

Trends in IEC environmental testing standards for LCD

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International standards contained in IEC publication 61747-5 (Environmental, Endurance and mechanical test methods) for use in environmental testing of Liquid Crystal Displays (LCD) have now been published. These standards were deliberated and enacted by international committee IEC TC47/SC47C/WG2 based on a Japanese proposal. These new standards integrate standards for mechanical environmental testing such as shock and vibration tests, atmospheric environmental testing such as temperature and humidity tests, and these standards have been combined with pre-existing visual inspection standards.

This report will discuss the background, details and contents of these newly-enacted standards, focusing on atmospheric environmental testing in particular.

1. IEC activity in creating LCD standards

The IEC (International Electrotechnical Commission) enacts international criteria and standards related to electrical and electronic matters. This organization is composed of Technical Committees (TC), Sub-Committees (SC), and an International Special Committee on Radio Interference (CISPR).

International standards are actually drafted within Working Groups (WG) composed of specialists gathered from around the world. The WG, which write the initial drafts, are subordinate to the various TC and SC.

Currently the IEC TC start with TC1 (Terminology) and go to TC106 (Testing Instrumentation and Methods for Measuring Electric and Magnetic Fields Associated with Human Exposure). LCD is deliberated by WG2, connected to SC47C, which itself belongs to TC47. In establishing standards, the WG study the proposals in comparison with standards from other TC.

Committees with items related to LCD include TC1 (Terminology) and TC25 (Quantities and Units, and Their Letter Symbols), which deal with items describing LCD standards and specifications. In addition, the multimedia field of TC100 is strongly connected to color management problems. LCD also has a strong relationship to TC104, which received jurisdiction of IEC environmental testing series that was transferred from TC50.

Fig. 1 shows the TC/SC/WG related to LCD standards.

IEC standards first go through the following seven stages, then are enacted and published: Preliminary stage, Proposal stage, Preparatory stage, Committee stage, Enquiry stage, Approval stage, and Publication stage. (Table 1)

As you can see, an item must pass through a large number of deliberations and votes before being published. At least three years are required from the time the theme is set until a standard can be published. Average items require about five years, and some can take more than 10 years.

Table 1 Project stages and related documents

Project stage	Related documents	
	Name	Abbreviation
0 Preliminary stage	Preliminary Work Item	PWI
1 Proposal stage	New Work Item Proposal	NP
2 Preparatory stage	Working Draft	WD
3 Committee stage	Committee Draft	CD
4 Enquiry stage	Enquiry Draft	
	Draft International Standard (ISO) Committee Draft for Vote (IEC)	DIS CDV
5 Approval stage	Final Draft International Standard	FDIS
6 Publication stage	International Standard	ISO/IEC

Source: "Outline of IEC Activities", Japan Standards Association (March 1998)

