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Chairman's Message

Defending The Line

Congratulations to the Santa Clara Valley Chapter of the EMC Society for another excellent colloquium. The event was well attended and an impressive number of exhibitors were present. It was a good time for exchange of ideas and information. Which brings me to the point of this column. Some of the presentations and hallway conversations raised some interesting questions when juxtaposed upon each other.

1. I spoke with one of the central EMC Society leaders about promoting product safety papers for next years EMC Symposium. Product safety has not had much of a history or presence in the Symposia records over the years. Half a session at this years Symposium in Chicago is devoted to biological effects, a great topic. But the question arises, what technologies do product safety people have to report on? Are we the presenters or the audience listening to experts from other disciplines or sciences presenting

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The **P**roduct **S**afety **N**ewsletter

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Opinions expressed in this newsletter are those of the authors and do not necessarily represent the opinions of the Technical Committee or its members. Indeed, there may be and often are substantial disagreements with some of the opinions expressed by the authors.

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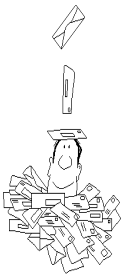
Letters to the Editor



Dear Editor,
The article "Designing Safety into Products" (Vol 6, Issue 3) was refreshing.

Much of our business is assisting product developers and designers from concept. In every case, except those in which marketing changes direction, the product passes first time through.

I should add, however, designing for safety can lead to over-kill and/or custom components, driving the cost of the product [up] (ie: is a TCO really needed in a heating device or can the heater be designed to open safely before there is a risk of fire or electric shock?).

The ultimate proof is in testing, testing, testing.

Although the up-front cost and time may seem unreasonable to a non-technical executive, designing Approval (and safety) into the product from concept will undoubtedly save many thousands of dollars in re-tooling, re-layout of PWBs, etc.

Laying out design criteria in regard to Approval, then testing hand made or machined prototypes has proven to be successful for many of our clients.
Best Regards,
John R. Allen

Dear John,
I appreciate your kind and encouraging remarks on the article “Product Safety as a Design Parameter”. I would comment on your items concerning safety “over-kill” and non-technical management’s lack of appreciation of safety considerations in design objectives. When the four elements listed under “How Safe is Safe Enough?” are satisfied, a reasonably safe product has been obtained. I would view any additional costs in the name of safety as possibly “over-kill” unless a convincing case can be made that the additional costs in fact enhance the safeness level of the product.

On the matter of non-technical management’s lack of appreciation of safety considerations, I find that both non-technical and technical managers need a better appreciation of mandated safeness levels, criteria for accepting safety risks, regulatory requirements and other safety accountability stipulations these managers have knowingly or unknowingly assumed. I cover these items in a second text, “Managing Product Safety Activities” which the PSNL may wish to include in this series.

Sincerely,
Paul W. Hill ❑

Designing Fire Prevention into Electronic Equipment

by Mike Grabois
Ascom Timplex

Abstract: Malfunctions in electronic equipment are the primary source of office fires. One of the best ways to prevent fires in electronic equipment is to interrupt the circuitry's access to the power source. Fuses in circuits and some power supply features may do just that. There are also some useful design tips that may reduce fire hazard.

Why Does Fire Happen?

It is well known that electronic systems have a tendency to fail occasionally. A majority of the failures are caused by thermal stress. Thermal stress implies temperatures high above the normal operating level. High temperatures on components may ignite the plastic of the packaging and in turn the PCB material. This kind of occurrence is difficult to predict and prevent, however, with appropriate selection of high quality components the risk may be minimized.

How Does Fire Sustain Itself?

The section above shows how fire most commonly starts. Other possible causes include: a broken air conditioner that allows the room temperature to rise or arcing on an intermittent contact of high voltage components or broken wire. Another question is why sometimes, once started, the burning process subsides and results in component or PCB damage, or sometimes sustains itself, propagates to other components, system modules, furniture, and eventually creates a major catastrophe.

The source of any thermal stress in electronic devices is a dissipation of power on resistive components in the form of heat during the passage of electric current. Most of the materials composing the PCB or semiconductor components are, or at least should be, fire retardant. This means that once the source of the heat is removed, the fire will extinguish itself automatically within some time period. Therefore, when current path is intact and electric current is present, heating up of the conductive elements and burning process can be sustained. Once current path is interrupted, the power access to the heating elements is removed and burning should subside and eventually stop.

