The Importance of Standards for PCBs when doing business in Europe

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Abstract:

Standards are important for harmonizing fabrication processes, health and safety requirements and to provide a high and reproducible level of quality products. However, standards are always written after the event, that means, after a process, a material or a technology has been developed and established. Europe is strong in developing new technologies in the mobile phone market as well as in automotive and industrial and health care electronics. The correct use of standards is important to insure consistency in quality and in meeting technical and health and safety requirements. For this reason, it is important that standards ALWAYS reflect the latest technology in fabrication and that new materials are incorporated at an early stage of developments. As standards are also required in case of a legal conflict, it is important that the use of standards is well understood and what is needed in case that “non standard products” have to be manufactured and supplied. The paper will help to provide an inside in these topics and what PCB fabricators have to do to avoid issues and expensive legal disputes in case of a technology or quality conflict.

Figure 1. Map for Europe with PWB Fabricators per country
Introduction.
For many hundreds of years Europe was divided into many different courtiers. In the beginning of the industrialization Europe consist of more then 25 larger countries. Each of this countries developed its own standards depending on the needs of its industry. This is history today. We have the European Union. As such, a lot of activities are ongoing in the field of standardization as well as in the process of harmonized from country to country. The objective is that easier trade will benefit the industry and the consumer in terms of product performance, cost and safety and health. However, we still have to deal with 25 major counties and 18 major languages. Each country has its own standard body. In addition the new environmental needs have also had a tremendous impact on the standards that are used today. The so called ECO labels from different organizations are often regarded as trade barriers and have to be dealt with. In addition the legal requirements specified under RoHS put additional restriction on materials that are legally allowed to be used. The paper will help to better understand the requirements when doing business with companies in Europe.

What standards do exist and which standards shall be use when doing business with European companies?

Europe consist of many countries. Therefore international recognized standards MUST be used. For PWBs this are the standards that are supported and maintained by the International Electrotechnical Commission (IEC) standards Working groups under the technical committee TC91. The IEC is in operation for more then 100 years. The organization was formed to harmonize the standards for electrical installation and equipment to insure high standards in safety. In addition, compatibility between the equipment for different vendors and manufactured in different countries have been achieved.

The basis of understanding how IEC standards become European standards is important. The characters IEC in front of the IEC document number are replaced by an EN
This means that an IEC 61249-4-12:2005 becomes an EN 61249-4-12:2005

Many of the national standards are generated in a “COPY AND PASTE” from the original IEC standard. However, the IEC standard is often very close related to standards created in the USA by the IPC or in Japan by the JPCA. When a new standard in Japan, in Germany, in the USA or in any other member countries is created, the IEC will receive a proposal from the national committee of this country to convert this standards in an IEC standard.

After a lot of discussions in the national and international working groups, and a complex voting procedure including all world wide members of the IEC that are part of this working group, the standard becomes an IEC standard. This procedure may take one to two years or in case of fast developments in technology, even longer. As the voting procedure allow each member country
to make comments and correction if required, the standards draft sometimes takes several years to be issued in its final stage. As a consequence, the original created standard draft (used to create the IEC standard) are often one to two years earlier on the market and are used in manufacturing new products.

**Lets look for an example of the IEC 61249 the material standard:**

Non-halogenated multifunctional epoxide woven E-glass prepreg of defined flammability Document Number:

IEC 61249-4-12:2005 Materials for printed boards and other interconnecting structures.

When this standard is used in the United Kingdom this becomes the following standard is part of the British Standard organization(BS):

BS EN 61249-4-12:2005 Materials for printed boards and other interconnecting structures. Non-halogenated multifunctional epoxide woven E-glass prepreg of defined flammability.

In Germany this standard will become part of the German standard system “Deutsches Institut für Normung” DIN.

As a result the original IEC 61249-4-12:2005, is in Germany DIN EN 61249-4-12:2005.

In many other European countries it may be similar.

The content is equal to the IEC publication. In some cases, the standards are also translated into the local language. However, in case of any legal issues the original IEC standard will be consulted.

