The Product Safety Engineering Newsletter

IEEE PSES Product Safety Engineering Society

What's Inside

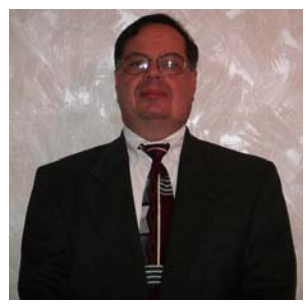
Vol. 5, No. 1 March 2009

President's Message

Two meetings already held this year could have a major impact on our society. Both of them went as I had expected them to go. The first one was TAB FinCom (TAB = Technical Activities Board and FinCom = Financial Committee). Our year-end numbers still look good for 2008, and once the numbers are finalized and confirmed, they will remove our Society from their watch list.

The second meeting is the SRC (Society Review Committee). This is a critical meeting because a new society in the IEEE is made a "Provisional Society" for a maximum of five years. We are now at that five year point (they waited a year to put us on the list). I have received a draft copy of what the SRC will submit to TMC (TAB Management Committee), and we can comment on the document before it is submitted.

As I expected, the SRC recommends that our society be turned back into a committee. Instead of EMC they are suggesting that it be IAS, as IAS would give us a lot more freedom than what EMC did. There are other possibilities which they did not mention. One option is to join with Reliability and rename their society to include Safety. Another option would be to make us a council. The option I most like is that we be turned into a full society. In my view, changing us back to a committee is just plain dumb. Over the next month or so I want to find out the thoughts of all our society members on this subject. Send me an email at j.bacher@ieee.org.



Things to consider are:

1. Current membership is about a third of what we projected our first year's membership numbers would be.
2. We do not have enough paper flow to justify expanding the newsletter to a magazine or publishing a journal.
3. We had significant financial hardships the first four years.

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The
Product
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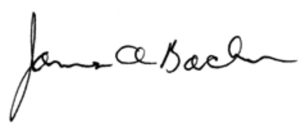
http://www.ieeecommunities.org/emc-pstc
http://www.ieee-pses.org/emc-pstc.html
http://www.ieee-pses.org/newsletters.html
http://www.ieee-pses.org/pses.html

4. We do not have enough members volunteering to help the different committees.
5. Two thirds of our members joined the IEEE to be a member of our society.
6. We are one of the few societies that are increasing society membership.
7. We are increasing IEEE membership at a time they are loosing members in the USA.
8. We have one of the most successful symposiums within the IEEE.
9. We are adding chapters around the world.
10. Our financial numbers now meet TAB FinCom's percentage requirements.
11. Is there a minimum size a society should be to be keep it around?

The next step will be for the PSES BoD to comment on the SRC report, which will be forwarded to TMC. Once the TMC has come to a decision in the matter, it will most likely make it onto the TAB Meeting Agenda for November. At that point in time I will have a chance to argue our points in front of the voting members. This is an open meeting so any society member who would like to attend this meeting and speak for or against the proposal may do so. Even if they decide to turn us back into a committee, it would not be effective until 2011, as it will be too late to remove us from the renewal in 2010.

Unless the PSES members tell me otherwise, I am going to push for making us a full society. If you agree with me please find a way to help us grow. We need more chapters, more technical committees, better symposium attendance, more symposium papers, more newsletter articles, and more members. All of these are going to be tough to do in today's economy. However if everyone puts in a little effort we can keep the society moving forward. Accomplishing these items will ensure our survival. One committee we need help with is marketing. We now have funds, so we need to revise our current material and start getting the word out about our society. So if you are familiar with marketing or know of someone who could help please let me know.



James A. Bacher
President IEEE PSES

Seeking Nominations for IEEE Medals and Recognitions

The IEEE Awards Board is seeking nominations for IEEE Medals and Recognitions and encourages the use of its online Potential Nominee Form. This form allows a preliminary review of a nominee by the selection committee and an opportunity to obtain feedback prior to submitting an official nomination form. The Potential Nominee Form is available on the IEEE Awards Web Page at:

http://www.ieee.org/portal/pages/about/awards/noms/potnomform.html

The deadline for submission of an official nomination form for any of the IEEE Medals and Recognitions is 1 July 2009. For questions concerning the Potential Nominee Form, please contact awards@ieee.org.

Chapter Safety Probes

To see current chapter information please go to the chapter page at: http://www.ieee-pses.org/Chapters/index.html

Congratulations to the IEEE Long Island Section Product Safety Engineering Society Chapter for starting a new Chapter.