My observations indicate that in order for a fire to last, it needs to be constantly fed by a power source. The start of the heating and burning process may be caused by any component or a signal trace which are overheating and causing the melting of the epoxy on PCBs or insulation on wires. The burning process, once started, produces a short circuit between the power rails. The power layers in the multilayer boards are especially susceptible to this kind of event. Once the material in the vicinity of the short circuit is burned out, the short circuit and burning process propagate toward periphery, thereby sustaining it further. The burning of the PCB ingredients produces strong flames that may heat up the PCB of neighboring modules start-

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Area Activities

by John Reynolds
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Change --
Our jobs are changing. Remember when the choice was only WHEN to have the engineer from CSA, UL and TÜV come in for product testing? The question is now "Should I choose 'UL/C' or 'NRTL/C' to provide certification to U.S. and Canadian requirements?"

Also, what laboratory should I use for Telecom requirements? I found out recently that AUSTEL, the Australian telecom agency, would not accept my CSA CB report. I had to have my product tested by a NATA accredited laboratory. UL was on the list but CSA was not.

The changes are for the better, though, through expanded services at different laboratories and wider acceptance of test marks. The trick now is to choose the path with the minimum number of stops that allows you to market you product to all customers. Finding the laboratory who provides the best package of services at the best price will be your ultimate goal.

We will not necessarily be going to the same three labs anymore. As customers of testing and certification laboratories, we need to be more vocal about our changing needs. The real goal is not the marks and licenses -- but to sell our product at a competitive price in whatever country we desire.

Chicago
Southern California/Orange County
Portland
Santa Clara Valley -
Seattle
Texas

Santa Clara Valley
Science Fair Awards:
The Santa Clara Valley PSTC once again has sponsored prizes for participants in the Santa Clara Valley Science & Engineering Fair. Over 400 entries from grades 4 through 12 filled the Exhibit Hall at the San Jose Convention Center, so our panel of judges - Bobbie Cronquist, Mark Montrose (SCV PSTC Treasurer), Roger

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Article Abstracts

Product Safety Abstracts
by Dave Lorusso
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508-435-5067 (fax)

"How Design Engineers Address Safety: What the Safety Community Should Know", was published in the February, 1994 issue of *Professional Safety*. The authors, Bruce W. Main and J. Paul Frantz present the results of a national survey of the mechanical design community to determine how safety is addressed in the design process. Results indicate that most respondents had not received formal training in safety methodologies common to the safety community. They were, however, aware of the importance of safety and product liability to designs.

"Environmental Safety and Health Compliance in the 1990s - Using Technology to Manage the Paper Chase" was published in the February, 1994 issue of *Professional Safety*. The author, Mark D. Hansen discusses a way to meet the documentation regulations of the Occupational Safety and Health Administration (OSHA), the Environmental Protection Agency (EPA), and the International Organization for Standardization (ISO) by utilizing existing technology. By utlizing document imaging, optical character recognition (OCR), and computerized document management systems, paperwork flow can be minimized.

The *Professional Safety* Magazine is a publication of the:
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"Nationally Recognized Testing Laboratories", was recently published in the *Job Safety and Health Quarterly*, the magazine of the Occupational Safety and Health Administration (OSHA). The author, Hank Woodcock, OSHA, describes OSHA's program to accredit Nationally Recognized Testing Laboratories (NRTL) as an early prototype that could serve as a model for "reinventing government", one of the new goals of the Clinton Administration. The article goes on to detail how the program began and what it takes to be accredited as a NRTL.

For more information, contact:
NRTL Recognition Program
U.S. Department of Labor
Occupational Safety and Health Administration
200 Constitution Avenue, N.W.
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Washington, DC 20210
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Technically Speaking

by Richard Nute

Probably the single most frequently occurring and most misunderstood issue in electronic product safety is electrically-caused fire. I thought I would review fire processes in plastics materials (the most common flammable construction material in electronic products).

The kind of fire that we are concerned with can be defined as an uncontrolled combustion process, usually accompanied by flames.

There are two combustion processes, flaming and flameless. This discussion is limited to flaming combustion. Flaming combustion is the one with which we are most familiar, where luminescent flames appear directly above the fuel material.

Flaming combustion is a chemical chain-reaction process which takes place exclusively in the gas phase. Solids and liquids do not burn. Only gasses burn. If you look carefully at any flame, you will see that it appears ABOVE the fuel material. This demonstrates that a gas is burning. However, the gas is evolved from the solid or liquid by heating the solid or liquid to a “suitable” temperature.

Let’s examine the process by which a solid or liquid contributes to a fire. Consider igniting paper with a match (presuming the match is already lit).

To initiate the fire (flaming combustion), the solid material (paper) must be heated by a source (the match) whose temperature is greater than the combustible material’s “flame-ignition temperature”.

As the material is heated and the material temperature increases, chemical decomposition (pyrolysis) occurs. Pyrolysis is a chemical change (decomposition) within the material and is indicated by a change in color and by evolution of smoke. Typical products of pyrolysis are flammable gasses, non-flammable gasses, liquids, and carbonaceous residues.

