Chair's Remarks

### L.3 Working Group and Task Force Reports

#### L.3.1 Standards Working Group on the Continuous Revision of C57.12.00

Standards Subcommittee

IEEE/PES Transformers Committee

WG Chair: Steven L. Snyder

October 30, 2019

The purpose of this WG is to compile all the work being done in various TF/WG/SC's for inclusion in the continuous revision of C57.12.00 in a consistent manner. This WG coordinates efforts with the companion Standard C57.12.90 so that they publish together.

The current standard was approved by the IEEE-SA Standards Board on December 5, 2015, with an official publication date of May 12, 2016. The standard is good for 10 years but is under continuous revision and will be next balloted when enough new material is available. The PAR which covers the ongoing continuous work on the document is good through December 31, 2021.

As agreed at the Fall 2016 Standards Subcommittee meeting, any new material provide to me for inclusion in the next revision, will first be presented to this subcommittee for the "official" vote of approval. I reported on two (2) new items at the Spring meeting and have not received any new material since. I have received a couple of editorial corrections which will be incorporated in the ballot. I am aware, however, of two (2) new topics currently in process that may be approved at this Fall meeting, which I will submit to the committee for electronic approval, when received by me.

Based upon this and other work in process, I anticipate the next revision ballot to begin in early 2020.  
Respectfully submitted,

Steven L. Snyder, WG Chair Standard C57.12.00

### **L.3.2 WG Standard Terminal Markings and Connections for Transformers C57.12.70**

**IEEE / PES Transformers Committee**

**Columbus, OH, USA**

**Marion**

**Tuesday, October 29th - 3:15PM – 4:30PM**

**Working Group of C57.12.70**

#### **Meeting Minutes**

**Chair Jason Varnell presiding with Secretary Kris Zibert recording minutes.**

**Call to order – 3:15PM**

The chair read the slides provided by IEEE-SA with regards to essential patent claims & copyright.

Introductions were made. The electronic roster was utilized to record attendance. Quorum was established with seven of ten members in attendance.

The Agenda was presented and approved. M: S. Antosz, S: R. Musgrove - passed viva voce.

The minutes of the Spring 19 meeting were presented and approved. M: S. Antosz, S: R. Musgrove – passed viva voce.

#### Reports:

##### a. Chair:

- Reviewed PAR and PAR dates

##### b. Antosz:

- TF – Nameplate Requirement
  - TF met via e-mail correspondence
  - TF recommended new sentence added to Section 6.1.3
- S. Antosz made a motion to include this sentence in the standard. S: Dan Mulkey.
  - Discussion regarding “tie-in” with C57.12.00.
  - Motion approved by unanimous consent.

##### c. Li:

- TF – Figure 11
  - Chair Varnell reported on the work of the TF on behalf of W. Li who was unable to attend.
- R. Musgrove made a motion to accept the figure as revised by the TF. S: Dan Mulkey.
  - Motion approved by unanimous consent.

#### Old Business:

##### a. “Tap terminal” definition

- Chair Varnell presented how the term is used in C57.12.70 and the existing definitions in C57.12.80.
- Discussion regarding use of X4 “midpoint” tap and “tap terminal”.
- Discussion by D. Mulkey to revise language in section 3.4 to say “A neutral terminal of a wye or zigzag winding in a three phase transformer shall be marked with the proper letter followed by the subscript 0, for exam, H0, X0, etc.” and “A terminal brought out from the winding for a use other than H0 or X0 shall be marked as a tap terminal.”
- Discussion regarding removing the word “neutral” from section 3.4 heading.
- Dan Mulkey makes a motion to change first sentence to say “A neutral terminal of a wye or zigzag winding in a three-phase transformer shall be marked with the proper letter followed by the subscript 0, for exam, H0, X0, etc.” S: S. Antosz. Motion approved by unanimous consent.

- S. Antosz made a motion to delete the sentence “A terminal brought out from the winding for a use other than that...”.
  - Discussion regarding section 6.4 that has similar language
  - Suggestion that document should be reviewed to make sure deleting the sentence doesn’t cause issues with the rest of the document.
  - M: D. Mulkey S: S. Antosz – amend the motion to keep the sentence but change end of sentence “To be marked as detailed in subclause 6.4.” Motion failed viva voce.
  - Main motion passed by unanimous consent, sentence to be deleted.

New Business:

- a. Introduction
  - Chair Varnell reviewed proposed introduction.
    - Discussion and revisions were made.
- b. Clause 6.2
  - Motion to add C57.12.38 and C57.12.34 to the first paragraph by L. Matthews. S: D. Mulkey. Approved by unanimous consent.
- c. Motion by D. Mulkey to go to SA Ballot. S: S. Antosz. Motion pass by a vote of 7 for and 0 against. 7 members were present.

