

The



EMC
SOCIETY

Product

Safety

Newsletter

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Vol. 8, No. 5 Nov. - Dec. 1995

Chairman's Message



Tech Council Update

Many of you have expressed interest in another update on our proposed restructuring within the IEEE. To review, TC-8 has long had a desire to grow from a technical committee within the EMC Society to a Technical Council that will have formal ties with several IEEE Societies. I had the opportunity to present our proposal to the IEEE Society Presidents Forum a few weeks ago. Here are my key points:

1. The lack of an adequate forum and professional association of product safety engineers is not being addressed in the engineering community as a whole. This deficiency exists in spite of the increase in product safety activity globally, including:

- European Union and its product safety directives,
- International safety standards work at IEC (through ANSI for the U.S.A.),
- Intense product safety assessment and certification activity in industry,
- Increased product safety activity within certain industry groups, shown by accelerated wholesale upgrading of standards (for example, semiconductor manufacturing equipment industry).

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The Product Safety Newsletter

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Letters to the Editor

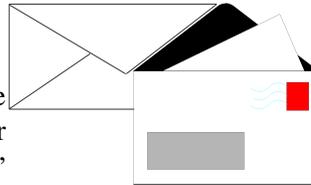
Dear Editor,

Congratulations on another excellent issue (March-April, 1995) of the PSN. Best wishes for a fruitful process of “organizational affiliation” considerations. I trust there will be no tendency to mix the disciplines of product safety and those of occupational/plant safety. There have been some high level efforts in the past to combine the two organizationally, which in my opinion would lead to critical omissions/conflicts for product safety.

I enjoyed the edifying article by Werner Poster, page 7 and following. Your coverage of the international issue(s) can continue to be a most valuable service to your readers, as the various differences in safety philosophy and legal/standards issues among countries are harmonized.

Mr. Poster’s good article contains one rather perplexing point under Risk Assessment, page 14. The concern is the basing of risk assessment/risk analysis on only probability and severity. Most regulatory strategy/protocol and product liability disciplines in the U.S. seem to necessitate the use of three distinct criteria for risk assessment that is practical enough to be used and can stand the scrutiny of practitioners and the courts.

The three are frequency, vulnerability (assumption of risk), and severity. Each of these needs to be separately identified, analyzed, and quantified if the accident prevention-design process and product liability demands of reasonableness are to be satisfied. Safety performance and hazard analysis have traditionally applied the questions of only frequency and severity and these were seriously flawed due to the



omission of “assumption-of-risk” considerations. Because awareness and avoidance are the bottom-line of accident prevention,

the courts have rightfully taught us that the criteria for determining unreasonable risk” must include the human behavior/human factors disciplines which drive assumption of risk/vulnerability analysis. **

When the many elements of “frequency” (number of products in use, use environment of the product, how often and under what conditions exposure to hazard occurs, etc.) are combined with the many elements of “Vulnerability” (below) under a single heading of “Probability,” the analysis become so complex, time consuming, and indecisive that practitioners usually end up blue-skying/omitting so much as to make conclusions quite indefensible in court. On the other hand, with three numerically compatible scales for Frequency, Vulnerability and Severity, the quantification process is quite simple and usually leads to a definitive conclusion as to whether a hazard is reasonable or unreasonable.

Supportive experience and rationale for the above are included in the materials of mine you so kindly chose to publish in past PSN’s (Volume 3, Numbers 4 and 5; Volume 7, Numbers 1 and 6).

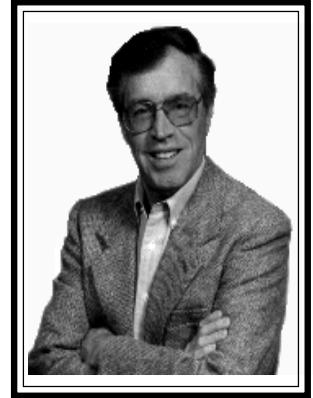
Experience in Europe with Deere and Company (1967-1982) helped me understand the how and why of significant differences in safety philosophy between the U.S. and Europe. I believe it

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Technically Speaking

Power Systems and Polarization

Copyright 1995 by Richard Nute
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A colleague recently asked what the power distribution system designations “IT” and “TN” mean.