As heat is continued to be applied to the evolved gas, the pyrolytic gas temperature continues to rise to the “flame-ignition temperature”. At this temperature, the flammable gasses, mixed

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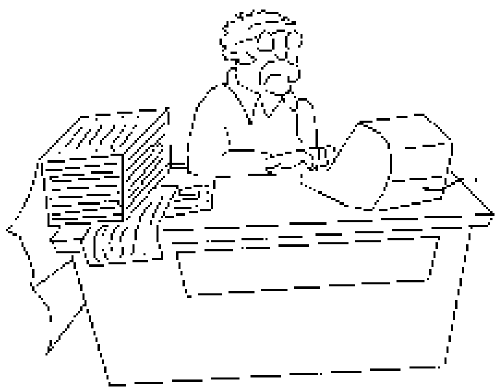
News and Notes



by Dave Edmunds
fax: (716) 422-6449

VDE Guide to the EMC Directive 89/336/EEC

The VDE Guide to the EMC Directive 89/336/EEC is now available in the U.S. through EuroPort. The guide consists of 308 pages and explains in detail the European Community Directive on EMC. As a guide to relevant standards, it has a section on interpreting Emission and Immunity Standards as well as sections on Harmonized Standards, BSI Publications Relating to EMC, Principal VDE EMC Specifications, and Principal US Commercial EMC Standards in addition to an action plan for achieving compliance.

Other VDE publications (in English) and international standards from IEC, ISO, DIN and others are also available from EuroPort. Call 508-526-1687 for more information and price quotations.
Information submitted by R. Volgstadt

USNC Nominates Candidate for IEC President

On January 24 the USNC officially named Mr. Bernard Falk, former NEMA President, as a candidate for the IEC President for the 1996-1998 term.

TC 76 Chairman

The Committee of Action (COA) of the IEC has reaffirmed Dr. B. Kleman term of office as Chairman of IEC TC 76 until March 1997.

IEC 825 Checklist

UL has copies of a checklist for IEC 825 first edition with Amendment 1 dated 1990. This checklist will be required when submitting a product that contains a laser to IEC 950. Clause 4.3.12 requires compliance to IEC 825.

Happy Birthday

Canadian Standards Association (CSA) was chartered in 1919, our congratulations on this occurrence of their 75 anniversary.

UL announces Generic Component Program

In a Subject 1950 letter dated January 31, 1994, UL announced several significant changes to the way they approach safety of low-voltage devices such as disc, tape and CD-ROM drives. In a 3 phase program, that has already started, UL has begun to evaluate low-voltage components as commodities rather than as individual products. Eventually, a PC manufacturer will be able to specify that any R/C drive that draws no more than a defined maximum amount of power and that has certain minimum flammability characteristics can be used in a certain location in its product.
The first phase will allow component manufactures to voluntarily have their products tabulated in the RCD. In the second phase UL will mail a list of these

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Prevention of Fire in Equipment

by Paul W. Hill & Associates

[We are greatful to the author for providing another installment condensed from his book "Product Safeness As A Design Parameter", 2nd Edition, 1990. The text is a registered copyright of Paul W. Hill & Associates, Inc., and is reproduced with permission. Details about the purchase of the book may be obtained by calling (407) 368 2538.

This is the second part of an article that first appeared in the May-June 1994 issue - Ed]

Placement of Over Stress Protection.
The placement of the over stress detection and control device is important. Fault testing should be conducted to insure that the over stress protective mechanisms protect all circuits in the equipment. Some circuits will be protected by one device on the load side of the power supply, others will not be adequately protected by this single device. For example, single point over current detection and control in the power source may be insensitive to over stress conditions in some secondary circuits. Sense and control devices may have to be provided for secondary circuits independently of those in the primary side of circuits.

Containment of ignition.
Should ignition occur it must be confined within the equipment. This requires that openings in equipment enclosures must not permit the ignition within to spread to adjacent areas. The principal openings in this context are openings in bottom panels through which flaming, molten or hot dripping materials can pass.
Hot molten or dripping is a characteristic of many polymeric materials when ignited.

Bottom panels may contain drainage and ventilation openings if the openings are covered with wire screens or perforated metal plates. Small area openings are allowed if the area above the openings pose little risk of ignition, contain only non-flammable materials or materials with flammability rating of V-1 or less flammable. Equipment safety standards contain tables of opening shapes, sizes and configurations permitted for various bottom panel thicknesses.

Large openings in bottom panels are permitted if the free fall of ignition causing materials to surfaces below are prevented by baffles or barriers over the openings. Safety standards

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Area Activities
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Volgstadt (PSN Editor) and John McBain - had their work cut out for them.

The criteria were straightforward: the project should deal with safety, it should show a well-thought-out goal and procedure, and the student should understand and be able to explain the project. Prizes were $50 for first place, $30 for second and $20 for third, as well as an award certificate for each.