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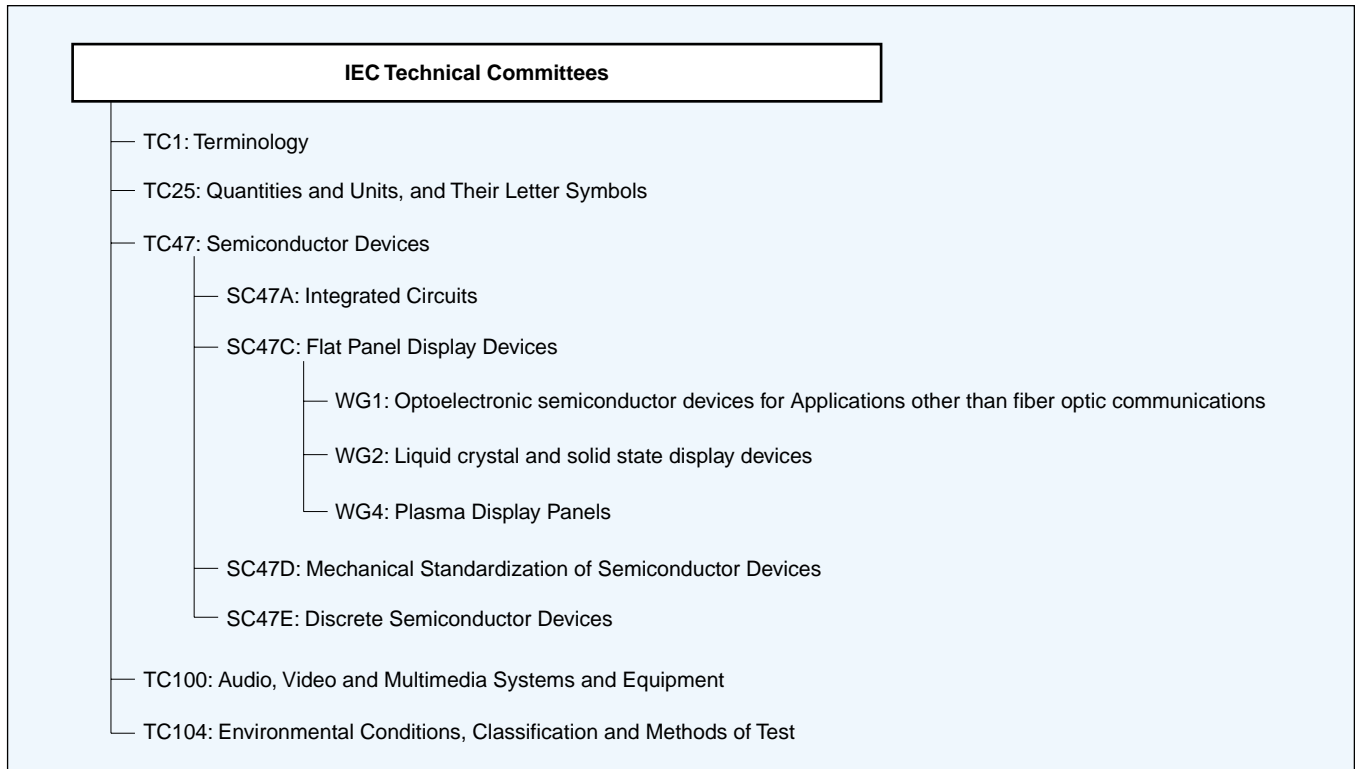


Fig. 1 IEC/TC/SC/WG related to LCD

2. IEC environmental testing standards for LCD

2-1 Details of enacting standards

Along with the growth in LCD production has come the establishment of the “Technical Committee on Electronic Display” and its attached “Subcommittee on Liquid Crystal Displays” in 1990 by the EIAJ (Electronic Industries Association of Japan). These groups were set up to strengthen standardization activity in Japan, and have initiated studies of EIAJ standards for all matters related to LCD.

The first standards enacted by this committee were related to environmental testing methods, and were published in 1992 as EIAJ ED-2531A “Environmental testing methods for Liquid Crystal Display devices”.

Since its inauguration by the EIAJ in 1990, this committee has been sending members to the IEC, and the committee has become the site of deliberations in Japan for IEC standards related to LCD. The name of the committee has now been changed to the “Technical Standardization Committee on Electronic Display Devices” (renamed from the “Technical Committee on Electronic Display”), “Liquid Crystal Display Group” (renamed from the “Sub-Committee on Liquid Crystal Displays”).

The English translation of EIAJ ED-2531A served as the proposal submitted to IEC/TC47/SC47C/WG2 by Japan, and after a series of deliberations and votes, the measures have been enacted as IEC 61747-5 (Environmental, endurance and mechanical test methods). The new proposal (NP) of February 1993 resulted in a committee draft (CD) approximately a year and a half

later in July 1994, and the proposal finally was approved for publication as an international standard in April 1998. Actual publication took place two months later in June 1998, requiring a total of five years and four months for the entire process.