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News and Notes

Role of warnings and instructions course

The University of Wisconsin will offer its "Role of Warnings and Instructions" three-day course April 14–16, 2009 at the Madison, Wisconsin campus. For information, call 800-462-0876 or visit http://epd.engr.wisc.deu/webK045.

North American appliance standard moving along

The draft tri-national North American version of IEC 60335-1 (*Household and similar electrical appliances – Safety – Part 1: General requirements*) moved closer to finalization at the February 2009 meeting of CANENA (www.canena.org). The schedule agreed upon at the meeting indicates balloting in Canada, Mexico, and the U.S. in late 2009, with publication estimated to occur in late 2010.

Ontario Raises the Bar for Electrical Products

In addition to requiring that electrical products sold in the Canadian province of Ontario bear a safety approval, the government of Ontario will very shortly require registration of the product manufacturer before such a product may be offered for sale within the province.

Ontario Regulation 438/07 states that "No person shall use, advertise, display, sell, offer for sale or other disposal any electrical product or device unless it has been approved in accordance with this regulation." Additionally, the Ontario Electrical Safety Authority (ESA) is requiring manufacturers of electrical products sold in the province to register with ESA between April 1 and August 30, 2009. The ESA is a "delegated administrative authority" accountable to the government of Ontario and responsible for administering and enforcing part of the province's electrical code and Regulation 438/07.

Besides registering, manufacturers must report to ESA any serious electrical incident, accident, or product defect; assist in the investigation of such; and undertake notification of the public.

Some additional facts:

§ Registration will cost $350 Canadian, with a yearly renewal fee of $300.

§ The registration requirement includes manufacturers of components as well as complete products.

§ Products covered include consumer, commercial, and industrial.

§ "Manufacturer" is defined as "the entity whose legal name appears on the certification or field evaluation report and is the owner of the certification or field evaluation."

§ Registered manufacturers will be listed in an online public database.

§ Small product quantities do not exempt the manufacturer. "All manufacturers of field evaluated electrical products must also be registered."

Visit www.esasafe.com to download the legislation, guidelines, and FAQs. Questions may be e-mailed to:

product.safety@electricalsafety.on.ca.

New PSES Jobs Web Page

PSES has a new page on our web site for employers and job seeks at http://www.ieee-pses.org/jobs.html. Employers may post jobs seeking regulatory or compliance-related personnel free of charge. Job postings will remain on this web site for a period of 6 months but may be removed earlier by request of the employer. We currently have over half a dozen postings.

Society members who are seeking jobs may list a description of the position they are seeking free of charge. A resume in PDF format may also be posted if desired. The listing will remain on this web site for 6 months, but the owner may submit a request to renew the listing every six months, indefinitely. It may be removed earlier by request.

See http://www.ieee-pses.org/jobs.html for posting policy and how to submit requests.

Technically Speaking

Ed. Note-This article is a timeless classic reprinted from a 1991 issue (V4N3) of PSEN.

by Richard Nute
Product Safety Consultant
San Diego

TESTING PURPOSES

Every product is subjected to a suite of tests. What are the purposes of these tests?

Often, we just perform the tests as prescribed in a standard, and with whatever conditions are specified by the certification house we are currently dealing with.

I have found that it is worth while to consider not what the standard or certification house requests, but rather what is the "thing" that is being tested, and what is its relevance to the safety of the product.

Let's look at a few of the popular and universal tests that are commonly applied to products.

INPUT TEST:

This test is to measure the input current and input power as a function of input voltage. The product is adjusted or stimulated to consume maximum current or power.

Note that the test has no pass/fail criteria as do most of the other tests. The input current and input power for specified input voltages are recorded.

What do we use the test data for?

Some standards imply the purpose of the test is related to proper sizing and loading of the supply to which the product is connected. Indeed, this is true for permanently connected equipment where the building wiring is specifically installed for the equipment. For plug-and-socket connected equipment, the building wiring is already installed; the issue is whether the building wiring has sufficient capacity to carry the additional load imposed by the product.

However, what is the safety issue? Whether permanently installed or plug-and-socket connected, the building wiring up to the point of product connection, is required by building codes to be adequately protected by circuit breakers or fuses. No matter what load is connected to building permanent wiring for either permanently connected products or plug-and-socket connected products, the installation remains safe.