After 2 hours of judging the first place award went to a team project, "Fire Alarms", by David Hernandez, Justin Martin and Roshun Patel. They compared different brands of fire alarms for response times to the same condition - burning toast in the next room. Second place, "Synthetic or Natural Fibers?", by Maria Palmer was an examination of burning characteristics of different types of fabric commonly used in children's sleepwear. Third place, "Heed the Warning", by Kasey Caillat focused on spontaneous combustion of oily rags.

Honorable mention awards were presented to four other projects: "How Things Fail" by Rinki Dedhia, "A Cool Fire Extinguisher" by Jamie Sergi, "What Materials Conduct Electricity" by Lindsay Johnson and "Strength of Radio Waves" by Frederick Alex Ware. Making the presentations was Murlin Marks, SCV PSTC Vice-Chairman and this year's President of the SCV Science & Engineering Fair.

Prevention of Fires in Equipment
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specify the baffle overlap distances and acceptable configurations.

Openings in bottom panels which do not comply with either the opening size limitations, baffles or wire screens, may still be acceptable if the requirements of the hot flaming oil test are satisfied. In this test a ladle of fuel oil is ignited and slowly poured onto the panel area to be evaluated. The flaming oil passes through the openings and falls onto cheesecloth, placed below the panel under test. The openings are acceptable if the flaming oil extinguishes as it passes through the opening and does not ignite the cheesecloth.

An important consideration in enclosure design is the five degrees projection requirement for defining the total area of a bottom panel. If components or assemblies above bottom panels are enclosed, only that portion from which flaming or glowing particles can be emitted requires a bottom panel. When the five degree projection rule is applied, any portion of the side panels of an enclosure falling within the projection must be treated as if it where a bottom panel. This requirement may require special attention for stacked or rack mounted equipment.

All doors and panels which form part of the fire containment enclosure must be securely attached to the enclosure by hinges or other permanent attachment means. Equipment should not be operable with these doors or access panels open or removed, if they are necessary to insure the integrity of the fire containment enclosure.

Interlocks are acceptable devices for doors and access panels to maintain enclosure integrity while the equipment is in operation.
The reliability of these interlock devices, electronic or mechanical in operation, will be considered by testing agencies. The reliability of the electronically operated interlocks will be expected to approach that of the mechanical interlock devices.

Flammable Consumables.
Flammable consumables are those materials consumed during the normal operation of the equipment and which pose a risk of ignition. Included in these materials are lubricants, paper products, inks and other liquids or chemicals periodically replenished by equipment operators or service personnel. The flammability of these materials constitutes a fuel load to any ignition within the equipment and may contribute significantly to the intensity of a fire or its propagation.

Safety standards have specific requirements for flammable liquids such as the maximum quantities permitted, flash point minimums, pressurization limits and provision for avoiding the accumulation of toxic or explosive concentrations of vapor-air mixtures.

It is good design practice to consider the possibility of spillage when replenishing flammable liquids. Reservoirs should be easily accessible and provide for refilling without dripping, undetected overflowing, or large residuals in filling hoses and pumps. If flammable liquids are pressurized care must be taken to avoid atomization if leaks develop or reservoir connections and filling caps are not properly secured. Ignition of flammable pressurized liquids is more likely when the material is in mist or atomized form, such as would occur from small leaks, diffusing more widely than in the liquid state.

Collection pans under replenishing points should be considered for corrosive liquids as well as for flammable liquids. It is also advisable to consider the merits of safety over the cost of using exchange bottles in place of replenishing from bulk containers using funnels, hoses and pumps.

Warnings associated with replenishment, and the disposal of spent consumables, may be necessary and should be placed at or immediately adjacent to replenishing points. These warning must be repeated in installation and operating instructions, and in the service manual.

Burn Characteristics Of Materials.

When considering flammable materials, such as plastics used in electrical insulation or structural members and enclosures, it would be helpful to have a system for rating characteristics of available materials relative to the following requirements:

1. The material is difficult to ignite when exposed to flames or ignition conditions.
2. The material will self-extinguish if the igniting energy source is removed, i.e., a protective device senses potential ignition conditions and interrupts power to the equipment.
3. The material does not produce burning or glowing particles and drippings capable of igniting new fire areas.
4. The material retains acceptable electrical insulation and mechanical properties at high temperatures such that additional hazards induced by insulation or structural failures would be less likely to occur.

The major materials selection problem for designers and product developers is to identify materials, without an extensive series of burn tests on each material under consideration, to determine if it satisfies these four critical properties. Clearly, some materials evaluation and classification method is needed to rank materials relative to resistance to ignition, burn rates and tendency to propagate fires should an ignition occur.

