

Date	Document	Project Nr.
------	----------	-------------

Comment Number	Author	Clause/Subclause	Paragraph Figure/ Table	Type of comment (General/ Technical/Editorial)	Comments	Proposed change	Resolution
1a	McNelly	Tables 4 &5	Columns 11-12 of table 4 and columns 12-13 of table 5	Technical	I have a question on clause 5.10.7.1. Does the 200kV BIL mentioned here conflict with the 110kV BIL in new table? I am confused as to why the neutral BIL was added to the table.	Impulse all neutral terminals for Class II transformers.	<b>Chair agrees</b> that neutral BIL testing shall become mandatory for Class II transformers.  <b>2/11 BKP – see the proposed change at the end of the table.</b>
1b	McNelly	Tables 4 &5	Columns 1 &2 of Table 4	Technical	I had thought at one time that there was support for considering 69kV HV winding transformers as Class II. What happened to this? Did it not have enough support, I thought from past surveys, that it did. The table with the list of required tests for the two classes of transformers is not shown. Does that mean that this issue was dropped or am I just confused?	Stop Class I at 48 kV Max System Voltage.	<b>C57.12.00-2006 still shows 69 kV as Class I.</b>
1c	McNelly	Table 6	Columns 8-13 of table 5	Technical	Table 6 lists the impulse test values for the Class I and Dist units as well as the Class II units. Does this mean that they are required tests then and if so where does it say this? It may be just me, but the tables seem more confusing than less.	Add requirements to C57.12.00 on table 19, page 45 for routine impulse tests for >501 kVA	<b>Table 6 is intended to show test levels; Table 19 covers the requirement. No changes required to the proposed text.</b>
3a	Molden			Editorial	Please include a reference to the source of this FOW information, i.e., C57.12.00-date.	Change to C57.12.00 rev 1993	<b>Agree</b> the Appendix will be modified to provide reference. <b>Subhash</b>

Comment Number	Author	Clause/Subclause	Paragraph Figure/ Table	Type of comment (General/ Technical/Editorial)	Comments	Proposed change	Resolution
3b	Molden			Editorial	My copy of C57.12.00-1980 does not include FOW levels at BILs lower than 95 kV, but then agrees with yours from the 95kV BIL up to 1050 BIL, It also includes an 1175 kV BIL for which the FOW level is 1530 kV and the time to spark over is 1.53 us.	Add 1175 kV BIL FOW level of 1530 kV	Agree Subhash to check.
3c	Molden			Editorial	I think it would be worth including a table note to the effect that: "This table is provided as a historical reference only and not meant to imply that the FOW test data are recommended for use in any current testing applications. Any and all non standard test requirements must be agreed upon between the supplier and user at the time of the transformer design."	Clarify note in appendix to indicate that this table is for historical purposes only.	Agree Subhash need a paragraph to lead into table.
5a	B. Patel		5.10	Editorial	Transformers shall be designed to provide coordinated low-frequency and impulse insulation levels on line terminals and low-frequency insulation levels on neutral terminals. The primary identity of a set of coordinated levels shall be its Maximum System Voltage. All other insulation requirements will be dependent on this identity. Basic Lightning Impulse Insulation Level (BIL) will be selected dependent on the degree of exposure of the transformer and characteristics of the over-voltage protection system	Transformers shall be designed to provide coordinated low-frequency and impulse insulation levels on line and neutral terminals. The primary identity of a set of coordinated levels shall be <u>its Maximum System Voltage and basic lightning impulse insulation level (BIL). BIL will be selected dependent on the degree of exposure of the transformer and characteristics of the over-voltage protection system.</u>	Agree
5b	B. Patel		5.10.4.1	Editorial	Low-frequency test requirements for distribution and Class I power transformers shall use applied-voltage and induced-voltage tests.	Low-frequency test requirements for distribution and Class I power transformers shall <u>be applied-voltage and induced-voltage test levels as specified in Table 4.</u>	Agree