The IEC is a world wide international standard organization. As such it has the objective to maintain the world wide responsibility for safety and reliability that will benefit the OEM and the consumer.

**Adopted European Standard (examples)**

Updated standards to include also halogen free laminate and prepreg

This part of IEC 61249 gives requirements for properties of modified non-halogenated epoxide woven E-glass laminated sheet 0,05 mm up to 3,2 mm, of defined flammability (vertical burning test), copper-clad. The flammability rating is achieved through the use of phosphorus compounds and/or aluminium hydroxide fire retardants contained as part of the polymeric structure. The glass transition temperature is defined to be between 150 °C to 190 °C.

Some property requirements may have several classes of performance. The class desired should be specified on the purchase order, otherwise the default class of material will be supplied.
EN 61249-X-Y
Materials for printed boards and other interconnecting structures. Reinforced base materials, clad and unclad.

Here are the sectional specification for X and Y

Part 2-1: Phenolic cellulose paper reinforced laminated sheets, economic grade, copper clad

Part 2-2: Phenolic cellulose paper reinforced laminated sheets, high electrical grade, copper-clad

Part 2-4: Polyester non-woven/woven fiber glass laminated sheets of defined flammability (vertical burning test), copper-clad

Part 2-5: Brominated epoxide cellulose paper reinforced core/woven E-glass reinforced surfaces laminate sheets of defined flammability (vertical burning test), copper-clad

Part 2-6: Brominated epoxide non-woven/woven, E-glass reinforced laminated sheets of defined flammability (vertical burning test), copper-clad

Part 2-7: Epoxide woven E-glass laminated sheet of defined flammability (vertical burning test), copper-clad

Part 2-8: Modified brominated epoxide woven fiber glass reinforced laminated sheets of defined flammability (vertical burning test), copper-clad

Part 2-9: Bismaleimide/triazine (BT), modified epoxide or unmodified, woven E-glass reinforced laminated sheets of defined flammability (vertical burning test), copper-clad

Part 2-10: Cyanate ester, brominated epoxide, modified or unmodified, woven E-glass reinforced laminated sheets of defined flammability (vertical burning test), copper-clad

Part 2-11: Polyimide, brominated epoxide modified or unmodified, woven E-glass reinforced laminated sheets of defined flammability (vertical burning test), copper-clad

Part 2-12: Epoxide non-woven aramid laminate of defined flammability, copper-clad

Part 2-13: Cyanate ester non-woven aramid laminate of defined flammability, copper-clad

Part 2-18: Polyester non-woven fiber glass reinforced laminated sheet of defined flammability (vertical burning test), copper-clad
Part 2-19: Epoxide cross-plied linear fiber glass-reinforced laminated sheets of defined flammability (vertical burning test), copper-clad

Part 2-21: Non-halogenated epoxide woven E-glass reinforced laminated sheets of defined flammability (vertical burning test), copper-clad

Part 2-22: Modified non-halogenated epoxide woven E-glass laminated sheets of defined flammability (vertical burning test), copper-clad

Part 2-23: Non-halogenated phenolic, cellulose paper reinforced laminated sheets, economic grade, copper-clad

Part 2-26: Non-halogenated epoxide, nonwoven/woven E-glass reinforced laminated sheets of defined flammability (vertical burning test), copper-clad

This is an example for different types of laminate and prepreg specification. Many other products like solder, surface finishes and test methods have similar detailed specification for process and performance as well as for testing characteristics

How European standards are implemented:
CENELEC or CEN Commission “Européenne de Normalisation Electrique” an EU organization that controls the standard of electrical goods.

The European Committee for Electrotechnical Standardization. A body developing electrotechnical standards for the Single European Market / European Economic Area in order to reduce internal frontiers and trade barriers for electrotechnical products, systems and services. CENELEC’s 19 member countries and 11 affiliate countries aim to adopt and implement the required standards, which are mostly identical to the International Electrotechnical Commission (IEC) standards. CENELEC works in co-operation with Comité Européen de Normalisation (CEN) and European Telecommunications Standards Institute (ETSI).