Such a series of comparative tests and a rating system for ranking the burn characteristics of materials is available and the subject of the following sections. The particular testing and ranking system selected for discussion is that for plastics because it is the flammability requirement of greatest concern in product safety standards applicable to electronic equipment.

Flammability Ratings.

A series of tests have been developed and employed for many years to simulate ignition conditions and rank materials with a flammability rating based on burn characteristics of the material. This flammability rating ranks relative performance of a material with respect to:

1. Resistance to ignition and self extinguishing

properties.
2. Burn rate or distance a flame or glow front will advance before it self-extinguishes.
3. Fire propagation by melting, dripping or otherwise generating particles or droplets capable of initiating new fires.

For the purpose of this discussion, smoke and toxic substances generated as by-products of the ignition will not be considered.

Unfortunately, safety standards for electronic equipment do not address toxic parameters in the flammability rating of materials.
However, the designer would be well advised to consider the smoke generating characteristics and the possibility of toxic products from the burning of materials used in the equipment.

The flammability rating of materials and the test methods involved in establishing the ratings are covered in detail in two Underwriters Laboratories standards;
UL 94, "Tests for Flammability of Plastic Materials for Parts in Devices and Appliances".
- and -
UL 746C "Polymeric Materials, Use in Electrical Equipment Evaluations".

The A and B parts of UL 746 covering short term and long term properties are of interest to parts fabricators and molders. ASTM standards also define burn tests for various classifications of flammable materials. For this discussion the tests and rating scheme of UL 94 and UL 746C only will be considered because they are the most likely to be encountered in product safety standards for electronic equipment.

There are three groups of tests and ratings for classifying the burn characteristics of polymeric materials most often used in electronic equipment. One is for a group of materials given a V designation flammability rating. The V designation is associated with the vertical position of the test specimen during flammability testing. Materials with V ratings are most often associated with enclosures or support structures with electrical insulation requirements. For example, printed circuit boards and those portions of the equipment enclosure intended for fire containment have V designated flammability ratings.

Another rating is designated H for materials which must be supported horizontally during tests because they melt, warp or otherwise physically distort at or near ignition temperatures. The H ratings apply most often to low density plastics and foamed materials.

The third group is designated VTM for very thin materials which tend to curl, or so distort during flame testing that they can
not be tested in either vertical or horizontal positions.
These materials are tested as a tube formed by a mandrel.

For clarification the most common material ratings encountered are listed in the following table.

Flammability Ratings

Flammability	Vertical	Horizontal	Very thin material
(least)	5V		

HF-1	VTM-0	
		V-0
HF-2	VTM-1	
		V-1
HBF	VTM-2	
		V-2
(most)	HB	

The rating of 5V is a special test using a five inch (127 mm) flame. Enclosures with material flammability rating of 5V would be the least flammable, while an enclosure having material rated HB would be the most flammable.

Selecting materials with flammability ratings. To obtain the required flammability characteristics the designer must specify the flammability rating of the material from which the part is to be fabricated. For many material situations the product safety standard will specify the flammability rating required for enclosures or parts of enclosures, barriers, guards, printed circuit boards, and various parts used near potential sources of ignition.

In some material applications the rating will not be specifically stated in the safety standard and the designer must make the determination. This determination can be done by either of two methods. One method is to list the part's end use characteristics and use the tables in UL 746C to determine the required flammability rating.

There are some differences among standards in flammability rating nomenclature. UL standards will use a 94 as part of the rating, for example, 94V-2. Other standards such as IEC and CSA will simply use V-2 for the same rating. The 94 comes from the rating's association with UL standard number 94. The differences in the UL, CSA and IEC ratings are not significant and can be viewed as equivalent.

Specifying Flammability Requirements. It is not difficult to specify a flammability requirement for materials used in equipment. The Underwriters Laboratories rating system is widely used and understood by materials suppliers, parts fabricators and molders.

Parts drawings and materials specifications need only reference the flammability rating and specify that the parts or materials be sourced from UL recognized suppliers. It is not necessary to expand on these requirements since suppliers recognized by UL are already familiar with the rating designations and marking requirements. For example, the specification on a part drawing, or procurement contract wording for an etched printed wiring board might read as follows: "Printed circuit board must be of 94V-1 or less flammable material, sourced from UL recognized suppliers and carry the supplier's UL assigned vendor code".

Materials and parts with flammability ratings recognized by testing agencies need be evaluated or investigated only for appropriate use in the application. Some end use flammability evaluations might be necessary if a testing agency considered application of the material inappropriate for the flammability rating or circumstances suggesting some modification of the material's flammability characteristics have occurred. For example, extensive grill work or large ventilation opening areas or extremely thin sections might lead a testing authority to require end use flammability testing, even though the base material is flammability rated.