Comment Number	Author	Clause/ Subclause	Paragraph Figure/ Table	Type of comment (General/ Technical/Editorial)	Comments	Proposed change	Resolution
5c	B. Patel		5.10.4.2 a.	Editorial	A voltage to ground (not necessarily to neutral) shall be developed at each terminal in accordance with Column 6 of Table 5. For ungraded windings, this voltage shall be maintained throughout the winding.	A voltage to ground (not necessarily to neutral) shall be developed at each terminal in accordance with <b>Columns 3, 4 &amp; 5 of Table 4</b> . For ungraded windings, this voltage shall be maintained throughout the winding.	Agree
5d	B. Patel		5.10.4.2 b.	Editorial	A phase-to-phase voltage shall be developed between line terminals of each three-phase winding. in accordance with Column 6 of Table 5 or Column 2 of Table 7, when applicable.	A phase-to-phase voltage shall be developed between line terminals in accordance with Column <b>3 of Table 4</b> .	Agree
9	Bill Henning		5.10.3.3 and table 7	Technical	George Iliff and Bill Henning both support the notion of tying Low Frequency Tests to System Voltage instead of BIL. If we adopt the new tables 4, 5, and 6, then section 4.10.3.3 and table 7 should be eliminated.	<b>Eliminate section 5.10.3.3 and table 7.</b> They were introduced to assure adequate test levels for low BIL options. With Low Frequency test levels tied to system voltage the precautions in this section are no longer needed.	Agree  Bipin to check for references.  <b>2/11BKP - YES, I will do this once all comments are reflected in the text to make sure the deletion of the table is consistent.</b>
11 17 30	Jerry Corkran Mahesh Sampat Steve Snyder		Table 4 applied test	Technical	<i>Disapproved" based on the changes listed for some of the proposed test voltages as compared to the existing test voltages,</i>	Keep present applied test voltages for all BIL's	The issue is largely concentrated on 25 and 35 kV system voltages where multiple BIL's have been used. If Applied is defined 2* rated volts + 1 kV then some test levels will rise for low BIL's and fall for high BIL's. If we use Class II Power Transformer philosophy, the test will be 1.5 * system voltage and all BIL's will use the lowest present permissible BIL. <b>The Chair recommends Class II test levels.</b>  Show both table options.

Comment Number	Author	Clause/ Subclause	Paragraph Figure/ Table	Type of comment (General/ Technical/Editorial)	Comments	Proposed change	Resolution
13a	Joe Foldi			Editorial	Table 4, Induced Test, Col 6: the heading should state if the voltages listed are Line to Ground or Line to Line and also it should state here or somewhere else the tap position for this test. The values don't seem to be 2 x rated. My proposal is to state the Line to Ground test voltages and tap position. Note 1 should be taken out.	Eliminate note 1 from table 4 and state tap position	Note 1 is where line to ground is defined. It also needs to indicate "Max tap . <b>BKP- disagree with indicating tap position since it's already covered in C57.12.90 sub-clauses 10.2 &amp; 10.3.</b>
13b	Joe Foldi		5.10.4.2 b.	Technical	Table 6, The note should say that the tap position should be selected to obtain a Switching Impulse test voltage on the low (or other) voltage winding terminals closest to their prescribed values but without exceeding them. This could be harmonized with Section 5.10.7.2.	Modify wording for table 6 to set test at tap which best stresses both high voltage and low voltage windings at their prescribed levels.	Agree <b>BKP- disagree with indicating tap position since it's already covered in C57.12.90 sub-clauses 10.2 &amp; 10.3.</b>
13c	Joe Foldi		5.10.1.1	Editorial	Section 5.10.7 Impulse Test: In Subsection 5.10.7.1 it lists the Impulse tests as RFW, 2 CW and FW for the Class II transformers, but no mention about the test details for the Distribution and Class I transformers.	Add wording to describe the type of BIL test Full ANSI is RFW, 2 CW, and FW Quality Control is RFW and 2 FW	Agree <b>BKP –C57.12.90 describes the test in details. I suggest we truncate the sentence as, "The lightning impulse test shall include reduced-full-wave, chopped-wave, and full-wave tests at the specified levels per Columns 1 and 2 of Table 6."</b> The sentence as it is doesn't specify details. I think Joe misread CW as 2CW. Subhash has forwarded request for new action item to address Distribution and Class I transformers.