The usual use of the test data is to evaluate the product rating markings. However, such data is not related to the safety of the product. If the rating markings are incorrect, there is no safety issue. The worst that can happen is nuisance tripping of building overcurrent devices. This, in itself is not a hazard, although remedies to nuisance tripping may result in hazardous situations.

The major safety issue for which we use input test data is to determine the adequacy of the current rating of the various primary circuit components. To prevent overheating, the current ratings of various primary components must be equal to or greater than the primary current. Components that must be considered include the power plug current rating, the power cord wire ampacity rating, the appliance coupler current rating, the fuseholder current rating, the power switch current rating, internal wire ampacity rating, internal connector rating, etc.

Another safety issue related to the input test is the temperature of various insulating materials within the product and the temperature of heated accessible parts on the product. As a general rule, maximum heating occurs when the product consumes maximum power. Thus, the "normal temperature" test should be conducted at the input voltage for maximum power.

However, the power difference as a function of input voltage is usually a low percentage of total power. Unless internal temperatures are very close to their ratings, the actual input voltage at which the temperature test is conducted is not usually significant.

(Some certification houses assert that maximum temperature of some devices within products is not related to maximum input power; in such cases, only the certification house can specify the input voltage at which temperatures should be determined.)

(Other certification houses specify the input voltage at which the temperature test is to be conducted regardless of power.)

The purposes of the input test are:

1. Determine whether the rating markings are acceptable.
2. Determine whether the primary components are suitably rated.
3. Determine the input voltage at which the temperature test should be conducted.

LEAKAGE CURRENT TEST:

For grounded products, this test is to measure the current in the protective grounding conductor. For two-wire products, the test is to measure the current between accessible conductive parts and ground.

In some cases, leakage current is measured following humidity treatment. Why should humidity affect leakage current?

This test has pass/fail criteria which are specified in the standard to which the product is evaluated. The measured value is recorded and compared with the standard.

Often, the purpose of the test is purported to be that of determining whether an electric shock is possible in the event of an open ground, or from accessible conductive parts of a two-wire product.

To identify the purpose of this test, let's look at what one would do to address a problem of excessive leakage current. Or, putting the question another way, what does one do in the design of a product to control or minimize leakage current (ignoring EMI suppression capacitors)?

To control leakage current, we must first know the source of the leakage current. Since there are no electrical components connected to the ground circuit (or to accessible conductive parts), where does the current come from? The current comes from the stray capacitance between the primary circuit and the ground circuit (or to accessible conductive parts). The dielectric of this stray capacitance is the insulation between the primary circuit and the ground circuit (or accessible conductive parts).

Therefore, to control leakage current, one must minimize the stray capacitance of the primary circuit. This is done by increasing the distance between the two plates of the capacitor (increasing the distance between the primary circuit conductors and grounded or accessible parts).

Some insulations may be hygroscopic (i.e., may absorb moisture). The presence of moisture within an insulator will alter the overall dielectric constant, thus increasing the value of capacitance. If the value of capacitance increases, so will the value of leakage current. Therefore, some standards specify humidity treatment prior to the measurement of leakage current.

The purpose of the leakage current test is:

1. Determine whether the insulation from the primary circuit to grounded or accessible parts is adequate to prevent electric shock.

DIELECTRIC WITHSTAND (HI-POT) TEST:

This test applies a relatively high voltage between the primary circuits and the protective grounding conductor. For two-wire products, the high voltage is applied between the primary circuits and accessible conductive parts (or foil wrapped around accessible non-conductive parts).

Continued on Page 8

In some cases, the test follows humidity treatment. Why should humidity affect this test?

This test has pass/fail criteria which are specified in the standard to which the product is evaluated. Note that this is not a measurement in that no value of any parameter is recorded.

What is the safety purpose of this test?

To answer this question, we need to identify what part fails when the product fails the test and we need to identify the consequences of that part failure.

Since we are applying a voltage between the primary circuits and the grounding circuit (or accessible conductive parts), the part we are testing is insulation. The insulation between any point of the primary circuit and the grounding circuit is either solid or air, or both solid and air in series.

In the event of a hi-pot failure, there is a failure of either the solid insulation or the air insulation. If the failure is solid insulation, then a conducting path is impressed upon the surface or through the solid insulation, and the insulation is destroyed catastrophically, becoming a resistor of indeterminate value. The resistance may be sufficiently low value to allow an electric shock to occur.