A motion to adjourn was made and seconded.

The meeting was adjourned at 4:28 PM.

The next meeting will be held in Charlotte, NC during the Spring 2020 meeting of the IEEE Transformers Committee.

**L.3.3 WG Standard Transformer Terminology for Transformers C57.12.80**

<b>Chair:</b>	<u>Clair Claiborne</u>	<b>Vice-Chair</b>	<u>James Graham</u>
<b>Secretary</b>	<u>Open</u>		
<b>Current Draft Being Worked On:</b>	<u>1.0</u>	<b>Dated:</b>	<u>NA</u>
<b>Meeting Date:</b>	<u>2019-10-28</u>	<b>Time:</b>	<u>9:30 AM</u>
<b>Attendance:</b>	<b>Members</b>	<u>6</u>	
	<b>Guests:</b>	<u>25</u>	
	<b>Total*</b>	<u>31</u>	

\* For details of attendance, please refer to AMS system of the Transformers Committee

Meeting Minutes / Significant Issues / Comments:

- 1) Chair’s Remarks:
 

The Vice-Chair opened the meeting at 9:30 a.m. on Monday 28 October 2019. It was noted we still need volunteers to review existing standards for definitions to be added or modified in the terminology standard.
- 2) Attendance Sign In sheet/ Quorum Check:
 

Quorum was achieved with five of six members present. 26 non-voting participants also attended. Six participants requested membership. One new member was added.
- 3) Approval of the Agenda
 

A motion to approve the agenda was amended to add approval of the minutes. The amended passed unanimously.
- 4) Call for Essential Patents

- A call for essential patents was made. No essential patent issues were reported.
- 5) Copyright policy  
The IEEE copyright policy was reviewed. The working group leaders will investigate copyright issues for sharing information from published works discussing shell form transformers.
  - 6) Approval of the minutes  
A motion to approve the Spring 2019 minutes was made and passed unanimously.
  - 7) Unfinished Business
    - a) Action Items:
      - Jim Graham – Post draft 1.0 of the standard on the Standards subcommittee website.
      - Hali Moleski’s Insulation Fluids review comments will be sent to the working group for review.
      - Richard von Gemmingen – review C57.116, and create a definition for a GSU transformer
      - Tim-Felix Mai – Review Dry Type Transformers standards.
      - Shankar Nambi – Review Insulation Life standards.
      - Dan Sauer – Create a definition of AC low frequency tests.
  - 8) New Business
    - a) Jeffrey Wright proposal – Core form and shell form definitions  
The working group discussed the proposed core form and shell form definitions at length but the proposal was not resolved. A motion was made by Jeffrey Wright to survey members of the Standards, Distribution Transformers, and Power Transformers subcommittees asking for comments on the proposed definitions. The motion was seconded by Lee Matthews and passed unanimously. Ryan Musgrove volunteered to research the Westinghouse shell form transformer patents and look for a shell form transformer description.
    - b) Don Platts proposal – liquid filled vs. liquid immersed terminology  
Comments from Don Platts and others related to the use of ‘liquid immersed transformers; vs. ‘liquid filled transformers ‘were shared with the working group. After much discussion, Jeffrey Wright made a motion, seconded by Lee Matthews, to modify the current term ‘liquid immersed transformer’ to ‘liquid type transformer’, keeping the existing definition and noting the terms ‘liquid filled’ and liquid immersed’ transformers are sometimes used. The motion passed unanimously.
    - c) A motion was made and seconded to recommend the Standards Subcommittee accept the paper titled *“Recommendations to the IEEE Transformer Committee (TC) on Recommended Changes, Deletions, and Insertions Related to Normalizing the References of Insulating Liquids throughout the IEEE TC Standard Series”*. During the motion discussion it was determined the white paper was not a standards document and no action was needed. The motion was withdrawn.
  - 9) The meeting was adjourned at 10:50 a.m.  
Next meeting – March 2020 at Charlotte, NC  
Minutes taken by Dan Sauer  
Submitted by: Jim Graham, Vice-chair  
Date: 03/25/2019

#### **L.3.4 WG Standards Transformer on Continuous Revision for C57.12.90**

Standards Subcommittee

IEEE/PES Transformers Committee

WG Chair: Stephen Antosz

October 29, 2019 Rev 0 (latest comments in green font)

#### **INTRODUCTION**

This is a working group by committee of task forces, for continuous revision of C57.12.90. The purpose of the WG is to keep track of the work being done in various TF/WG/SC’s for inclusion in the continuous revision of C57.12.90 in a consistent manner.