18a	Pierre Riffon		Column 6 of Table 4 header.	Editorial	The heading of column 6 of Table 4 shall be changed for : " 2 x Nominal Voltage"	Insert word "Nominal" for "Rated" in header of column 6 in table 4.	Agree done
18b	Pierre Riffon		Note 4 of table 4	Editorial	Note 4 of Table 4: Rated voltage is not clearly defined in IEEE C57.12.00. Either defined the terms "rated voltage" in the definition section or change "rated" for "nominal".	Change rated to Nominal	Agree done
18c.	Pierre Riffon		Note 1 of table 5	Technical	Note 1 of Table 5: This sentence does not apply to 735 kV and 765 kV test levels. Make clear that this is a general rule for nominal system voltages of 345 kV and below and that other induced test levels apply to 500, 735 and 765 kV nominal system voltages.	The test levels for 735 kV and 765 kV transformers have enhanced levels of 2 times the Line to ground voltage.	Chair questions the need for the listed low frequency test. What condition would make the low frequency test requirements more onerous than other Class II transformers, where a 1.8 multiplier seems to be sufficient?  New table for meeting.
18d.	Pierre Riffon		Note 4 of table 5	Editorial	Note 4 of Table 5: Rated voltage is not clearly defined in IEEE C57.12.00. Either defined the terms "rated voltage" in the definition section or change "rated" for "nominal".	Change rated to Nominal	Agree done
18e.	Pierre Riffon		5.10.1.1.	Editorial	In 5.10.1.1 Basic Lightning Impulse Insulation Level (BIL): Make also reference to Table 5.	Refer to table 5 as well as table 4.	It already does.

18f.	Pierre Riffon		Table 6	Technical	<p>The main reason of my negative: Table 6. The 0,83 ratio for defining the switching surge level from the BIL rating has been historically good for most of the systems voltages. Nevertheless, for EHV systems like 735 kV and 765 kV, this ratio is sometime too high and lower ratios have been proven to be full satisfactory for service conditions. For instance, for our Hydro-Quebec 735 kV system, the BSL level associated with 1950 kV BIL is 1550 kV e.g. a ratio of 0,79 instead of the proposed 0,83 ratio. This BSL level is well used worldwide for 800 kV systems and specified by all IEC standards. Specifying a standardized BSL level of 1620 kV for 1950 kV BIL transformers will lead to an unnecessary transformer and bushing cost increases. This cost increase can not be justified by any service related problems. We do request to change the 1620 kV value to 1550 kV or the keep these lines blank and by adding a note saying that for EHV transformers, the BSL level should be specified by the user based on its insulation coordination practices.</p>	Set Switching surge level at 1550 kV for 1950 kV BIL ratings.	Need discussion
------	---------------	--	---------	-----------	--	---	-----------------

18g	Pierre Riffon		Table 6	Technical	Table 6: Delete the note since its is not clear what it is meant. Furthermore, all windings of a power transformer shall be designed and constructed to withstand switching voltages induced from any of the windings.	Eliminate note	<b>Disagree</b> if the ratio is high as the highest voltage winding may become over-stressed.  Do not eliminate the note.
20a	Jean-Christoff Riboud		Column 5 of tables 4 and 5	Technical	<p><b>Comment #1 Table 4 &amp; 5</b></p> <p>It could useful to give guidance on how to determine the necessary minimum insulation of impedance grounded Y ( column 5 of table 4 and 5)</p> <p>For RTE in France the minimum insulation (applied test) is based on the voltage appearing on the neutral during the single phase short circuit which is :</p> <p>Voltage on neutral = Asymmetrical factor of short circuit * Neutral impedance * single phase short circuit current</p> <p>And the single phase short circuit current can be determined according to “Transformer engineering “ ed 1951 chapter VI part I page 150  <math>I_{\text{fault}} = 3 E_{\text{leg}} / (Z_{\text{positive}} + Z_{\text{negative}} + Z_{\text{zero sequence}} + 3 Z_{\text{neutral}})</math></p>	Specify method for minimum neutral impedance ( <b>insulation???</b> ) for impedance grounded windings.	<p><b>Agree</b></p> <p><b>BKP- I think you meant “insulation” in the previous column.</b></p> <p><b>BKP-I don’t mind adding guidance but generally standard is not the place for guidance. I don’t know of an existing guide where we can add this.</b></p> <p><b>This should be an application guide. IEEE 32 Grounding devices/</b></p>