Smoke and Toxic Emissions.
Safety standards for equipment do not yet address the hazards associated with smoke and toxic emissions resulting from the combustion of materials, particularly plastics, used for electrical insulation, structural members and enclosures. Part of the reason is the difficulty in determining requirements. Many factors in the combustion process determine the type and amount of smoke and toxic substances that will be produced. Until product safety standards establish requirements, the burden for making reasonable safeness judgments on materials subject to ignition lies with the designer and product developer.

Litigation actions based on a fire situation could weigh heavily on the amount of consideration designers and product developers gave to smoke and toxic fumes generation in the materials selected for use in the equipment. ❑

Technically Speaking
Continued From page 6

with atmospheric oxygen, will self-ignite, and flaming combustion occurs. For the purposes of this discussion, the flame-ignition temperature of paper is taken as 451° F or 232° C.

Note that, for ignition, the GASSES must attain the “flame-ignition temperature,” not the solid material (although the solid material must be heated sufficiently to evolve flammable gasses). Consider that gasoline produces gasses at room temperature, but those gasses do not burn spontaneously. Instead, the gas above a container of gasoline must be heated to its “flame-ignition temperature” before a fire occurs. Such a gas is very dangerous since a small spark is sufficient to achieve “flame-ignition temperature.”

To sustain flaming combustion, the production of flammable gasses (pyrolysis), must be sustained. Heat for pyrolysis must be continually supplied to the solid or liquid material, either from an external source or from the flame.

Sustaining flaming combustion after the external heat source stops generating heat (i.e., the match is taken away) depends on the heat of the remaining flame.

If the heat from the flame exceeds the heat necessary for pyrolysis, flaming will be sustained. Likewise, if the heat from the flame is small, there will be less pyrolysis, the temperatures will decrease, and the fire will die.

So, a sustained fire is dependent on sustained thermal feedback from the flame to the solid material.

Considering the situation in terms of the law of conservation of energy, pyrolysis is an endothermic (heat-absorbing) chemical process; flaming is an exothermic (heat-producing) chemical process. If the exothermic reaction produces more energy than that required by the endothermic reaction, and there is adequate thermal coupling between the two processes, then fire will be sustained.

In addition to producing heat, the flame also produces combustion products, usually carbon monoxide, carbon dioxide, water vapor, other gasses produced by pyrolysis and flaming of the particular material, and solid carbonaceous residues. Some of the solids are carried off by convection currents, and some are left behind as ash.

Now, let's consider ignition of a plastic material from a non-flame source, i.e., electrical heating.

Electrically-caused fire is electrical heating of a material to ignition temperature followed by combustion. So, we'll now consider the situation of non-flame heating and ignition.

In the case of plastics, as the material is heated, first the plastic softens, often changes color, then produces smoke, then boils.

Published decomposition temperatures of common plastic materials range from 200° C for PVC to 500° C for PTFE, with most others in the 300° C range. My measurements suggest a decomposition temperature of 225° C for polyester.

If heating is continued, and since we have no flame from an electrical heat source, the combustible gasses evolved from the heated plastic will "self-ignite" at a temperature slightly higher than the "flame-ignition temperature." Typical plastic self-ignition temperatures range from about 350° C for polyethylene and polypropylene to 580° C for PTFE.

Sustained flaming combustion after the external heat source stops generating heat (e.g., the fuse opens) depends on the heat of the remaining flame.

For plastic materials rated HB, most of the pyrolytic gasses are flammable. The heat in the flame of such plastic materials usually is more than the heat necessary for sustained pyrolysis. After ignition, when the external heat source is removed from the material, flaming is sustained.

For materials rated V2, V1, V0, or 5V, most of the pyrolytic gasses are non-flammable. The heat in the flame of the remaining flammable gasses of such plastic materials is less than the heat necessary for sustained pyrolysis. After ignition, when the external heat source is removed from the material, the rate of combustion will decrease until extinction occurs.

The fire process is:

1. Fuel material.
2. Pyrolysis (an endothermic reaction requiring heat).
3. Pyrolytic products:
    a. Combustible gasses.
    b. Non-combustible gasses.
    c. Liquid products.

ing a similar
- The power supply should shut its output or outputs down only after a significant voltage drop on the common rail, indicating a massive short circuit.

- The power supply should allow overload to persist for a few seconds before activating the shut down in order to permit a destruction of a shorting device or material, if they are small and localized, or filter out the glitches.

Incorporating Smoke Detection Equipment into Electronic Design

I once have investigated a peculiar application of smoke detectors used in common fire alarms. The conclusion was that it is much easier, more cost effective and efficient to use fuses in combination with power supply shut down feature. However, I would like to share some findings, should anyone contemplate “improving” a system or device in this manner.