The current members of CENELEC are: Austria, Belgium, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Spain, Slovakia, Slovenia, Sweden, Switzerland and the United Kingdom. Albania, Bosnia/Hertzegovina, Bulgaria, Croatia, Former Yugoslav Republic of Macedonia, Serbia and Montenegro, Turkey and Ukraine are currently ‘affiliate members’ with a view to becoming full members. Although CENELEC works closely with the European Union, it is not an EU institution.

As to be seen on the list most of the European countries are following the IEC standards.
What about the others?

A. Company specification.

However, Europe have also a number of large OEM companies. In this operations, company standards have been developed and used as a part of the purchasing contract.

Large companies in Europe uses there own standard specification. However, in many cases these are very similar to IEC or other standards. Only specifics, not included in public standards, are specified in separate company standards.

Key reason for using company standards are innovation, leadership in technology and “proprietary property protection” to keep information inside the company. Suppliers to this companies are often requested to sign “Non Disclosure Agreements” to keep the information confidential. This is an important part for company standards and specification when new product developments are involved and confidentiality must be maintained.

B. What are other innovative companies doing?

To create standards for latest technology, the JPCA and the IPC as well as the World Electronic Circuit Council (WECC), are also involved in drafting/ writing new standards. As this are standards that serving a short term need, many of these standards representing very much “State of the Art” technology for PWBs (PCBs). Individual companies that are using IPC, JPCA or WECC standards have to insure that the purchasing agreement spells out in details the standard and standard version number. It is also recommended that copies of the standards are enclosed in the purchasing agreement.

Many electronics assembler and PWB fabricators in Europe are manufacturing using the IPC standards as a basis for advanced product and innovative manufacturing technology. In such cases, it is recommended that this is also part of the purchasing contracts. It is important to understand that IPC standards are current and well adopted with the fast changing technology in the market place.

Ecological standards and legal requirements.

Beside technical and production standards, it is important that also the ecological standards are kept up to date.

RoHS requirements MUST be fulfilled. This is not only “Lead Free” electronics, it also contains also the ban of mercury, cadmium, hexavalent chromium, PBB and PBDE!

As this is a legal requirements, there is no room for discussion. PWBs and electronic devices supplied into Europe MAST be RoHS compatible since July 1st, 2006. To meet RoHS compatibility requirements is the responsibility of the total supply chain. An assembler can not excuse himself by saying that he ordered RoHS compatible components and solder. The assembler and everybody in the supply chain have is in charge of meeting this legal requirements.
The IPC has developed standards that can help the individual company in the supply chain to ask the right question and to be specific in the declaration. However in many companies the know how is missing to fulfill the proof of being RoHS compatible. Local analytical labs often try to help. However, in many cases also here the know how is marginal and may not be sufficient to protect the fabricators.

International operating test laboratories that are IEC partners and which are IEC approved test laboratories, like Underwriter Laboratories (UL), have sufficient resources and know how to help PCB fabricators and assemblers to meet RoHS requirements. In addition as such organizations are operating around the world, support in Europe is possible also in local language. This is an effective way for clarification at every step in the supply chain until to the end user.

Figure 2  An indication of the responsibility in the supply chain. The responsibility can not be delegated from one supplier to the next suppliers. It is everybody’s responsibility. However help can be hired to do the job properly in a professional manner.

The challenge for halogen free laminate and prepreg as well as PWBs

In many cases, PWB fabricators and OEMs are using the legal requirements of RoHS also to request the move to halogen free laminate. It is the impression by many PWB fabricators that halogen free PWBs are legal. However, so far and in the near future, halogen free PWBs are legally not required by the European commission.

The next question is: “Are halogen free PWBs a technical requirement?” The answer is that many laminates and prepregs that are on the market for
making PWBs do meet the needs for temperature resistance at higher soldering temperatures needed for lead free soldering processes. If halogen free laminate is available on the market and it is used in many PWBs in mobile phones and other consumer and industrial electronics. Even with the knowledge at the PWB fabricator that many of the halogen free laminates are more difficult to drill and are more demanding in the metallization process.