The “power distribution system” is all parts of an electric system between the “bulk power source” and the consumer’s service-entrance equipment. For the purposes of this discussion, the “bulk power source” is the secondary of a power distribution transformer, where the output voltage is the utilization voltage, commonly taken as 100, 120, 127, 220, 230, or 240 volts.

There are three basic power distribution systems, TN, TT, and IT. Within the TN system, there are three variations, designated TN-S, TN-C, and TN-C-S. We will examine what these designations mean, and how they affect safety of the system and of products connected to the system.

Also, we will define “polarization” as it applies to the power distribution system and to the safety of products.

And, we will discuss power distribution system grounding.

Here is what the letters mean:

- T = terra (earth)
- N = neutral (the neutral conductor of the power system)
- I = impedance (value not specified)
- C = combined
- S = separate

Terra (or earth) means, literally, the body of the earth. For the purposes of this discussion, it means an electrical connection to the earth by means of a ground rod buried in the earth.

Neutral means the neutral conductor of the power system. There are two definitions. Conventionally, the neutral conductor is the common point of a three-phase, four-wire (“wye”) bulk power source. This is the first definition.

In two of the three systems, TN and IT, the neutral conductor is connected to the earth by means of a ground rod. From this, we have a second definition: the neutral conductor is the one connected to ground. This definition is important because it is used to identify the neutral conductor

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Area Activities

by Kevin Ravo

Underwriters Laboratories

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Effective this issue, I will be taking over for John Reynolds for this column. I have to start by extending a note of thanks to John for all his contribution to the Area Activities column in the past. I hope I can continue to provide information and news of interest from the chapters around the country. I welcome any suggestions regarding content and format of the column. I will try to take it as complete yet concise and timely as possible.

In addition to suggestions on content and format, I would like to invite anyone to send in any 'activity' information you think may be of interest to the readers of the Newsletter. In addition, I will be contacting officers in the Local Groups to get information on a regular basis - basically making a pest of myself!

Now, on with the Area Activities:
(Note:some information dates back to Sep '95)

Santa Clara Product Safety

September Meeting:

This was an annual planning/dinner meeting hosted by the Committee. Several items of interest were discussed as follows:

Financial Report - There is a fund balance. Funds are generated through participation in events such as the Colloquium, and meeting attendance. Ideas for how the funds could best be used were solicited and should be forwarded to: Mark Montrose voice: 408-247-5715

Future Programs - Ideas for future programs were solicited and the Survey form should be used to submit these ideas. If you need a form or want to pass along an idea contact:

Ed Karl

voice: 408-563-7184

e-mail: karCedward@amat.com

EMC Symposium - A call for papers for the 1996 EMC Symposium was made by Mark Montrose.

PSTC Status with IEEE - Brian Claes gave an update on the status of the Committee. He indicated that the Committee had the support of the EMC Society (from the highest levels). There will be more of a move under way to establish the PSTC as a "Working Group" a designation which allows for operation with less restrictions. In October, a Task Force will be launched to evaluate the scope of and develop a charter for a "Safety

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The Road to CE Marking

by Ann Been, CE Mark Project Manager- Instrument Systems,
Abbott Diagnostic Division, a Division of Abbott Laboratories

The following article was re-printed with permission from the European Community Quarterly Review (Vol. III, Issue 3, 3rd Quarter 1995), a publication of Technology International, Inc. Technology International is the US. subsidiary of Interference Technology International, Ltd., a UK. appointed Competent Body, and can be reached at (800) 242-8399.