There are two types of smoke detection devices which may be incorporated into the electronic equipment in order to prevent or alleviate a fire hazard: smoke detectors with photo-electric components or with an ionization chamber. Those with photoelectric action require a certain amount of smoke in order to react. The ionization type devices perform better in cases exhibiting low smoke levels or flame presence since they react to the presence of ionized particles. The smoke detector with an ionization chamber also is better suited to the application in electronic equipment. Among the AC and low voltage DC powered devices, the low voltage DC type is probably more convenient for electronic equipment applications. These devices may be powered from the secondary power supply voltages (+12 V). Such a device should have independent contacts that may be used to trigger a circuit breaker type device with remote trip coil or a relay.

To minimize equipment damage, fuses are recommended over smoke detectors. Fuses typically produce much better protection since they may prevent fire at a very early stage, and therefore, significantly lessen damage. For smoke detectors to react, they require some fire to be present. That means that at least one of the circuit modules, including the PCB, or some times even more, will be destroyed. In addition, smoke detectors have the potential for false alarms and require periodic maintenance.

During my investigations, I have entertained some thoughts about applying current and voltage detectors for accurate indication of a potentially dangerous malfunction. Although I never used this approach, in combination with very accurate gauging of the current consumptions by the modules and overall system, it may result in a more accurate and more efficient damage prevention technique. In conjunction with appropriate software support, it may also provide an accurate failure detection tool for remote or local applications.

Summary

The requirements of fire prevention in electronic equipment are often overlooked or neglected by design engineers. However, the liabilities may be significant, both the legal aspects and in terms of the impact the reputation of the product and the company. The design of fire prevention measures may be difficult —

there is a large number of “what if” cases that are not easy to cover and it is impossible to eliminate any damage completely. However, with due caution and thought to the design and proper use of fuses or other overcurrent protection devices, it is relatively easy and inexpensive to create a healthy and safe system.

Mr. Grabois is a staff engineer at Ascom Timplex. Mike has a BSEE from Moscow Institute of Railway Engineering and a MSEE from New York University. He has worked in digital and analog design at Ascom Timeplex since 1985 and has been involved in design of equipment power distribution, power supplies and high-speed backplanes. ❑

News and Notes
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component manufacturers to the end-use manufacturers who use them. The last phase will allow the end-use manufacturers to change their Reports to reflect the new descriptions.

Under the new system, a typical description might look like: "Hard Disk Drive - R/C (NWGQ), input voltage 5/12 V d.c., loading current max. 1.5/0.5 amps, F/R minimum 94V-1, minimum clearance from uninsulated live parts 4.0mm.”

The RCD will be changed to reflect manufacturer’s name, model number of the component drive, electrical rating, flame rating (typically of the bezel) and laser class, if applicable.

In the same letter, UL also announced expansion of its Listed Field-Installed Accessory Program. The expanded program will address drives that are intended for installation by non-service personnel (typically, retail store employees or consumers).

If you’d like more information about this bulletin or about the Generic Component Program/Expanded Listed Field Installed Accessory Program, please contact Tom Burke at UL, Santa Clara (408-985-2400, X2286) or your local office.

The following material was obtained from the December, 1993 edition of the TMO Update, *published monthly by The Marley Organization. This publication is a confidential newsletter providing subscribers with information in the fields of government and non-government standardization. Contact The Marley Organization at 203-438-3801 for subscription information.*

Equal Treatment under NRTL

ANSI Accredited Committee Z34 Chairman and MET Laboratories Inc. (MET) President, Leonard Frier, as he has successfully done in the past, has become the advance advocate for U.S. independent conformity assessment third-party organizations by: (1) Filing a requested comment with OSHA’s Nationally Recognized Testing Laboratory (NRTL) program that they assure equal treatment, (ie., through the U.S. Trade Representative), for the product’s of U.S. NRTL clients in Germany before granting NRTL status to TÜV Rheinland of North America (TÜVNA), the wholly owned subsidiary of the German Government’s notified body, TÜV Rheinland; (2) filing suit against Robert B. Reich as Secretary of Labor to have all OSHA NRTL references to “Underwriters Laboratories, Inc. and Factory Mutual Research Corporation” declared invalid as they, among other things, do not comply with the requirements imposed by OSHA on other NRTL’s such as MET. This legal action follows numerous petitions to OSHA for “equitable treatment” by various NRTL’s. It is apropos to state that the ACIL (American Council of Independent Laboratories) has filed similar comments to OSHA on the TÜVNA NRTL application, and OSHA has granted additional time for ACIL to detail still other arguments against granting the NRTL status. ❑

Chairman's Message
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safety-related information.