If the failure is air insulation, then a conducting path exists for the duration of the test. When the high voltage is turned off, the system returns to normal because air is a renewable insulation. A shock could exist for the duration of a primary circuit overvoltage.

So, the failure of the primary-circuit-to-ground insulation could result in an electric shock.

But, why test with a voltage often more than 10 times the rated input voltage?

Inductors have the property of storing energy in magnetic fields. Usually, energy in magnetic fields is converted to some other energy form such as the kinetic energy of a rotating shaft (of an electric motor). Occasionally, magnetic energy is released as a high-voltage impulse into the power distribution system. Such releases are normal (e.g. - during the starting process of an electric motor).

Because high-voltage impulses are impressed upon the power line, all insulations on a power distribution system (including product internal insulations) must have sufficient electric strength to withstand not only the normal system operating voltage, but also the normal system overvoltages. Consequently, product mains-to-ground insulations must be tested with a high voltage to confirm that the insulations will not break down when subjected to high-voltage impulses, which normally occur on power distribution systems.

For type-testing, there is merit in converting this test from a pass/fail test to a measurement of the breakdown voltage of the weakest insulation in the product. This is done by increasing the voltage until breakdown occurs, recording the voltage, and examining the unit to identify the failed insulation. This tells you the margin between the required electric strength and the actual electric strength. It also tells you what the weakest insulation is. This is valuable information in the event of a failure of the production line hi-pot test.

Some authorities now advocate that the weakest insulation should be a specific air insulation especially installed in the product, where the breakdown voltage of that air insulation is less than that of the weakest solid insulation. This construction has the advantage of protecting the solid insulation from catastrophic breakdown in the event of ANY overvoltage. The breakdown voltage of the air insulation can be set at any convenient value.

However, safety standards authorities and certification house authorities commonly do not permit breakdown of either air or solid insulation at any value less than that specified in the standards.

The purposes of the dielectric withstand (hi-pot) test are:

1. Determine whether the insulation from the primary circuit to grounded or accessible parts

has sufficient electric strength to withstand the worst-case overvoltage which could occur in service.

2. Determine the insulation with the least value of electric strength.

TEMPERATURE TEST:

This test is to measure the normal operating temperatures of various components and materials. (For the moment, we will ignore the fact that some standards specify measurement of temperatures under fault conditions.)

The measured temperatures are compared with maximum temperatures specified in the standard.

Why do we measure temperatures? What is the safety consequence of a component or material exceeding the temperature specified in the standard? How do we choose what components and materials to measure? Why does the standard specify some components and materials and not other components and materials?

Probably the most obvious reason to measure temperatures is to prove that accessible parts are not hot enough to cause a burn injury.

But what is the purpose of measuring internal product temperatures?

All components and materials will fail as a function of temperature. Products commonly use metals for conductors and for structure. For metals, the temperature for failure of either the conductor function or the structural function is sufficiently high that it can be ignored.

However, products also commonly use thermoplastic for insulation and for structure. For thermoplastics, the temperature for softening can be of the same order as the normal temperature for power dissipating components such as power resistors and power semiconductors. If the structural function of a thermoplastic is weakened, so, too, may be its insulating function. Failure of an insulator may result in electric shock or electrically caused fire.

Therefore, we need to measure temperatures of thermoplastic insulations and thermoplastic structural parts (assuming the failure of the structural parts will result in a hazard — which usually will be the case).

Examples of thermoplastic insulations are wire insulations, connector bodies, transformer bobbins (including EMI filter coil forms), and sheet insulations.

Other materials may exhibit chemical change as a function of temperature. If such materials are used as insulators, then we must ascertain that the material operating temperature is less than that at which the chemical change occurs. (The chemical change may also alter the material's insulating characteristics.)

An example of a material which incurs a chemical change as a result of being subject to a high temperature is the epoxy of a glass-epoxy circuit board.

Some components, when heated, can evolve a gas. If the component is sealed, the pressure due to the evolved gas can cause a catastrophic rupture of the container. Some containers will release such pressure in the form of an explosion, while others will release the pressure gradually. An explosion could result in an injury.

Examples of sealed components which can evolve a gas when heated include electrolytic capacitors and sealed batteries. Today, most electrolytic capacitors incorporate pressure relief mechanism which prevent explosion. Nevertheless, we still measure and control the temperatures of electrolytic capacitors and batteries.

Often, rather than measure the temperature of the material, we measure the temperature of the heating device, such as a transistor or diode. In this case, we get a worst-case measurement, where the insulation associated with that component can never achieve the temperature of the heating device.