Currently there are five Task Forces in three different Subcommittees, as follows:

1. PCS – Cont Rev to Test Code C57.12.90 Clauses 5-9, & 12, TF Chair: Hakan Sahin
2. PCS – Audible Sound Revision Clause 13, TF Chair: Ramsis Girgis

3. Dielectric Test – Cont Rev to Impulse Tests in Clause 10, TF Chair: Pierre Riffon
4. Dielectric Test – Cont Rev to LowFrequency Tests Clause 10, TF Chair: Bill Griesacker
5. Insulation Life – Cont Rev to Temperature Test Clause 11, TF Chair: Ajith Varghese

### **SUMMARY**

The revised document was published in March 2016 as IEEE Std C57.12.90-2015. Shortly after the document was published, one error and one omission were discovered, so a Corrigendum was done and published on March 23, 2017.

### **STATUS**

A new PAR was approved by NESCOM in December 2017 and has a life of 4 years.

UPDATE as of Oct 29, 2019: We have been planning to shut down work for this Standard (and C57.12.00 concurrently) at the end of 2019, and then open for balloting in 2020. There has been some more work finalized at Task Force and Subcommittee meetings this week. I am waiting for those TF/SC Chairs to forward to me their minutes and notes and instructions along with the official text, for me to put into the 12.90 document for ballot.

There is one TF (#1 above) that I expressed concern to the TF Chair after the TF meeting and again at the PCS Subcommittee meeting that the work that has been done since Fall 2016 has not been surveyed and approved by PCS Subcommittee, nor has it been forwarded to me as WG Chair in the Standards Subcommittee. I asked the TF Chair to gather whatever work the TF has approved since Fall 2016, to summarize the actions and decisions, and to survey the PCS Subcommittee for concurrence and approval. Then forward to me and the Standards Subcommittee. I asked him to do all this by Dec 31, 2019. Whatever is not completed by Dec 31, 2019, will have to wait until the next revision.

### **FUTURE REVISIONS AND PENDING WORK**

As agreed at the Fall 2016 Standards Subcommittee meeting, any new material provided by the various Task Forces to this WG Chair for inclusion in the next revision, will first be approved by the responsible technical subcommittee (Diel Test, PCS, Dist, IL, etc) and then presented to the Standards Subcommittee for the “official” vote of approval.

Since this is a continuous revision document, there continues to be ongoing work in the various Task Forces.

Changes *already approved* for the next revision:

1. Changes to 9.3.1 Wattmeter-voltmeter-ammeter method from Mark Perkins’ PCS TF for Revision of C57.12.90. Final survey approved in Nov 2015 in both the TF and PCS. The following text is to be added just prior to Figure 18 for three-phase transformers:
 

An alternate method for either single phase or three phase transformers is to provide capacitive compensation for the transformer impedance at the terminals of the transformer so that the AC source need only supply the real power for the test. Figure 18 shows the apparatus and connections for a single phase transformer for this alternate method and the method can also be used in a three phase configuration. In this case, the wattmeter will measure the real power of the transformer under test plus the power of the capacitors, which will be very small compared to the power in the transformer. The load loss in the transformer is determined by subtracting the loss in the capacitors from the measured loss. For modern oil film capacitors, a loss of 0.2 watts per actual kVAR may be used unless a specific capacitor bank loss is known. This method requires a separate CT or set of CTs at the transformer for setting the current and measuring the transformer impedance. The advantage of this alternate method is that the phase angle between the voltage and current at the wattmeter is low (closer to zero degrees) due to the capacitor compensation, so any phase angle errors in the loss measurement circuit are much less significant.
2. Add in subclause 10.3.1 and 10.3.1.1 Lightning Impulse, the following words in red; by Pierre Riffon’s WG Revision to Impulse Test in Dielectric Test Subcommittee. Submitted on 11/4/2016. These subjects

have been surveyed within the Dielectric Tests SC and within the TF. The 4<sup>th</sup> survey got a 100% approval rate.

10.3.1 Impulse tests shall be made without excitation. The impulse waveshape parameters such as peak voltage, front time and tail time are determined on the test voltage curve which is obtained after having processed the recorded curve using the test voltage function method, as defined in IEEE Std. 4.

2a. 10.3.1.1 Full-wave test

The test wave rises to crest in 1.2  $\mu\text{s}$  and decays to half of crest value in 50  $\mu\text{s}$  from the virtual time zero. The crest value shall be in accordance with the assigned basic impulse insulation level (BIL), subject to a tolerance of  $\pm 3\%$ ; and no flashover of the bushing or test gap shall occur. The tolerance on virtual front time should be  $\pm 30\%$ , and the tolerance on time to half of crest should be  $\pm 20\%$ . However, as a practical matter, once the manufacturer has proven that they have test equipment limitations, the following shall be considered:

a) If the standard impulse shape cannot reasonably be obtained because of low winding inductance or high capacitance to earth and the resulting impulse shape is oscillatory so that the relative overshoot magnitude exceeds 5 % then the front time may be increased to reduce the overshoot amplitude. In all cases, the front time shall not exceed 2.5  $\mu\text{s}$  regardless of the overshoot amplitude.