20b	Jean-Christoff Riboud		Table 7.	Technical	<p><b><u>Comment #2 Table 7</u></b></p> <p>The applied voltage levels are different from the previous version and different from the IEC. I would suggest to stick with the IEC standard values and replace</p> <p>173 by 185 207 by 230 242 by 275 345 by 360 518 by 520</p> <p>Or at least if this is considered as not acceptable by the WG the figures shall be rounded up to the next 5 kV.</p>	Standardize applied test levels for Class II transformers in Table 7 with IEC	The Chair recommends eliminating Table 7 and this comment is not necessary
21	Roger Hayes		Table 6	Editorial	When performing switching impulse tests, should there be a default position concerning the status of an available neutral terminal? I suggest it should be grounded unless otherwise requested by the user. This also of course affects the design as mentioned in clause 5.10.1.2.	Ground neutral terminals during switching impulse testing.	<p>Agree-Subhash will send to C57.12.90.</p> <p><b>BKP- The proposed change makes sense but it belongs to C57.12.90.</b></p>
22a	Subhash Tuli		Header.	Editorial	Header for this survey is incorrect and needs correction.	Correct it to say Liquid filled transformer Dielectric Test Tables Survey	Agree Wagenaar should do.
22b	Subash Tuli		Tables 4 and 5, notes 2 and 4	Editorial	From tables # 4 and # 5: Reverse footnote #2 with #4 and #4 with #2.	Reverse order of notes 2 and 4	Agree done

22c	Subhash Tuli		5.10	Technical	<p><b>Clause # 5.10: Item (A) &amp;(B):</b>  In Item #A: Replace 69 kV with 46 kV and revise new tables # 4 and #5 accordingly.</p> <p>In Item #B: Replace 115 kV with 69 kV and revise new table #5 accordingly.</p> <p>.</p>	Stop Distribution and Class I Power Transformers at 46 kV and start Class II Power transformers at 69 kV in tables 4 and 5	Disagree
22d	Subhash Tuli		5.10.1.5	Technical	<p><b>Sub-Clause 5.10.1.5:Windings that have no terminals brought.</b></p> <p>Add an additional statement that “ Before final assembly turns ratio and DC resistance measurements shall be carried out to verify the design and assembly”</p>	Add an additional statement that “ Before final assembly turns ratio and DC resistance measurements shall be carried out to verify the design and assembly”	Agree <b>BKP-The proposed change makes sense but it’s a procedure and should be part of C57.12.90 and Performance Characteristics Subcommittee. Subhash to follow up.</b>
22e	Subhash Tuli		5.10.7.1.	Technical	<p><b>Sub-clause 5.10.7.1: Lightning Impulse tests.</b></p> <p>A statement in the first paragraph “ <b>When lightning Impulse tests are required on line terminals , the neutral terminals rated 200 kV BIL and above shall be impulse tested”</b></p>	<p>A statement in the first paragraph “ <b>When lightning Impulse tests are required on line terminals , the neutral terminals rated 200 kV BIL and above shall be impulse tested”</b></p> <p>The above statement in bold letters must be replaced with this bold statement</p> <p>“ <b>For class I and II Transformers, Lightning Impulse tests are required on all line and neutral terminals. However Chopped wave tests shall only be performed on line terminals”.</b></p>	<p>Discussion of threshold test level.</p> <p><b>BKP- I agree with your proposal of discussion at the meeting. In Subhash’s suggested wordings I don’t think you need to include,” However Chopped - - - “. Standard lighting impulse test for neutrals don’t require CW.</b></p> <p><b>2/11 BKP – see the proposed change at the end of the table.</b></p>