Such a measurement accounts for misrouting of

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wires in case they should bear against the heating device.

The purpose of the temperature test is:

1. Determine whether materials are subject to a temperature at which they are likely to fail, where such failure would result in a hazardous condition.

CONCLUSION:
Obviously, we could continue this discussion to cover a large number of tests. But, I believe these four tests are sufficient to illustrate the point.

Too often, we just test the product, and record the data.

I believe it is useful, for each test, to consider the consequences of failure of that test, and what one would do to the equipment to make it pass the test. This exercise forces one to consider what is being tested, and how it fits into the "big picture," the overall set of components that make the product safe.`

Tip: ***Best way to get your boss to approve your trip to the 2009 Symposium on Compliance Engineering is to submit a paper that gets accepted for the symposium! Or volunteer and tell him you have to be there!***

IEEE PSES Membership savings

UL University Offers IEEE PSES Members 15 Percent Discount

UL University (ULU) has established a discount code which will provide all IEEE-PSES members with a 15 percent discount off the price of all ULU instructor-led workshops, online programs, videos, books, and other services/products offered under the ULU brand. The discount is automatically applied during registration or purchase of ULU products. Registration or product purchase can be accomplished online at www.uluniversity.com or by calling 888-503-5536 in the U.S. or the country-specific number posted on the ULU website.

To receive the discount, members must enter or mention the discount code found in the Members Only section of the PSES website.

If you or any member has specific questions regarding ULU products or services, please call or email me or call the local country specific number posted on the UL University website.

Tony Robertson
Manager – Customer Training

Advantages of Membership in the IEEE PSES

Makes you part of a community where you will:

- Network with technical experts at local events and industry conferences.
- Receive discounts on Society conferences and symposiums registration fees.
- Participate in education and career development.
- Address product safety engineering as an applied science.
- Have access to a virtual community forum for safety engineers and technical professionals.
- Promotion and coordination of Product Safety Engineering activities with multiple IEEE Societies.
- Provide outreach to interested engineers, students and professionals.
- Have access to Society Publications.

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E-Mail List: http://www.ieee-pses.org/emc-pstc.html
Virtual Community: http://www.ieeecommunities.org/emc-pstc
Symposium: http://www.ieee-pses.org/symposium/

Membership: The society ID for renewal or application is "043-0431". Yearly society fee is US $35.

Back to Basics Department

The Engineer's Role in Product Liability

by Luiz Claudio Bonilla de Araujo

INTRODUCTION

The safety of consumer products directly affects all of us. We each risk injury or death when we use unsafe products, and the costs of product safety are reflected in the prices we pay for the products we buy. However, society has available an array of tools for influencing these decisions.

Of all the various external social pressures, product liability has the greatest influence on product design decisions. In industries with potentially high-hazard products, but not subject to significant product-related regulation (e.g., industrial machinery), product liability probably dominates design decisions, in terms of safety considerations. In industries subject to moderate regulatory pressures (e.g., industries subject only to CPSC regulation), the influence of product liability likely overshadows that exercised by regulators.[8]

Engineers often play a role in at least one stage of product safety litigation cases. They may create the problem when designing the product; detect the problem by testing and inspecting before production is started; confirm or not the problem, when providing expert testimony in court; or solve the problem by investigating product failures.

The purpose of this article is to introduce the main concepts of product liability and discuss the role of engineers in the creation, detection, confirmation and correction of problems related to product safety litigation.

PRODUCT LIABILITY LAW

Product liability law deals with the rights of consumers or other persons who are injured as the result of some defect in the construction, design, or labeling of a product. A **construction defect** is basically a quality-control problem—the particular product that caused the injury does not meet the manufacturer's own established standards.1 A **design defect** occurs when a properly assembled product is inherently unsafe due to some flaw in its design. A **labeling defect** occurs when a manufacturer fails to notify consumers of hazards that may be associated with use of the product.

Traditionally, and until very recently, product safety has been a matter of private law subject to common-law control[1]. Under this traditional approach, the primary means of controlling product safety, other than market adjustments, was through lawsuits based on the common law of tort or contract that allowed consumers injured by an unsafe product to be compensated for their losses and injuries. Although the federal government has begun to play a more active role in regulating product safety, the common law is still the most important parameter of this aspect of the legal environment of business.[1]

The following is a brief description of the legal principles that usually provide a foundation of product liability litigation.