Note 1: The overshoot can be reduced by increasing the front resistor value of the impulse generator. The use of low inductance connections between the impulse generator and the tested transformer are also recommended.

3. New wording in subclause 10.3.1.3 Chopped-wave test, approved by the TF and SC following the Louisville meeting in Fall 2017.

**10.3.1.3 Chopped-wave test**

A chopped wave is inherently a full lightning impulse wave, except that the crest value shall be at the required level and the voltage wave shall be chopped at or after the required time to flashover (time to chopping) but not later than 6  $\mu\text{s}$  after virtual origin. The virtual front time of the chopped wave may be different than the virtual front during a full-wave test because of the presence of the chopping gap. Nevertheless, the tolerance on the virtual front time for the chopped-wave test should remain as defined for full-wave test.

The gap or other equivalent chopping device shall be located as close as possible to the terminals of the transformer without disrupting its electrical field distribution. The distance between the chopping device and the test object shall not exceed a lead length greater than the total height of the transformer (tank + bushing). The impedance between the tested terminal and the grounded end of the chopping device shall be limited to that of the necessary leads. The voltage zero following the instant of chopping should occur within 1  $\mu\text{s}$ . However, for some winding and transformer designs (particularly low-voltage windings of high stray capacitance, layer windings, high capacitance windings, UHV transformers requiring large clearances, etc.), the circuit response after chopping may not be oscillatory it may be overdamped or may collapse to zero with a lower frequency (slower voltage collapse). For such cases, the time interval to the first voltage zero after the instant of chopping may be significantly greater than 1  $\mu\text{s}$  and this deviation shall be accepted if the chopping gap is located as described above.

In order to have a common procedure for the determination of the steepness of voltage collapse, the steepness of the voltage collapse shall be the time interval between the instant of the voltage chopping to the instant where the applied voltage is 20% of the voltage level at instant of chopping. This time interval should be equal to or less than 0.8  $\mu\text{s}$ .

Only for cases...*(this paragraph and the last paragraph remain as they are in the 2015 edition, including the three NOTES)*..."

4. Add the following text in red to subclause 10.8.2 Test Procedure (for Induced Test). This work was done in Bill Griesacker's (formerly Bertrand Poulin) Task Force. The work started in 2015 and after several

surveys was approved by the TF and SC in October 2018. It stipulates a limit of overpressure applied inside a transformer tank during induced voltage test.

### 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 69 kV and above. These measurements shall be made in accordance with 10.9.

The pressure inside the transformer tank during induced test shall not be increased by artificial means for the purpose of reducing the PD level. The liquid level and pressure inside of the transformer tank and/or conservator tank shall be configured such that oil head pressure during the induced test does not exceed the pressure under usual service conditions. Any exceptions that increase tank pressure by more than 3.5 kPa (0.5 psi) over normal operating pressure, such as the use of an elevated test facility conservator tank, requires customer approval prior to test. A note shall be added to the certified test report confirming this approval.

Note: Increasing the pressure for diagnostic purposes, such as to identify and possibly reduce suspected bubbles in the liquid, may be done as a remedial step to diagnose a source of high PD. To be considered valid, the test shall be repeated with no added pressure as stated above.

#### 5. Tap changer position during Induced Test

Fall 2018 Bertrand reviewed in the TF the text to be added. It received 100% approval. He was to forward it to the Dielectric test Subcommittee for inclusion in C57.12.90. I am not sure that I have the exact text. Need to add the text here ...

#### 6. Other revisions to subclauses 10.2 to 10.4 from Pierre Riffon's TF for revision of impulse tests.

6a. This text was approved by the Task Force and SC in Spring 2019. Add the following text in red to subclause 10.3.2.1 Connection of tertiary bushings during impulse test

##### 10.3.2.1 Terminals not being tested

Neutral terminals shall be solidly grounded. Line terminals, including those of autotransformers and regulating transformers, shall be either solidly grounded or grounded through a resistor with an ohmic value not in excess of the values given in Table 3.

Tertiary winding terminals shall be considered as line terminals.

When buried stabilizing winding terminals have been temporarily brought out of the tank for testing purposes only, they shall be connected the same way as they will be in service during impulse tests (grounded or in open circuit).

When a stabilizing winding terminal is brought out of the tank for grounding purposes, this terminal shall be grounded during impulse tests.