23	Loren Wagenaar		Table 7	Technical	I agree with many of the comments that have been received on this survey. I particularly agree with the removal of Table 7 since I have never used it. Does it have any practical purpose anymore?	Eliminate Table 7	Agree.
27a	Mark Perkins		C57.12.90	Editorial	The changes in these tables may have a direct impact on C57.12.90 and this needs to be addressed so that both standards are consistent.	Check requirements I C57.12.90 for consistency with the revisions of C57.12.00	Agree done
27b	Mark Perkins		Table 5 columns 6 and 7	Editorial	As was mentioned in the last working group meeting, there may be some issue regarding what the nominal system voltage is for generator transformers where the LV voltage rating falls between the different nominal voltage levels in Table 5. As a result, the voltage level specified for the induced test in Table 5 may not be reached for the LV winding. This may need a clarifying note.	Add words to provide proper induce of low voltage windings for non-standard system voltages as is typical of generator transformers.	Agree done.
27c	Mark Perkins		Appendix	Editorial	In my opinion, the standard is not an appropriate place to document historical information so the table on front of wave testing levels should not be included.	Move it somewhere else	Disagree the appendix is the natural repository for historical information.

28	Bruce Forsyth		Column 5 in tables 4 and 5	Editorial	Unless I missed it, it appears the “Imp” that appears in headings in tables 4 & 5 has not been defined. I think some sort of clarification is required for this and any other abbreviations that are used.	Spell Impedance	Agree done
29	Dong Kim		5.10.7.1.	Technical	Table 5 applied test column need to be reviewed with the previous table 6, column 7. Different test levels related with BIL levels within the same system voltage.	Examine applied test levels in new table 5 and compare to old class II	New Class II test levels are 1.5 * system voltage.
30a	Steve Snyder		Notes in tables old table 4	Editorial	Section 5.5.1 reference is made to Tables 4 and 5. The “old” Table 4 contained notes that I believe are still pertinent in the new document, and should be included. These don’t necessarily need to be continued in the format of notes, but the information retained and presented in the text.	Retain old notes	Define what material should be retained.
30b	Steve Snyder		5.10	Editorial	Section 5.10 Insulation Levels, a new statement was added “The following tables on subsequent pages ..... of liquid-filled power transformers.” I suggest changing that statement to something similar to “ <i>The following Tables 4, 5, 6, 7 show various system voltage, insulation, and test levels for liquid-filled transformers.</i> ” The tables pertain to more than power transformers.	Show an index of the tables at 5.10	Agree, same comment as Bipin Patel.

30c	Steve Snyder			Editorial	Section 5.10 Insulation Levels, one of the new statements refers to “Table 6 High Frequency Insulation Levels”. Table 6 is actually titled “High Frequency Test Tables”. I am not sure which designation is more accurate, but they should be consistent (the same).	Change index page in 5.10 to state High Frequency Test Tables instead of High Frequency Insulation Levels	Agree  2/11 BKP Clause 5.10 – - <u>Change, “Table 6 lists high frequency insulation Levels.” To “Table 6 lists high frequency test levels.”</u>
30d	Steve Snyder		Table 4	Technical	Table 4 : I strongly request that we bring back the preferred BIL designation for each of those instances where multiple BIL levels are listed. This could be done by making the preferred BIL <b>boldface</b> , as it was done in prior editions of the standard.	Insert Bold type for preferred BIL levels	Chair agrees that this would make selection easier for many users.
30e	Steve Snyder		Tables 4 and 5	Editorial	Table 4 : As a personal preference, I would structure the tables so that the BIL columns immediately follow the “Nominal System Voltage” (column # 2), and then follow that with the applied and induced test levels. Just a personal choice.	Place BIL before Applied tests in the table	Chair disagrees with this move. Low frequency tests are dependent on system voltage. Bil is dependent on exposure. Placing the Low frequency tests close to the system voltage identification solidifies the relationship.
30f	Steve Snyder		Column 4 of table 4.	Technical	Table 4 : If I am interpreting the table correctly, it appears that transformers designed for GrdY application would be required to withstand an applied potential test. Many single-phase distribution transformers so designed have one end of the winding internally grounded, making this test impossible to conduct.	Transformers with solidly grounded neutral terminals and no external link should not be given an applied test	Agree, this appears to be an error that was introduced..  BKP- This can be covered by appropriate wordings under sub-clause 5.10.2.