The initial year and a half constitute the core activity within this process, and after that the time is spent on formal procedures consisting of comments, revisions, and votes. This process is hardly suited to our current rapid pace of technological progress, and so the IEC is currently conducting internal studies on methods of speeding up the standards enactment process.

2-2 Outline of standards

As previously discussed, a draft of EIAJ ED-2531A was deliberated, but when the items reached the publication stage, they became integrated into IEC 60747-5 (Semiconductor devices: Discrete devices and integrated circuits-Part 5: Optoelectronic devices) and compiled as an amendment concerning visual inspections.

These visual inspections are not closely related to environmental testing, but this organization can be understood as a result of the structure of the IEC standards system.

Table 2 shows the table of contents for IEC 61747-5.

2-3 General

The section titled “1. General” covers the area of purpose and applications, as well as making provisions for standard conditions. The standard reference temperature used for general electronic parts is usually 20°C (IEC 60068-1). These measures prescribe 25°C as the standard reference temperature, the same as the temperature for semiconductor device standard reference temperature (IEC 60749).

Table 2 Table of contents for IEC 61747-5

<p>1. General</p> <p>1.1 Scope and object 1.2 Normative references 1.3 Terms, definitions and letter symbols 1.4 Standard atmospheric conditions 1.5 Visual examination and verification of dimensions 1.6 Electrical and optical measurements 1.7 Electrical operating conditions</p> <hr/> <p>2. Mechanical test methods</p> <p>2.1 Robustness of terminations 2.2 Soldering 2.3 Vibration (sinusoidal) 2.4 Shock 2.5 Acceleration, steady state 2.6 Bond strength test</p> <hr/> <p>3. Environmental and endurance test methods</p> <p>3.1 Change of temperature 3.2 Storage (at high temperature) 3.3 Storage (at low temperature) 3.4 Low air pressure 3.5 Damp heat, steady state 3.6 Damp heat, cyclic (12+12-hour cycle) 3.7 Composite temperature/humidity cyclic test 3.8 Light exposure 3.9 ESD test</p>	<p>4. Miscellaneous test methods</p> <p>4.1 Permanence of marking 4.2 Scratch test (of face plate) 4.3 Life test</p> <hr/> <p>5. Visual inspection of monochrome matrix liquid crystal display modules (Excluding all active matrix liquid crystal display modules)</p> <p>5.1 General 5.2 Visual inspection of displays</p> <hr/> <p>6. Visual inspection of monochrome liquid crystal display cells (Excluding all active matrix liquid crystal display modules)</p> <p>6.1 General 6.2 Visual inspection of displays 6.3 Seal inspections (see figure 13) 6.4 Visual inspection of contact pad area (see figure 14) 6.5 Visual inspection for chipped material at the borders and edges of the support plates of cells</p>
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IEC 60068-1 sets 20, 23, 25, and 27°C for referee measurements and tests, but the new LCD standards sets 20, 25, 30, and 35°C for referee measurements and tests. This change is based on the greater susceptibility of the numerous LCD functional characteristics to be affected by temperature, and so reflects the opinions of LCD manufacturers concerning the necessity of using an extremely wide temperature range. (Because IEC standards publications have now become five digit numbers, the previous environmental test method 68 series has become the 60068 series, and the semiconductor-related 74X series has become the 6074X series.)

2-4 Mechanical testing

The second section is titled “2. Mechanical test methods”, and contains standards for robustness of terminations, solder heat endurance, vibration, shock, acceleration, and bond strength of flat surface terminals. Most of the items are borrowed from the IEC 60068 series on environmental test standards, and measures include the use of large glass panels in conditions for severity. Comparatively mild conditions are prescribed due to construction involving internally-injected liquid.

Furthermore, just as with the bond strength test for flexible flat cables, examples of actual tests used by LCD manufacturers were used for reference in setting original methods for items with no pre-existing standards.

