

T&E Update

Testing • Engineering • Consulting

Issue 14



Essentials of Product Safety

When designing for Product Safety compliance, the main goal is to prevent hazards from occurring that could injure or damage the operator, service personnel, the equipment, or the equipment surroundings in both normal operation and single fault conditions. The main hazards concerning Product Safety are: Electric Shock, Energy, Fire, Mechanical, Radiation, and Thermal Hazards. While each product has different hazards and different requirements for preventing hazards, this article describes some general methods of designing for Product Safety Compliance. Before designing your product, be sure to determine which standards apply to your product specifically and ensure you are designing to those requirements.

Electric Shock Hazards. Voltages above 30Vrms, 42.2Vpeak, or 60VDC are considered hazardous and shall not be accessible. The user shall not be able to contact any voltages above this level without using a tool. Any doors, access panels, or covers that can be opened without a tool shall not allow access to hazardous parts.

Energy Hazards. After making sure that you do not have any accessible parts containing hazardous voltages, you must then ensure that the accessible parts do not contain enough current to be considered hazardous. The hazardous energy level may vary from standard to standard, however, typically the limit is 240VA or 8A.

Fire Hazards. One of the biggest concerns in product safety is fire. The primary goal is to prevent any hazards from creating a fire in your unit, or if a fire does occur the flames will not escape your unit and set off an external fire. Therefore, you must look closely at the openings on your units, especially any bottom openings. All plastic components used inside a fire enclosure must

have a certain flammability rating depending on the standard. V-0 rated plastic is usually a good choice.

Mechanical Hazards. The operator of the equipment shall be protected against any moving parts that could cause an injury. This can be accomplished by not having any accessible moving parts, by using guards over moving parts, or by interlocking a door or cover so the moving part shuts down when the user opens the door or cover. If due to the nature of the equipment you cannot prevent access to the moving part, you should be sure to adequately warn the operator by marking the equipment with the appropriate warning label.

Radiation. Just because a hazard is not visibly present, you must still ensure that protection is provided. Such hazards include ultraviolet radiation, laser radiation, sonic radiation (audible noise), and ionizing radiation. The most commonly overlooked radiation hazard is laser radiation. Most fiber optic units and some LEDs have hazardous levels that are not safe for the naked eye and therefore must be guarded or labeled with an adequate warning.

Thermal Hazards. Not only do you not want your product to catch fire, but also, the components shall not exceed their maximum temperature. If the components overheat, this could cause the exterior of the product to become hot and cause a burn to the touch or cause material in contact with the unit to catch fire. In addition, components that overheat can also cause the insulation of that component to diminish and therefore could cause a shock hazard.

Designing for European Compliance

When designing your product for European compliance, keep the

following safety guidelines in mind:

Labeling The product must be marked with the rated input voltage that must include 230V either within a range or directly (230V~, 115/230V~, 100-240V~). The rating must also include the IEC symbol for the voltage being used, AC ~ or DC $\overline{\text{—}}$. The input rating must also include the rated current or power (depending on the standard) and frequency. The unit shall be marked with the manufacturer's name or trademark and model number. If there is a user replaceable fuse, there shall be a marking adjacent to the fuseholder indicating the rated current, voltage, and time characteristic of the fuse (T5A 250V). If the fuse is an IEC fuse, the IEC symbol shall be used, $\overline{\text{—}}$.

Protective Earth

If your product has a protective earth (PE) connection there are several things to remember. The PE conductor must be green and yellow. All PE connectors must be double crimped so that both the wire and the insulation are crimped. If a PE conductor is soldered (to an inlet) the wire must be routed through the hole and bent prior to soldering. The PE conductor shall be routed from the inlet or cord directly to a chassis stud. It should be secured by a lock washer and nut. Additional conductors may then be connected to the same stud via a second lock washer and nut. The IEC PE symbol shall be marked adjacent to this stud, ⏏ .

Power Switch

If your unit has a power switch that is intended to serve as the disconnect device then it must be an all-pole switch (disconnects both line and neutral). If the switch is an all-pole switch it shall be marked with O and I to indicate OFF and ON. If the switch

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used is not an all-pole switch the markings O and I cannot be marked on the switch.

Components

USE EUROPEAN APPROVED COMPONENTS!! This will save you much time and money. If European approved components are not used, the component either has to be replaced (which may require EMC retesting, performance retesting, etc.) or an additional evaluation must be performed on the component to ensure it meets the European requirements. Common European approval marks include TUV, VDE, or CE. If you are relying on a CE mark as the component approval, be sure to obtain the manufacturer's declaration of conformity to ensure the correct safety standard was applied.