Negligence

Negligence from the standpoint of product liability results from the failure of the manufacturer or seller to exercise "reasonable care," thereby exposing the user or consumer to unreasonable risk of harm when the product is being used as intended.2

Breach of express warranty

Breach of express warranty occurs when the product does not meet the representations made by the manufacturer with the result that damage or injury occurs. It is not necessary that such representations be made in writing, neither are the words "guarantee" or "warrant" required for the existence of an express warranty.[2]

Examples of descriptive language that can form the basis of an express warranty are: heavy duty, commercial grade, skid-proof, 1000 lb carrying capacity.

Breach of implied warranty

An implied warranty is one which is implied by law rather than being specifically made by the seller. The basis for this rests primarily on definitions found in the Uniform Commercial Code. Two sections of this code, Sections 2-314 and 2-315, largely form the basis for liability suits predicated upon breach of implied warranty.

The reasoning of this principle is the following:[1] "If the buyer, expressly or by implication, makes known to the seller the particular purpose for which the article is required and it appears that he has relied on the seller's skills or judgment, an implied warranty arises of reasonable fitness for that purpose."

The significance of this principle is that a seller may be held liable if he knows the use for which the product is intended and makes an improper recommendation. For example, small metalworking companies lacking a metallurgical staff often rely entirely upon the advice and recommendations of their steel suppliers in electing a particular alloy for a component or new application. Should this alloy not perform satisfactorily because of a metallurgical deficiency, it is quite likely that the supplier could be held liable.

Strict liability

As its name suggests, strict liability imposes a very strict standard of producer conduct. Producers are required to pay full compensation to consumers injured by defective products, even though the producer has exercised all reasonable care in the design and manufacture of the product.[1] Nevertheless, an important consideration resulting from the concept of strict liability is that anyone in the chain of distribution, from manufacturer to retailer, may be held liable, provided the product has not been altered. Alteration or modification of a product is a common basis for the defense in product liability litigation.[2]

Elements necessary to establish liability

The basic elements that a plaintiff must establish in order to recover from a manufacturer under strict liability are relatively straightforward. The plaintiff must show that he or she was injured by a defective product, that the injury occurred because the product, that the defect caused the product to be unreasonably dangerous, and that the product was defective when it left the manufacturer's control.[1]

ENGINEERING INVOLVEMENT IN PRODUCT LIABILITY

Regardless of who shares the blame for the product liability problem, engineers always play a role in its creation, detection, confirmation or solution. They may be called upon to conduct pre-production safety reviews or investigate a product failure. In addition, they may testify in a product liability lawsuit.

How do engineers cause a product liability problem?

In general, the engineer or technical person associated with design activities must be versatile, creative, and well informed. In addition to a solid foundation in the basic physical sciences, the designer must possess a comprehensive knowledge of materials and manufacturing processes. Furthermore, he must be familiar with his company's organization and the function of other industries, particularly those with which he will have direct or indirect contact. Finally the designer should be cognizant of the human element, the physiological and psychological factors involved in both manufacture and the use of a product.[2]

Generally, the problems related to product safety are caused because engineers and designers fail to follow the "Cardinal Rules of a Safe Design," which are summarized below.[3]

1. Eliminate or design out all hazards existing in the product under reasonably foreseeable conditions of service and commerce, including intended use and reasonably foreseeable misuse.

2. Enclose or otherwise physically guard hazards existing under reasonably foreseeable conditions of service and commerce, including intended use and reasonably foreseeable misuse. This must be done through physical design features of safety "hardware" at the earliest feasible stage of the design process.

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3. Eliminate or mitigate all hazards existing in the product under reasonably foreseeable conditions of service and commerce, including intended use and reasonably foreseeable misuse, through warnings, instructions, training, administrative routines, procedures, packaging and/or other safety "software."

Where conflicts of the literature (including standards) exist, apply the first three cardinal rules.

Specifically, problems are created when one of the following deficiencies occurs during the product design and/or development phase.

—*Failure to test adequately*
A product safety problem may arise when engineers fail to perform or specify any meaningful tests to ensure public safety.

A common error is to believe that conformity with safety standards is enough to guarantee a safe design. Compliance with published safety codes and standards does not guarantee a reasonably safe product.[3] This can be easily confirmed by reading the "recall notices" issued by CPSC. For example, electrical products under recall usually bear the Listing Mark of Underwriters Laboratories, which is a recognized standardization and certification agency.