30g	Steve Snyder		Table s 4 and 5	Editorial	Section 5.10.1.1 Basic Lightning Impulse Level (BIL). "A basic lightning impulse insulation level (BIL) from Table 4 shall be assigned .....". This should say "from Table 4 <b>or Table 5</b> shall be assigned .....".	Insert from tables 4 or 5	Agree.
30h	Steve Snyder		5.10.4.4	Editorial	Section 5.10.4.2 Applied-Voltage Requirements lists the criteria for conducting the applied-voltage test, but it lists the induced voltage requirements too. I suggest adding a section 5.10.4.4 specifically for the induced voltage test requirements.	Establish a special header for the induced test	Chair believes that wording can be added to present section to specifically define needs for the induced test.

30i	Steve Snyder		Table 5 columns 6 and 7	Technical	<p>Perhaps this is a good time (and location) to add the special induced voltage test for single-phase, single bushing distribution transformers that have one end of the primary winding internally grounded ? That would be section 6.2 in C57.12.20-2005, as follows : <i>“For single-phase transformers with a BIL of 150 kV or less that have one high-voltage bushing and a high-voltage terminal permanently connected to ground, no applied-voltage test is required. Induced-voltage tests shall be performed by applying between the terminals of one winding a voltage that will be developed from the high-voltage line terminals to ground. This voltage shall be 1000 V plus 3.46 times the rated transformer winding voltage, but in no case shall the line-to-ground voltage developed exceed 40,000 V for 125 kV BIL or 50,000 V for 150 kV BIL. For this test the neutral terminal shall be grounded. An applied-voltage test shall be applied on the low-voltage winding.”</i> I know the distribution transformers' working groups are moving in a direction to get this requirement moved into C57.12.00, where it properly belongs. I suggest coordinating this effort with Ken Hanus.</p>	Induce solidly grounded windings to 3.46* rated line-ground voltage +1000 V.	<p>Discussion. The chair generally finds 2 * rated line voltage sufficient and consistent with past practice. What caused the need for 3.46* line to ground voltage?</p> <p><b>BKP- It appears that the dist. subcom has already done some work on this. We need to find out their basis for the 3.46 factor. At least the wording here clears the way for the applied potential test that Steve brought out in his earlier comment.</b></p>
34	Gustav Preininger		Table 7	Editorial	<p><u>Table 7 (seven)</u> shows some printing errors.</p>	Fix the printing errors	<p><b>Plan to fix by eliminating the table.</b></p>

32a	Eric Davis		5.10.1.1	Editorial	5.10.1.1: Change “from Table 4” to “from Table 4 or 5”. The BILs for Distribution and Class I transformers are in Table 4 while the BILs for Class II transformers are in Table 5.	Add “or table 5”	Agree
32b	Eric Davis		5.10.2.2	Editorial	5.10.2.2: 1 <sup>st</sup> and 2 <sup>nd</sup> paragraphs - Change “of Tables 4 & 5” to “of Table 4 or 5”.	Table 4 or 5	Agree
32c	Eric Davis		5.10.3.3	Editorial	5.10.3.3: Change “of Tables 4 & 5” to “of Table 4 or 5”.	Reword 5.10.3.3	Agree reworded
32d	Eric Davis		5.10.4.2 b	Editorial	5.10.4.2 (b): Delete the period after “winding”.	Delete period after winding.	Agree
32e	Eric Davis		5.10.4.3	Editorial	5.10.4.3: Change “low-frequency” to “applied-voltage”. We changed the title of 5.10.4.2 from low-frequency to applied-voltage. Since the exceptions seem to directed to the conditions of 5.10.4.2, we should make a similar change in the text.	Rework wording of 5.10.4.3	Agree..

### 5.10.7.1

#### AS IS

**The lightning impulse test shall include reduced-full-wave, chopped-wave, and full-wave tests at the specified levels per Columns 1 and 2 of Table 6 for Class II power transformers. Lightning impulse tests shall not be made on windings that do not have terminals brought out through the tank or cover. When lightning impulse tests are required on line terminals, the neutral terminals rated 200 kV BIL and above shall be lightning impulse tested. Lightning impulse tests are not required on terminals brought out from buried windings in the following cases:**

**PROPOSED CHANGE:**

**The required lightning impulse test levels are shown in Columns 1 and 2 of Table 6. Lightning impulse tests shall not be made on windings that do not have terminals brought out through the tank or cover. When lightning impulse tests are required they shall be performed on line as well as neutral terminals. Lightning impulse tests are not required on terminals brought out from buried windings in the following cases:**