Wiring

Primary wiring (230V, 115V) shall not be able to contact low voltage wiring (5VDC, 12VDC, etc) or exposed low voltage parts. This can be prevented by routing the primary wiring and securing it with cable ties. Another method is to add an additional layer of insulation over the wiring such as shrink sleeving. As an alternative, you can use UL1015 wire for the primary wiring. This wire is considered to be reinforced insulated wire and is allowed to have contact with low voltage wiring.

All primary wiring must be double secured. This can be accomplished by using double crimp on all connectors, by hooking the wire prior to soldering, or by using a single crimp connector and a second means of securement (shrink sleeving the wire or cable-tying the wire to another wire).

Enclosure

One of the most difficult requirements to meet while still obtaining your desired design is enclosure openings. Openings in an enclosure must meet the requirements for both electrical enclosure and fire enclosure. You want to ensure that the user cannot access anything hazardous: if there is a fire you don't want the fire to escape your unit; and you don't want burning material to fall out of your unit. There are many different circumstances and standards, each with different requirements for enclosures. Typically, there should be no openings in the bottom of the enclosure. Openings in the top and side of

enclosures shall be limited so that the test finger and test pin cannot access hazardous voltages or hazardous moving parts. For Information Technology Equipment (EN60950), the openings cannot exceed 5mm in any direction or 1mm in width regardless of length. Also the test pin is 3mm wide and expands to 4mm wide with a length of 15mm.

Another consideration for enclosures is the strength of materials. The enclosure must withstand the various force, push, tip, and drop tests during a safety evaluation. If the enclosure is plastic it must meet certain flammability ratings depending on the applicable standard.

Overcurrent Protection

Adequate protection shall be provided in your unit in the case of a short circuit or overload. Typically a fuse or circuit breaker is required in the input portion of the unit. This protection must be adequate for the load it is protecting.

Disconnect Device

There must be a method to remove all power to your unit in the event that a hazard occurs. A disconnect device can be a switch or breaker that is accessible from outside the unit. It can be an appliance inlet or the plug at the end of the cord. If a unit is permanently connected, there must be a switch in the unit or the installation instructions must state that an all-pole disconnect device must be located adjacent to the unit.

Spacings

Adequate isolation must be provided between user accessible circuits (low voltage circuits) and hazardous voltage circuits (primary, telecom, high voltage secondary circuits), as well as from hazardous voltages to ground. This can be accomplished by using isolating components such as transformers or opto-isolators. Spacings must be maintained inside these components, on PCBs, and inside the unit. Spacings consist of creepage and clearance distances. Creepage is the distance along the surface and clearance is the distance through air. The actual required creepage and clearances differs for each standard and each product. However, if the spacings are not considered in the design stage, it will require re-spinning the board later and can cause substantial time delays in getting the product to market.

Special Hazards

Each unit must be examined to ensure that all hazards have been addressed.

Some other matters to look out for are UV light, Lasers, Interlock circuits, and batteries. All laser modules shall be approved to EN60825 (Safety of Lasers). All batteries shall be protected against overcharging and reverse polarity.

Manuals

One thing often overlooked is creating Installation, User's, and Service Manuals for your product. You must tell the installation personnel how to hook up your unit (requirements for voltage, power, ventilation, etc.). Also, you must tell the user how to properly use the unit (how to turn it on, don't throw it in the bathtub, etc.). If you specify any servicing for your unit, it shall be described in a service manual.

The items described here do not cover all product safety issues, so be sure to consult the standards that apply to your product. Remember, considering Product Safety in the design stage will save you lots of headaches later! Call Berri Remenick at 301-473-1255 for more information or to request a pre-compliance evaluation.

UL60950 to replace UL1950

The new standard for Information Technology Equipment is currently being used for obtaining UL approvals. UL60950 3rd Edition was released in December 2000 and will be replacing UL1950 3rd Edition. Until April 1, 2003, evaluations can be done to UL1950 3rd edition or UL60950 3rd edition. After April 1, 2003, all evaluations must be to UL60950 3rd edition. Products previously approved to UL 1950 3rd edition are still valid until April 1, 2005. After that date, any product still being produced must have their approval updated to UL60950 3rd edition.