2-5 Weatherability

The third section, titled “3. Environmental and endurance test methods”, prescribes test conditions related to Change of temperature, Storage (at high temperature and low temperature), Low air pressure, Damp heat, Composite temperature/humidity cyclic test, Light exposure, and ESD (electrostatic discharge) tests.

This section also borrows from the IEC 60068 series and the IEC 60749 series, and determines supplementary conditions appropriate to LCD characteristics.

Tables 3 and 4 show conditions for items related to temperature testing, with Table 3 showing the low test temperatures and Table 4 the high test temperatures.

The original Japanese proposal set the low-temperature range down to -40°C, but this was further lowered to -50°C based on opinions from the European committee members.

**Table 3
Low test temperatures**

-50 ± 3°C
-45 ± 3°C
-40 ± 3°C
-35 ± 3°C
-30 ± 3°C
-25 ± 3°C
-20 ± 3°C
-15 ± 3°C
-10 ± 3°C
-5 ± 3°C
0 ± 3°C

**Table 4
High test temperatures**

+100 ± 2°C
+90 ± 2°C
+85 ± 2°C
+80 ± 2°C
+75 ± 2°C
+70 ± 2°C
+65 ± 2°C
+60 ± 2°C
+55 ± 2°C
+50 ± 2°C
+45 ± 2°C
+40 ± 2°C
+35 ± 2°C
+30 ± 2°C

The IEC 60068 series dealing with general electronic parts, as shown in Tables 5 and 6, has a wider temperature range.

Table 5
Low test temperatures
(60068-2-1)

-65 ± 3°C
-55 ± 3°C
-40 ± 3°C
-25 ± 3°C
-10 ± 3°C
+5 ± 3°C
-5 ± 3°C

Table 6
High test temperatures
(60068-2-2)

+200 ± 2°C
+175 ± 2°C
+155 ± 2°C
+125 ± 2°C
+100 ± 2°C
+85 ± 2°C
+70 ± 2°C
+55 ± 2°C
+40 ± 2°C
+30 ± 2°C

2-6 Other tests

The next section, “4. Miscellaneous test methods”, standardizes marking tests only.

This subject deals with testing the difficulty of fading of the display printed on the LCD device and so uses IEC 60068-2-45 (Environmental Testing, Part 2: Tests, Test XA and guidance: Immersion in Cleaning solvents) for reference. The standards proscribe the use of freon solvents.

2-7 Visual inspection

The final two sections are “5. Visual inspection of monochrome matrix LCD modules” and “6. Visual inspection of monochrome LCD cells”.

As noted above, these sections were taken from pre-existing LCD-related standards IEC 60747-5 (Semiconductor devices: Discrete devices and integrated circuits-Part 5: Optoelectronic devices) and were combined with these standards.

3. Conclusion

The development of LCD technology is making rapid strides. With new applications continually being developed for the technology, the market is growing rapidly. The need to maintain product reliability during this time of growth is beyond question.

Assuring international clarity presents a major problem for the domestic market, and as a result, these international standards should merely be mimicked for domestic standards. In that sense, international standardization activity can be considered to be increasingly vital to Japan as well as to the rest of the world.

For copyright reasons, detailed contents of the standards have been omitted. For such details, please refer to the reference literature listed.

[Bibliography]

- 1) “EIAJ IEC Activities '98”, Electronic Industries Association of Japan
- 2) IEC 60068-1 Environmental testing. —Part 1: General and guidance
- 3) IEC 60068-2-1 Environmental testing. —Part 2: Tests. Tests A: Cold
- 4) IEC 60068-2-2 Environmental testing. —Part 2: Tests. Tests B: Dry heat
- 5) IEC 60068-2-45 Environmental testing. —Part 2: Tests. Test XA and guidance: Immersion in cleaning solvents
- 6) IEC 60749 Semiconductor devices —Mechanical and climatic test methods
- 7) IEC 61747-5 Liquid crystal and solid-state display devices. —Part 5: Environmental, endurance and mechanical test methods
- 8) IEC web site (<http://www.iec.ch>)