When stabilizing winding terminals are brought out of the tank for the purpose of grounding the winding and closing the delta, these terminals shall be connected as intended for service during impulse tests.

*The rest of the clause remains as is.*

6b. This text was approved by the Task Force and SC in Spring 2019. Add the following text in red to subclause 10.2.4 Tap positions during Switching Impulse Test

##### 10.2.4 Tap connection

The choice of the tap connection shall follow the following rules:

- The tap position shall be selected in order to induce, as close as possible (preferably within  $\pm 3\%$ ), the rated switching impulse withstand voltage value on the LV winding terminal;
- If the LV winding has no rated switching impulse level, the tap position shall be selected in order to induce, as close as possible (preferably within  $\pm 3\%$ ), 83% of the LV winding rated BIL value on LV winding terminal.

It should be noted that for some cases, the LV winding may receive a voltage which is less than its rated switching impulse level or 83% of its rated BIL and this shall be accepted.

It should be also noted that for some other cases, the LV winding may receive a voltage which is higher than its rated switching impulse level or 83% of its rated BIL, this shall be accepted and the transformer shall be designed for it.

For transformers having a preventive autotransformer, the tap changer shall be in a bridging positing if this operational mode is permitted for continuous operation."

7. Bill Griesacker's TF (formerly Bertrand Poulin) for revision of low frequency tests. Revisions to subclauses 10.5 to 10.10.

7a. This change was approved by Bill Griesacker's TF (formerly Bertrand Poulin) for revision of low frequency tests, and approved by the Dielectric Test Subcommittee during the Fall 2019 meetings. Reduce the acceptable PD levels in subclause 10.8.5 Failure Detection during Induced Test for Class II Power Transformers. Add the following words in red, and delete the words in blue text:

10.8.5 Failure Detection.

- a) The magnitude of the partial discharge level does not exceed ~~500~~ 250 pC during the 1-h test period.
- b) The increase in partial discharge levels during the 1-h period does not exceed ~~150~~ 50 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.

There are no other changes to subclause 10.8.5. It will remain as is.

7b. Bill Griesacker's TF (formerly Bertrand Poulin) for revision of low frequency tests. Revisions to subclauses 10.5 to 10.10.

Additions from Phil Hopkinson to detect improper core grounding in 10.7.7 for Special Induced-Voltage partial discharge Test for distribution and class I power transformers with a wound core. Wording to insert into IEEE C57.12.90

**10.7.7 Special Induced-Voltage Test for distribution and class I power transformers with a wound core, Low-High winding construction and having a high voltage winding voltage of 25 kV, (15 kV to ground) or greater to detect improper core grounding. Note that this test is intended only for detection of inadequate core grounding issues and not for accessories like dead front bushings, tap changers, current limiting fuses or dual voltage switches, which may have difficulty passing the test at 100 pc. The transformer may or may not contain such components. If the transformer fails the test with such components, the components may be removed or bypassed and the test re-run. The Design Test shall be conducted on a transformer with functionally similar core grounding.**

**10.7.7.1 Minimum test duration and application of voltage**

1. Voltage shall be raised to 100% of rated volts for 30 seconds and PD shall be measured and recorded.
2. Voltage shall be raised to 110% of rated volts for 30 seconds and PD shall be measured and recorded.
3. Voltage shall be raised to 150% of rated volts, held for 1 minute and PD shall be measured and recorded.
4. Voltage shall be lowered to 140% of rated volts, held for 1 minute and PD shall be measured and recorded.
5. Voltage shall be lowered to 130% of rated volts, held for 1 minute and PD shall be measured and recorded.

6. Voltage shall be lowered to 120% of rated volts, held for 1 minute and PD shall be measured and recorded.
7. Voltage shall be lowered to 110% of rated volts, held for 10 minutes and PD shall be measured and recorded

PD is to be measured as apparent charge in pico-coulombs (pC). One reading shall be made at the end of each interval.

#### 10.7.7.2 Test Frequency

As an induced-voltage test applies greater-than-rated volts per turn to the transformer, the frequency of the impressed voltage shall be high enough to limit the flux density in the core to that permitted by 4.1.6.1 of IEEE Std.C57.12.00-2010. The minimum test frequency to meet this condition is given in Equation (27):

$$\text{Minimum test frequency} = \frac{E_t}{1.1 \times E_r} \times \text{rated frequency} \quad (27)$$

where

- $E_t$  is the induced voltage across winding (V)
- $E_r$  is the rated voltage across winding (V)

#### 10.7.7.3 Grounding of Windings

When a transformer has one end of the high-voltage winding grounded, the other windings should be grounded during the induced-voltage test. This ground on each winding may be made at a selected point of the winding itself or of the winding of a step-up transformer that is used to supply the voltage or that is connected for the purpose of furnishing the ground.