Codes and standards, even those prepared by internationally known standards writing and setting bodies, must be seen solely as good starting points for design purposes. Adequate laboratory and field tests, addressing normal use and reasonably foreseeable misuse, should be conducted to verify product safety design factors throughout the product's useful life and disposal [4]. The results of these tests must be used to make design decisions following the cardinal rules mentioned previously.

—*Failure to perform safety analyses*
When systematic written hazard analyses are not performed or not initiated in time to be utilized during the design phase, a safety problem may remain unnoticed until its too late (or too costly) to perform the necessary changes, or until an accident occurs.

Hazard analysis must be conducted using currently accepted techniques as early as possible during the design phase. Appropriate corrective action must be taken when product safety hazards are identified. Findings (details regarding potential hazards) and decisions (regarding corrective actions) must be documented.[4]

When a systematic hazard analysis is not conducted, the first and second cardinal rules of a safe design may be overruled, putting the integrity of the whole project in jeopardy.

—*Failure to warn*
In this case, the third cardinal rule of a safe design is not practiced.

If the manufacturer has done his utmost to eliminate or control the hazard, but there still is a remaining risk of injury to the user, the product must be provided with warning labels or signs.

The effectiveness of warnings depends on the quality of the warning design, the kind of hazard and the adequacy of the analysis used to determine hazard communication needs.

However, it is improper to use warnings as post-design "band-aids" to mask defects and deficiencies that reasonably could be overcome by appropriate design remedies.[5] As mentioned before, warnings should be used only after all attempts to eliminate or enclose the hazards have been carried out.

How do engineers detect a potential problem?
The engineer's evaluation should indicate whether or not a defect or hazardous condition exists in the design of a product.

A *predesign analysis* determines those hazards that might be present in a product to be developed. It may be the basis for the preparation of specifications and criteria to be followed in the design; it may indicate undesirable product characteristics, materials, and design practices to be avoided; it may determine safeguards to be provided; and it may tentatively establish tests to be undertaken to verify safety devices and safety-critical aspects that could lead to a liability.[7]

A *postdesign analysis* determines whether or not selected designs, equipment, and procedures meet the criteria established as a result of the predesign analysis. Evaluations must be made to determine whether or not designs that do not provide the best in safety should be modified or redone.[7]

Safety analyses should start as soon as possible after the product is conceived and should be supplemented continually until the product is released for production.[7]

Most hazardous characteristics of products can be uncovered by examination. The examination may be an investigation by visual or other senses of workmanship or material or whether or not a specific condition exists, by gauging or measurement, or by simple physical manipulation. For example, examination will permit a person to determine whether or not the product has sharp edges or points or, if the product is electrically powered, whether or not there are any places where an uninsulated conductors might be touched accidentally.

Tests must be performed to demonstrate that a specific operation can be accomplished, that a piece of equipment will operate, or that a material has or lacks a certain property. A test may verify that values for a stipulated operational parameter fall (or do not fall) within specified limits, and that application of a stipulated operational parameter will not cause a failure, damage, or hazardous condition.[7]

How do engineers confirm the problem? (engineers as expert witnesses)

The expert witness is one who by virtue of education, training, and experience or a combination of these factors can discuss the operation and function of a particular process or mechanism.[2] Usually the expert witness is an engineer, scientist, or other professional whose specialized education endows him with the knowledge required to understand the matter before the court.

In general, before any legal proceedings can be undertaken in a personal injury or liability case involving a consumer product, it must first be determined what legal principles are involved.[2] From the engineer's standpoint, such clarification can be very helpful to the organization and direction of the technical or scientific investigation. In other words, his findings and subsequent reports should not only be accurate and factual but should also, as far as possible, fundamentally support the legal principles or legal direction his counterpart attorney takes in the case.

The main objective of the expert witness is to collect physical evidence which will help him to establish the root causes of an accident where the product was involved. From the standpoint of failure analysis in product safety litigation, physical evidence consists of any component or tangible material discovered during an examination which would help determine the failure mechanism or the causative factors associated with the failure.[2]

The most important aspect of the process of collecting evidence for product liability litigation is the requirement of continuity of evidence—that is, the maintenance of a continuous record of the possession and condition of the physical evidence. Since several years may elapse before the case comes to trial, it is essential that the condition of the product at the time of the failure be established and, if possible, maintained, so that the trier of the fact (judge or jury) may evaluate its condition.[2]

The documentary or written evidence in an investigation is just as important as the physical evidence and in many cases more so.[2] Information about the operating conditions—for example temperature, speed, flow rate, etc.—and service history is very important and should also be collected as part of the technical data package. These data on the actual service conditions should then be compared to the design conditions to determine whether any abnormality exists.