The main difference between UL60950 and UL1950 is the clauses have been renumbered and the material has been moved around in the standard. Some of the other significant changes include: a new method of measuring leakage current (now called touch current); the requirements for ground impedance testing have been clarified; some requirements for centralized DC power systems have been clarified; and an index has been added for easier reference.

FAQ's on CE



The European Union

- With the creation of the 'united states' of Europe comes the promise of free trade across the borders of its Member States which include: Austria, Belgium, Denmark, France, Finland, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, Sweden and the United Kingdom
- Legal documents (Directives), outlining the responsibilities of both vendors and users of goods, were developed.
- The CE Marking was established to indicate compliance with the Directives.

CE Marketing Elements

- The CE Marking is NOT a safety mark as the UL Listing Mark is for the US or the GS Mark is for Germany.
- The CE Marking is not purchased from or issued by an Agency.
- The CE Marking is a 'self-declaration' applied by the Manufacturer or official representative to show compliance with ALL applicable Directives.

What Do the Directives Say?

- Member States agree to accept the CE Marking on goods entering their markets.
- Member States agree to report and share information on any infringements of the requirements.
- Manufacturers agree to meet all stipulations of the Directives and be able to prove compliance.
- Products must be safe - Harmonized Standards or European Norms (or lastly, National requirements) should be used.

Low Voltage Directive (73/23/EEC)

- Became mandatory on January 1, 1997
- For products intended for connection to Mains voltages between 50 and 1000V~.
- Generally for household products, office or laboratory equipment.
- For products where hazards are primarily electrical in nature.
- 'Documented internal QUALITY ASSURANCE' required.

Machinery Directive (89/392/EEC)

- For products where hazards are primarily mechanical in nature.
- May require Failure Analyses plus evaluations to safety standards.
- Some products require a Notified Body.
- More consideration for other hazards: noise, vibration, etc.

RTTE Directive (1999/5/EC)

- For products connecting to the telephone network or containing radio transmitters

- Requirements for the Low Voltage Directive apply without minimum voltage limitations

Amendment ('CE Marking Directive') (93/68/EEC)

- Most importantly, adds the use of the CE Marking to some of the Directives from which it was missing.

Complying with the Directives

- Labeling must be acceptable for the EU. Using symbols per IEC 417 makes this easier...fewer translations are necessary on the product silk-screens.
- By applying the CE Marking you agree to provide User Instructions in any language of any Member State if requested. (English, French and German should be the minimum available.)
- A DECLARATION OF CONFORMITY is created by the Manufacturer and distributed with the product: Product name and model number, Directives, Standards, Manufacturer information, Responsible party and signature.
- A documentation package, including drawings, schematics, User Manuals, Service Instructions, Theories of Operations and Test Reports must be prepared. This information must be available upon request within a 'reasonable period of time.'
- An Internal Production Control must be implemented at the place of manufacture.

General Philosophy of the Product Safety Standard

To prevent injury or damage due to:

Electric shock:

Access must be prevented to Hazardous Voltage above:
30 Vrms 42.4Vpeak 60Vdc

Energy hazards:

Power supplies or high capacitance circuits may have sufficient energy during fault conditions to cause arcing, fire, or ejection of molten metal. Access to circuits capable of delivering in excess of 240VA or more than 20 joules of energy should be prevented under any condition.

Fire:

High temperatures resulting from overloads, component failures, insulation breakdown, high resistance or loose connections, etc. The location of combustible materials and heat sources must be controlled, the temperature of flammable materials shall be limited, low flammability materials should be used, and/or enclosures and barriers must contain fire.

Mechanical hazards and heat:

- Prevent injury to Operator due to accessible high temperatures and moving parts, sharp edges or points.
- Ensure that equipment is stable and structurally sound.
- Provide adequate guarding or interlocking.

Chemicals:

Limit exposure to chemical hazards in normal use and single fault conditions:

- “Tip-over test” with liquids.
- “Reservoir overflow” tests.
- Other tests for integrity of container or vessel.

Radiation:

The following emanations may be part of the intended or normal function of the machine. Equipment is judged on a case-by-case basis considering the intended function, location and use of the equipment being evaluated. Parts of other standards, relevant to the particular radiation source(s), may be applied.

- Sonic
- Radio Frequency
- High intensity visible and coherent (laser) light
- Ionizing radiation (X-ray, beta, gamma, etc.)
- Infra-red
- UV

Spacings

(The following data are typically encountered for IT Equipment under the conditions stated. Please refer to the currently valid IEC60950 for complete tables and application notes.)