#### 10.7.7.4 Failure detection

The test is considered passed if PD recorded in step 7 of 10.7.7.1 does not exceed partial discharge level of 100 pC. Judgment shall be used in test intervals such that momentary excursions beyond 100 pC may be acceptable, however at the end of step 7 of 10.7.7.1 PD must not exceed 100 pC.

Note —Normally, transformers will pass the test if they are equipped with outside core grounds and with shielded and grounded inside outer core loops. In cases where pass-fail is marginal at the 110% voltage level, it is useful to continue reducing voltage until partial discharge is extinguished. Core gassing results in bubbles between core laminations that push liquid out and leave only gas that ionizes at much lower voltages than the insulating liquid. Hence, core gassing usually results in partial discharge (pd) extinction well below rated voltage. Most other components in the transformer behave more linearly and do not persist with partial discharge at or below rated voltage.

8. Revise to subclause 11.1 from Ajith Varghese's TF under Insulation Life SC regarding reducing resistance measurement reheat time from 60 minutes to 30 minutes during Temperature Rise test. This work was approved by the TF and the SC at Fall 2019 meeting. The exact text change and location is not yet clear. This has not yet been received from the TF/SC.

The Task Force will stay as a Continuous Revision TF to review the Temperature Test procedures, tentatively to be chaired by Robert Thompson. At this time (Fall 2019), there are no specific topics being reviewed.

### PENDING WORK

1. Possible future revisions from Hakan Sahin's PCS TF for Revision of C57.12.90. (formerly Mark Perkins was TF Chair until Fall 2016)
  - a) to add a new clause 4.5 in General Section that a transformer be tested with the same insulation liquid that it will use in service. For example, a unit to be filled with ester liquid should (or shall?) not be tested with mineral oil in the factory. Or this requirement may be put into C57.12.00 Clause 8.1 General Testing. This work was to be forwarded after Fall 2018 to Standards SC. However, I am not sure I saw it on that SC's agenda. Fall 2019 this topic was not discussed anywhere. It seems to have been dropped.

- b) Load Tap Changer performance 8.7 voltage test and 9.6 current test. Text seems to have been approved in Fall 2018, and moved up to the Perf Char SC. Spring 2019 this work was not on TF or SC agendas, so the result is not clear. Was it surveyed in TF and SC? Fall 2019 this topic was not discussed anywhere. It seems to have been dropped.
- c) Addition in 5.4.1 new wording for winding resistance test requirement on wye connected transformers with neutral bushing brought out. Fall 2018 meeting minutes not clear as to disposition of this issue. Spring 2019 this work was not on TF or SC agendas. Was it surveyed in TF and SC? Fall 2019 this topic was not discussed anywhere. It seems to have been dropped.
- d) Altitude correction under clause 11.4.2. Spring 2019 this work was not on TF or SC agendas. Note that clause 11 is out of scope of PCS. Note in Spring 2019 PCS Minutes say that this topic will be handled in Standards SC. Was it forwarded there? Fall 2019 this topic was not discussed anywhere. It seems to have been dropped.
- e) OLTC continuity tests. Spring 2019 this work was not on TF or SC agendas. Fall 2019 this topic was not discussed anywhere. It seems to have been dropped.
- f) Typo correction for altitude correction, subclause 11.4.2. This is discussed in Spring 2019 minutes, but not clear what the decision was. Fall 2019 this topic was not discussed anywhere. It seems to have been dropped.
- g) I received an email in Aug 2019 from Ajith Varghese, Chair of Diel Test SC that DGA limits are supposed to go into C57.12.90 (and 12.00). Ajith said this work is to be done in Hakan's TF. I've not seen it on an agenda. The status of this is very unclear.
- h) Discussed at Fall 2019 meeting. It is unclear what decisions were made, if any. These topics will be reviewed after the TF/SC minutes are published.
- a. Number of short-circuit tests under subclause 12.3.4. This work was discussed in Spring 2019 and continued in Fall 2019.
  - b. Ratio test voltage and frequency under subclause 7.1.2. Request to change frequency bandwidth. Was New Business in Spring 2019.
  - c. Request to revise the Ratio test methods under subclause 7.3, since these are not used any more. Mostly, ratio meters are used.
2. Other possible revisions to subclauses 10.5 to 10.10 from Bill Griesacker's TF for revision of low frequency tests. Ongoing work continues.
- Class I transformer PD test revision to the test procedure – Don Ayers. This TF met for the first time in Columbus Fall 2019. Nothing to report yet.
  - Clarification of measuring voltage during low frequency tests – Bertrand Poulin. This topic was not on the TF or SC agenda during Fall 2019. Not sure the status.
  - Text for venting bushings during PD test, discussed in TF during Fall 2018. Dave Geibel Study Group. It was surveyed in Diel Test SC in Sept 2019 to add the following note to 10.8.5 Failure Detection. I'm not sure the status. No decisions made during Fall 2019.