Subsequent to his technical examination and report, as litigation progresses, the technical expert may be required to participate in the "discovery procedures" initiated by opposing counsel. These procedures vary, depending on the jurisdiction. One of these procedures is the

Continued on Page 16

"interrogatory." The engineer, acting under subpoena, must furnish, in writing, the answers to a series of questions. The engineer may use any records, drawings, or other reference material available to him.

If the litigation is proceeding in a federal court, or in a state using federal rules, then the pretrial discovery procedure may take the form of a "deposition." The witness must appear with whatever records and files have been requested and must respond to questions posed by opposing counsel, unless instructed not to answer by his attorney. The best defense is adequate in-depth preparation, not only about the issue at hand but about peripheral matters and the current state-of-the-art.

How do engineers solve the problem?

The proper application of failure analysis can provide a valuable adjunct to the total engineering input into a product design. The utilization of this technique can point out design errors, materials limitations, and fabrication defects where they exist in the product. From a purely engineering viewpoint, this knowledge can be fed back into the design of the product, improving its reliability and usefulness as a whole.[2] With the evolving recognition of the need for product liability prevention, the expert on how things fail collaborates with the designer to anticipate product failures and to design out the hazards.[6]

In many cases, failures may have occurred which were potential causes of accidents but accidents did not result. It is important that such failures be investigated to determine if the failure was unique or if the failure was characteristic of the component or product.

The product may be modified to reduce failure-prone features and materials, and processes are selected to reduce or eliminate the susceptibility of failure. Through this collaboration, the quality assurance requirements are established and standard material specifications are adopted that formalize in writing the engineering requirements for each component.[7]

It is especially advisable if more than one case of failure occurs to a safety-critical component or assembly, and the company knows about it, that either corrective action be taken or the reason for the lack of corrective action be justified.[7] If an accident should occur and no action had been taken on previous similar failures, the manufacturer has a high chance of losing in any further litigation.

Customer complaints should be given the same due consideration for the same reasons. In some cases the customer may have the failed or defective component which could be obtained for test and analysis. Quick response to a customer's complaint of a failure is often good for customer relations and it may also prevent litigation.

CONCLUSIONS

Unfortunately, although the engineering and science fields have made considerable technical progress over the last three or four decades, failures and thus product liability claims are still a problem.

As mentioned earlier in this article, the engineer, because of the nature of his profession, may be involved in one or more aspects of a product safety litigation:

§ When he is serving as the primary or sole designer, he can and must anticipate the probable uses and misuses of a particular product. He must select courses of action or alternative solutions to eliminate or contain hazards. Failure to do so, will probably result in product safety litigation.

§ When reviewing a design, he must be able to make a distinction between a reasonably safe product and an unreasonably dangerous one by balancing the product's utility against the potential risks of harm derived from its use. In this case, he must be able recommend appropriate changes or determine whether or not monitoring and/or warning devices are required.

§ When serving as an expert, he is in the position of being the evaluator of the technical merits of the case and deciding whether a basis for litigation exists. Once this determination has been made, he can assist the attorney in developing the strategy of the litigation.

§ When solving a product liability problem, he has to perform analyses in failed products to determine the potential causes of failures. Furthermore, he has to establish corrective measures to be taken in order to avoid future similar failures.

The only way engineers will be well prepared to play these roles is through good academic preparation and continuing education.

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(Footnotes)

1 Manufacturers must be aware that construction defects may in reality be design defects. That is, they may be caused when the designer does not take into account the variability of the production process or does not consider the possibility of human error.

2 Actually, if the manufacturer wants to achieve a higher protection against liabilities it is necessary to go one step further than designing a product to be functional and safe when used as intended; it is also important to design against *reasonably foreseeable misuse*.

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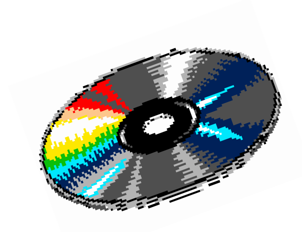

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Correction Notice: Oon Page 25 of the Index for the September 2006 eDJ (PSEN Vol02 N03): The author is listed as “Carl Schmuland” when it should have been “Charles Sidebottom.”

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