In actual facts who need halogen free PCBs? In many cases this are the marketing people that believe that **Halogen Free sells better**. As competitors form other companies following the same principles, a market for halogen free PWBs have been developed.

The understanding of many marketing people is that Halogen free PWBs are free is NOT correct. The material and the processes for drilling and plating are more complex and so more expensive. As halogen free laminate and prepreg are more modern materials, they often perform better at higher soldering temperatures with a higher thermal resistance. However, in today’s world nobody wants to pay more for PWBs. As a consequence the PWB fabricator has to absorb the cost in many cases.

**ECO Standards**

A number of ECO standards have been developed in different countries. For an OEM it is expensive and time consuming to get an agreement that the produced electronic equipment meets the needs of the **ALL local ECO label**. All of this standards are trying to achieve the same. However, each standard is a little different. If an equipment is certified by one ECO label standard it will not automatically meet the other standards as well.

The industry was looking for alternative options to meet ecological and human safety standards. This is needed to insure that the equipment will not have a negative impact on the health of the operator.
Figure 3  Typical ECO labels used in Europe.

The Eco Standard ECMA-370 was developed (dated June 2006)  
Ecma International - European association for standardizing information and communication systems has developed a new standard for:

Product environmental attributes  
– THE ECO DECLARATION = TED

TED is a self declaration process that will take the generic attributes and requirements of the ECO labels and combined this to a self declaration form.  
The new ECMA-370 standard which is free to download from www.ecma.ch  
The annex B is the product declaration, containing both legal and market requirement.  
Based on this forms, OEMs and EMS have the opportunity to analyze there products and to define whether or not the ECO requirements are met.  
In case of a high importance of meeting ECO standards e.g. for government tender offers, the new ECMA-370 standard will help the industry to incorporate at the design already what is required to meet individual ECO requirements that may be in line with the requirements specified for ECO labels as well.
Voluntary program criteria mapping

Green Public Procurement tenders frequently refer to voluntary eco labelling programs. The following table shows a mapping between some voluntary programs for IT products that define attribute criteria and their corresponding sections in ECMA-370.

<table>
<thead>
<tr>
<th>Sections in Annex B of ECMA-370</th>
<th>EU Flower</th>
<th>German Blue Angel</th>
<th>Japanese Eco Mark</th>
<th>Nordic Swan</th>
<th>Swedish TCO</th>
<th>Energy Star</th>
</tr>
</thead>
<tbody>
<tr>
<td>P6 Batteries</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>PS Energy</td>
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<td>X</td>
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<tr>
<td>P10.1 Acoustic Noise</td>
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<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>P10.3 Chemical Emission</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>P10.5 Electromagnetic emissions</td>
<td>X</td>
<td>X</td>
<td>X</td>
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</tbody>
</table>

www.itecodeclaration.org may be consulted for further information on voluntary programs for IT products.

NOTE: Eco labels set pass/fail criteria for attributes resulting in no qualification for the eco label if only one criterion isn’t met. In contrast, TED reports the result of each criterion or the attribute values allowing a better assessment of the product environmental performance.

Summary
Economical, technical and ecological subjects are important for successful businesses and or products. Standards will help to conform and meet customers and OEMs expectation. However, it is important to select the right partners that can support the marketing activities of a fabricator or OEM at a level that is expected by the end used. The fulfillment of legal requirements is mandatory. However, the fulfillment of marketing needs like in the case of “halogen free PWBs” may have its price for the fabricator as well as for the end user.
By applying the latest technical and ecological standards in a correct way, and differentiating between MUST and WANTS in a weighted process, a success in business will be guarantied.

References:
- GMM and VDE European Market information on Europe 2005
- EIPC Workshop on halogen free PWBs Cologne, Germany August 30, 2006
- IEC Stand development work TC 91, Berlin, Germany, May 15 to 19, 2006
- Standard ECMA-370, Geneva, Switzerland, 1st addition / June 2006