“If partial discharge is observed during the induced testing of the transformer and appears to be generated within an OIP bushing(s), it is permissible to “vent” the bushing(s) to atmosphere using the bushing manufacturer's instructions to allow for the dissipation of gas bubbles in the oil. Gas bubbles sometimes form following a temperature rise test during cool down or may be present for other reasons. Reestablishment of the bushing gas space blanket and resealing of the bushing must also be performed in accordance with the bushing manufacturer's instructions following completion of the induced test.”

3. Possible change to sound test from Ramsis, regarding whether or not it is critical to do the sound test at elevated core temperature. This item was discussed at Fall 2019. No conclusions. Work is still ongoing. There are no changes at all, to the Sound Test clause 13 for this revision.
4. No other changes to Impulse Test clauses 10.2 to 10.4 from Pierre Riffon's TF. This Task Force did not have any work to do and did not meet at Fall 2019 meeting.

Respectfully submitted,  
Stephen Antosz, WG Chair  
Oct 29, 2019

### L.3.5 WG Standard Transformer Terminology for Transformers C57.152

Standards Subcommittee,  
IEEE / PES Transformers Committee

October 27, 2019, 1:45 – 3:00 PM  
Hyatt hotel, Columbus, OH, USA  
UNAPPROVED MINUTES

- A. Welcome  
The chair, Marcos Ferreira opened the meeting at 1:45 PM. The secretary, Peter Werelius informed that he is recording the meeting for the aim of writing the minutes.
- B. Circulation of Attendance Rosters  
Attendance rosters circulated, the attendances were asked to write an M to be a member, and G to be a guest.
- C. Attendance for Quorum  
The RFID system registered 104 attendees. 48 attendees requested membership in circulated paper roster. This is the first meeting, all requesting membership accepted. All members except the vice chair Raka Levi present. Requirement for quorum was fulfilled.
- D. Approval of Agenda  
Wallace Binder made the motion to approve the agenda and Axel Kraemer second it. The group unanimously approved the agenda.
- E. Call for Patents  
The chair presented slide 1-4, dated January 2, 2018 informing the IEEE patent policy and participants duty to inform. There were no issues related to patent assurance brought up by attendees in the meeting.
- F. IEEE Copyright Policy  
The chair presented IEEE-SA Copyright Policy slides 1-2 informing the audience of the policy. There was a quite bit discussion how the new policy for copyright would affect our new revision for C57.152 among the attendees such as Phil Hopkinson, Mario Locarno, Malia Zaman and Michelle Turner. This discussion involved how to handle the existing published documents (C57.152-2013 the last revision for guide).  
Michelle cleared it out by informing that the WG responsibility follow the policy for all new material added to the document, and for already published material (e.g. C57.152-2013) IEEE-SA will make a

review and request support from the WG if needed.

#### G. Presentation of Title and Scope

The chair presented the approved Title and Scope. He made a comment that the WG later may change the term “liquid-filled” to “fluid-filled” in the title and scope.

Title: IEEE Guide for Diagnostic Field Testing of Fluid-Filled Power Transformers, Regulators, and Reactors

Scope: Diagnostic tests and measurements that are performed in the field on fluid-filled power transformers and regulators are described. Whenever possible, shunt reactors are treated in a similar manner to transformers. Tests are presented systematically in categories depending on the subsystem of the unit being examined. A diagnostic chart is included as an aid to identify the various subsystems.

Additional information is provided regarding specialized test and measuring techniques. Interpretive discussions are also included in several areas to provide additional insight on the test or to provide guidance on acceptance criteria. These discussions are based on the authors’ judgment of accepted practice. It should be noted that the results of several types of tests should be interpreted together to diagnose a problem.

Manufacturers’ acceptance criteria should also be consulted as it may take precedence over the criteria in this guide.

#### H. Volunteers reviewing the document, and suggest changes/additions

After quite a bit of discussion, the chair suggested to post the existing documents on the IEEE website, password protected for members of the WG only, to be reviewed and suggestions sent to chair no later than 6 weeks prior the Charlotte meeting. The chair and secretary will summarize suggestions and send out to members and guests together with agenda for Charlotte meeting, about two weeks prior the Charlotte meeting.

Wallace Binder submitted a proposal for modification of Table 1 at the meeting.

All members and guests feel free to review section of interest and send your suggestions.