Clearances in Primary Circuits and between Primary and Secondary Circuits.

Nominal mains supply voltage: 150<V≤300V
 Transient rating: 2500V Installation Category: II
 Pollution Degree: 2

Working Voltage <i>(up to and including)</i>		Insulation		
V _{peak} Of V _{dC}	V _{rms}	Operational	Basic/Supplementary	Reinforced
71	50	1.0	2.0	4.0
210	150	1.4	2.0	4.0
420	300	1.7	2.0	4.0
840	600	3.0	3.2	6.4
1400	1000	4.2	4.2	6.4
2800	2000	8.4	8.4	8.4
7000	5000	17.5	17.5	17.5
9800	7000	25.0	25.0	25.0
14000	10000	37.0	37.0	37.0
28000	20000	80.0	80.0	80.0
42000	30000	130.0	130.0	130.0

Clearances in Secondary circuits: 150<V≤300V
 Transient rating: 1500V Pollution Degree: 2

Working Voltage <i>(up to and including)</i>		Insulation		
V _{peak} or V _{dC}	V _{rms}	Operational	Basic/Supplementary	Reinforced
71	50	0.7	1.0	2.0
140	100	0.7	1.0	2.0
210	150	0.7	1.0	2.0
280	200	1.1	1.4	2.8
420	300	1.6	1.9	3.8
700	500	2.5	2.5	5.0
840	600	3.2	3.2	5.0
1400	1000	4.2	4.2	5.0
2800	2000	8.4	8.4	8.4
7000	5000	17.5	17.5	17.5
9800	7000	25.0	25.0	25.0
14000	10000	37.0	37.0	37.0
28000	20000	80.0	80.0	80.0
42000	30000	130.0	130.0	130.0

Creepage Distances


Pollution Degree: 2 Material Group: IIIb


Working Voltage <i>(up to and including)</i>	Insulation	
V _{rms} or V _{dC}	Operational/Basic/Supplementary	Reinforced
50	1.2	2.4
100	1.4	2.8
125	1.5	3.0
150	1.6	3.2
200	2.0	4.0
250	2.5	5.0
300	3.2	6.4
400	4.0	8.0
600	6.3	12.6
1000	10.0	20.0

(Creepage Distance may never be less than Clearance for the Working voltage and Insulation under consideration)


International Symbols Commonly Used


Information Technology Equipment


 **Alternating Current**
(after 'V' in ratings)
 IEC417, No. 5032


 **Danger - High Voltage**
 ISO3864, No. B.3.6

 **Attention**
 ISO3864, No. B.3.1

 **Protective Earth**
 (adjacent to PE connection)
 IEC417, No. 5019

 **Direct Current**
(after 'V' in ratings)
 IEC417, No. 5031

 **Double-Insulated**
 (NO earth connection)
 IEC417, No. 5172

 **Fuse replacement**
(with fuse info adjacent to symbol) IEC417, No. 501

2001 Testing Workshop Series



Washington Labs is continuing its Free Workshop Schedule for 2001. These popular seminar/practical workshops include demonstrations, guest speakers, the latest EMC and safety compliance news, and lunch!

BELLCORE AND MORE BELLCORE

Telecommunications equipment must meet requirements for Bellcore GR-1089 & GR-63. At the August 24 Workshop hear the inside scoop on gaining EMC, Safety and Environmental compliance from experienced test engineers, manufacturers and evaluators.

AUGUST 24

OCTOBER 12*

NOVEMBER 9

Be sure to register early as positions fill up quickly.

Call Patty or Melissa at 301-417-0220 to register today.

*Frederick location

Part 68 Transition

Telecom terminal equipment that currently requires registration with the FCC will no longer be submitted to the FCC as of July 24, 2001. In December 2000, the FCC announced it would be privatizing Part 68 responsibilities. The Administrative Council for Terminal Attachments (ACTA) is the newly formed industry council for Part 68 certification requirements and administration.

The ACTA is responsible for adopting and publishing technical criteria for terminal equipment and administering a database of all approved terminal equipment. The FCC will no longer be accepting applications as of July 24, 2001. The ACTA will be announcing the new process prior to that date.

The ACTA will be publishing new requirements for Part 68 compliance. The technical requirements will be the same as the current FCC Part 68 requirements. The submission process will differ. The details are still to be worked out by the members of the ACTA, however, under the proposed method, manufacturers will have two choices for demonstrating compliance. They can either self declare compliance by testing in-house or at a 3rd party laboratory and submitting the declaration of conformity to the ACTA database or they can submit to a TCB who will perform the testing and submit to the ACTA database.