2. I attended a presentation given by a long-time veteran of the IEC standards scene on the latest from the world of international information technology safety standards. It was an excellent update that was occasionally punctuated with apologies for the standard's inadequacies, this after many years of gestation. Eventually, the discussion migrated to comparing alternatives for the very nature of standards, from very prescriptive (as we have today) to very generic ("products must be safe") to hazard-based standards.

During the session, prescriptive standards were criticized, on one hand, as stifling innovation by being very specific about applying the past to product design and/or product evaluation requirements. On the other hand, they were defended out of concern that exclusively high-level requirements would result in a plague of widely varying interpretations. Additional concerns were expressed for effects of varying interpretations made by test houses. Is continued use of prescriptive standards that draw an ***arbitrary line*** separating what is "good" and acceptable from what isn't the best practice?

3. I regret I was unable to attend Rich Nute's presentation on "The Myth of Accessibility". However, his slides in the colloquium record appear to take a very interesting tack: rather than deal with accessibility using a collection of prescriptive, arbitrary (though widely accepted) requirements, he based his approach in terms of a ***principle*** or ***collection of principles***.

While it may seem like a stretch relating all the above together, to me it came down to the fundamental issue of what we safety professionals do. How much time do we spend enforcing arbitrary lines that someone else developed, lines that we can't well defend as optimum from either an engineering or technological standpoint? Why do we presume interpretations as to what is ***safe enough*** would differ so widely? And, assuming we can know why, what can we do about it?

Product Safety Practice—Brokering?

Let's shift gears, applying considerable imagination in comparing product safety practice to the legal profession. In both cases, the practitioners, equipped with their familiarity with codes and standards, serve as experts arguing claims or resolving differences, frequently before independent third parties or judges.

Is our role to bridge the gap between safety-related science and technology and the classic engineering and management disciplines? Does product safety practice have a technology basis or core? Or are we arbitrating someone else's arbitrary technical requirements? With all the negative press about how the legal profession is perceived today, are we as highly valued by our organizations or customers as lawyers are? In what ways do we uniquely add fundamental value to the product or service?

**Product Safety Practice—
Principles of Safety**

Let's take a step back and look at a bigger picture. From a societal standpoint, laws in a democracy represent a contract between the individual, various groups and the society as a whole in order to fairly maintain order and balance. When there is general widespread agreement as to what is right and wrong and what is acceptable and unacceptable, history has shown the collection of laws can be at a fairly high and generic level and be both simple and brief. However, as societal cohesiveness breaks down, as a primary set of consistent principles are no longer widely followed and standards of conduct splinter, laws become more complex as various interests fight for their "rights" and privileges. These laws change over time according to who's in power, what's fashionable, etc. The point is this: ***rules proliferate and become more prescriptive as principles become less understood and agreed to.***

Does proliferation of prescriptive requirements merely attest to the fact that there is little agreement as to what is safe enough? If this is the case, will a large body of specific rules really help in attaining the goal of suitably safe products?

Summarizing some of the questions posed above:

1. Why do prescriptive requirements, even if arbitrary and technologically indefensible as optimum, seem to be preferred over high-level or generic requirements?
2. Can we promote a principle-based agreement reflecting what is ***safe enough***?
3. To what extent is safety widely taught as a core discipline in our engineering schools, thoroughly integrated in the same way as other key engineering principles?
4. What core technologies are substantially unique to product safety practice?
5. Is our primary role to migrate safety-related technology or science-based enhancements from other disciplines into mainstream engineering practice?

Maybe we should consider a change in our job descriptions. Maybe we should be promoting safety in terms of engineering and management principles, implicit and explicit contracts to be maintained between producer and customer, rather than focusing on fine-tuning rules having long-forgotten origins that arbitrarily divide the acceptable from the unacceptable. As a reflection of this, perhaps our Symposium papers should address how we can promote the return of safety practice to the core of engineering and management practice, particularly if it becomes clear that we do not have a technology-based core around which our engineering is practiced.

I hope to address some suggestions in the next issue. In the meantime, I'd like to hear your comments on the subject, particularly if you have a different perspective or have ideas on what improvements should be made and how to make them.

Brian Claes
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For Pamela & Roger Volgstadt

A Baby!

Rebecca Danae Volgstadt

born February 26, 1994

Institutional Listings

We are grateful for the assistance given by these firms and invite application for Institutional Listings from other firms interested in the product safety field. An Institutional Listing recognizes contributions to support publication of the Product Safety Newsletter of the IEEE EMC Society Product Safety Technical Committee. Please direct inquiries to:

Ervin Gomez at (408) 553-7684 (phone) or (408) 553-7694 (fax)

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Employment Wanted

As a free service to our readers, the Product Safety Newsletter will periodically list Regulatory Compliance professionals who are available for employment. Those with employment opportunities are encouraged to contact the following individuals directly.

Seeking employment as a Regulatory Engineer:

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