Specifically, the following persons volunteered:

- Section 3 Definitions, and section 4 Purpose of tests
  - Dan Doors
  - Alwyn VanderWalt
- Section 5: Maintenance test and information
  - Timothy Raymond
  - Wallace Binder
  - Mario Locarno
  - Joe
  - Stephanie Denzer
- Section 6: Safety
  - Ali Naderian
  - James Cross
- Section 7 Test and Test Techniques and section 8 Diagnostic Chart, and Annexes
  - Charles Sweetser
  - Cornelius Plath
  - Mario Locarno
  - Ronald Hernandez
  - Niclas Gustavsson
  - Larry Christodoulou
  - James Cross
  - Diego Robalino
  - Mario Alonso
  - Poorvi Patel

- Samragini Dutta Roy
- Thomas Melle
- Florin Faur
- Marc Foata
- Rainer Frotscher (specifically section 7.4)

I. Adjournment

The meeting adjourned at 3:00 PM

Respectfully submitted,  
Marcus Ferreira – Chair

Peter Werelius - Secretary

**L.3.6 IEEE / IEC Continuous Cross Reference TASK FORCE FOR  
CROSS REFERENCE OF IEEE TO IEC**

**Fall 2019 Meeting**

**Columbus, Ohio October 27**

Minutes of the Task Force Meeting

The task force meeting was held at 3.15pm on October 27, 2019. 2 of 4 members were present, so a quorum was not achieved, 28 guests also attended, for a total attendance of 30. Due to lack of quorum the agenda and the meeting minutes from previous meetings could not be approved.

This was followed with a detailed presentation on the differences between IEEE and IEC standards for Insulation System testing of LV applications, MV dry transformers and Liquid Immersed transformers by Roger C Wicks.

For LV applications a comparison was done between the IEEE 117 - IEEE Standard Test Procedure for Thermal Evaluation of Systems of Insulating Materials for Random-Wound AC Electric Machinery and IEC 61857-1 - Electrical Insulation Systems–Procedures for thermal evaluation – Part 1: General requirements – Low-voltage.

For MV dry type transformer a comparison was presented between IEEE C57.12.60 – IEEE Standard for Thermal Evaluation of Insulation Systems for Dry-Type Power and Distribution Transformers and IEC 61857-41 - Electrical insulation systems - Procedures for thermal evaluation - Part 41: Specific requirements for electrical insulation systems for use in dry-type high-voltage transformers with operating voltages of 1kV and above.

For liquid immersed transformers a comparison was presented between IEEE C57.100-2011 – Standard Test Procedure for Thermal Evaluation of Insulation Systems for Liquid-Immersed Distribution and Power Transformers and IEC 62332-1 – Electrical insulation systems (EIS) – Thermal evaluation of combined liquid and solid components – Part 1: General requirements and IEC 62332-2 – Electrical insulation systems (EIS) – Thermal evaluation of combined liquid and solid components – Part 2: Simplified Test

At the Spring 2020 meeting in Charlotte NC, Richard Marek has agreed to present a comparison of the IEC 60076-7 and C57.91 (Loading Guide).

The task force meeting was adjourned at 4.10 pm.

Respectfully submitted  
Vinay Mehrotra  
TF Chair

October 29, 2019

Encl. Presentation from Roger C Wicks

**L.4 Old Business**

Core gassing has been considered by three task forces under the Power Transformers, Dielectric Tests and Performance Characteristics subcommittees. These task forces submitted approved language to each respective subcommittee and each subcommittee subsequently approved motions to send the language to the WG for C57.12.00 and C57.12.90.

**L.5 New Business**

The working groups for C57.12.00 and C57.12.90 presented a plan going forward to incorporate the approved core gassing recommendations and a separate set of task force recommendations regarding PD testing on wound coil transformers. The working groups will incorporate this new language into the standards by the end of the year and will send to the chair of the Standards subcommittee to send out to the SC members for approval by email vote to submit the revised standard for SA ballot.

The SC chair appointed Dan Blaydon as the new chair of the WG for C57.163 to prepare and submit a new PAR to begin revision before expiration on 12/31/2025. Ramsis Gergis and Scott Digby will join Dan as vice chair and secretary respectively.

Jim Graham brought to the attention of the SC that there is a request to form a PAR under the TC regarding an entity guide for practical techniques for measuring and demagnetizing power transformer remanence, specifies the specifications of measuring and demagnetizing instrumentation systems. Gary Hoffman and Ramsis Gergis will work with the requesting entity to get clarity.

**L.6 Adjournment**

The meeting was adjourned at 5:57 PM EDT by the Chair.

Respectfully submitted by Marcos Ferreira, Standards SC Secretary