More info on the ACTA can be found on their website at www.part68.org.

more on staff to do the same.) Now, he says he spends all his free time changing diapers and playing with the kids and running errands in the truck. (Sure, Berri.)

The next time you're in Frederick be sure to stop in and see Berri and his team of compliance professionals – they'd love to show you around the new facility. (Check to see if his bike's in the parking lot while you're there.) Or if you have a safety compliance question or need, give him a call at 301/473-1255.

Employee Spotlight

THE SAFETY MAN

This past January, Washington Labs was excited to announce the opening of its first full-service satellite lab location in Frederick, Maryland. This facility is managed by our own five-year veteran; Berri Remenick. Berri is the Manager of Product Safety for Washington Labs.

Compliance testing for product safety is a growing service area for the company. Berri has expanded the safety offerings to include testing of medical devices, information technology equipment (ITE), audio-video, lab equipment, manufacturing equipment, and others.

When he's not managing the safety compliance testing team, Berri's working with clients on their test plans and speaking on safety topics at workshops and other events for Washington Labs. Recently, Berri conducted the first Washington Labs' free workshop onsite at Frederick. We were overwhelmed with the response and interest in our new format featuring practical hands-on demos; several attendees even brought some of their own prototypes for review during the workshop, Berri noted.

Before joining our team in 1996, Berri was assigned as an Electrical Engineer for the US Navy Multi-functional Information Distribution System (MIDS) Test and Evaluation (T&E) program for



the Analytical Systems Engineering Corporation in Alexandria, Virginia. While there he also provided assistance to the USN Program Office on the Joint Tactical Information Distribution System (JTIDS) program for Link 16 development, installation and integration testing. He'd also previously done work on the Hybrid Electric Vehicle Challenge.

Berri has a Bachelor's of Science degree in Electrical Engineering from The Pennsylvania State University and is a die-hard Nittany Lions fan. He is a member of the Institute of Electrical and Electronics Engineers. Berri and his wife, Megan, live in Hagerstown, Maryland with their two small children, Olivia, 10 months, and Griffin, 3-1/2 years.

Before children, Berri tells us he liked to play golf and ride his motorcycle. (The appearance of his bike in the parking lot at WLL in Gaithersburg soon inspired

The Art of the Technical File / Technical Construction File

When you prepare for the safety testing of your unit, your mind is focusing on the testing itself. Will the unit pass? Will we have to make any modifications? Certainly these are important questions that you may ask yourself during the testing of your product. After your unit finally passes, you will be thinking, "I'm glad that's over with!"

But not so fast– the testing is just the beginning of the end. The end is the Technical File (TF), which brings together all of the required elements to show compliance with the applied standards, and incorporates the items listed in the directive. The Technical File is a neat, organized, professionally prepared report, which should be accepted by any authority in Europe. The TF/TCF is a descriptive document that should make the product as understandable as possible to a third party that may not be familiar with your product.

The TF has seven sections of supporting documentation that you, the client, will provide.

The following lay out diagram is what a Technical File looks like.



Parts List – A top level parts list: showing power supplies, transformers, fans, fuses, terminal blocks, etc.

Schematics – Schematics of all PCBs with hazardous voltages, telecom

connections, or batteries, and a Block Diagram for the entire unit.

Ratings Label – Artwork for, or a reproduction of, the label that will be affixed to the equipment, showing the

CE mark and the power input and output ratings.

User's Manual – Copies of the User's Manual and Installation Instructions that are required to ship with the product.

Theory of Operation – A brief (one or two paragraph) overview of the principles that make the equipment function.

Specs – Manufacturer's specifications for each Critical Component. Each must state the power input and output. They can be manufacturer's spec sheets or descriptions from a product catalog.

Certs – European safety certificates. Can be either a manufacturer's Declaration of Conformity to the appropriate European safety standard, a TUV Certificate, or a VDE approval.

Some of these sections you will already have, others you will need to create before the product is marketed. For a few you will need to collect information specifically in order to complete the TF (example: Safety certificates).

As a rule, the safety certificates cause the most delay in the publication of the Technical Files. Why? Because in many cases you, the client, must contact each manufacturer individually in order to request the certificate for each critical component in your product.

You will need all the documentation outlined above to complete the Technical File in order to support your claim to meeting the European guidelines.

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