In 1993, Abbott Diagnostics Division became aware of the product Directives coming out of the European Community with regard to product safety. In particular, we were interested in the Electromagnetic or EMC Directive. As a manufacturer of In-Vitro Diagnostic equipment whose products fall under the scope of the FDA chapter, ADD was accustomed to working in a regulated environment. We had just completed certification to the ISO 9001 standard. The conventional wisdom at that time was that these new "CE Mark" Directives were just another piece of the ever-tightening regulatory landscape. After investigating the requirements of the Directives and the methods that could be used to declare compliance, ADD chose to perform testing on it's newest product in an attempt to be in compliance with the EMC Directive before product launch at the end of that year.

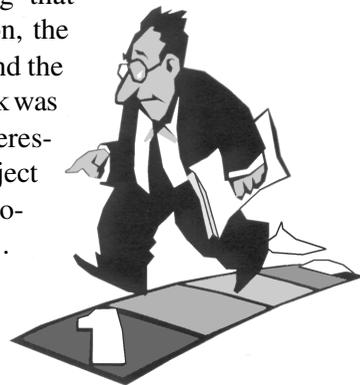
Looking back on that period of time when the "CE Mark" was just a phrase, we can assess the mistakes that we made and come away with a clearer picture of how to comply with the EMC

Directive. During that initial certification, the time, resources and the expense of this task was consistently underestimated by the project engineers and program managers.

Much knowledge was gained the hard way through trial

and error. ADD has come a long way since that time, and we have managed to successfully obtain technical certification for a total of 4 of our current products. We expect work to be completed on an additional 14 products by the end of this year, in time to meet the 1996 deadline. We have successfully implemented a Division procedure detailing how to obtain the CE Marking for our products, and integrated the maintenance of the CE Marking into our change procedure.

So how do you meet the compliance deadline without the luxury of a 2 year learning curve? First of all, don't panic! Although it can seem overwhelming at first glance, a calm head and good plan are all that are required to successfully meet the requirements. First take a deep breath. Now, take the following steps:



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Upcoming Requirements for Clearance and Creepage Distances for IEC 950

by Lal Bahra, P. Eng., UL Northbrook
voice: (708) 272-8800
fax: (708) 272-2474

Basic Safety publication, IEC 664-1 (1992), Insulation Coordination for Equipment Within Low- Voltage Systems, Part 1: Principles, requirements and tests, was developed and published in 1992 by SC28A. According to IEC Guide 104, all technical committees of IEC, shall align the requirements of equipment standards with those of the basic safety publications where possible. Working Group 6 of technical committee TC-74 for IEC 950, has started to work on revising sub-clauses 2.9 and 5.3 of IEC Publication 950, Safety of information Technology Equipment. Sub-clause 2.9 deals with clearances, creepage distances and distance through insulation while Sub-clause 5.3 deals with electric strength testing.

REQUIREMENT FOR CLEARANCES

Present requirements for clearances in IEC 950 are based on a mixture of mains supply voltage, pollution degree and the applicable over-voltage category. These were based on previous publications of SC28A namely IEC 664 (1980) and 664A (1981). SC28A has published 28A/-, OO/CDV, which will be later published as an amendment no. 1 to IEC 664-1. WG6 has looked deeply into IEC 664-1 and this upcoming amendment and determined that there were differences between IEC 950 and IEC 664-1 and its would be amendment no. 1.

IEC 950, Table 3 gives three different clearances for 4000V peak impulse voltage and pollution degree 2, as follows.

- A. 3.2 mm for basic insulation with a mains voltage of up to 150V r.m.s.
- B. 3.2 mm for basic insulation up to a mains voltage of up to 300V r.m.s.
- C. 2.0 mm for operational insulation up to 150V r.m.s and 2.5 mm up to 300V r.m.s.

In item "C" above the value of 2.0 mm and 2.5mm, are actually smaller than required by IEC 664-1, which is 3.0 mm and may result in a flashover.

Requirements for clearances in IEC 664-1 are based on impulse withstand voltages. According to the recent paper

28A/100/CDV of SC28A, it is now known that pollution has no effect on clearances. Previous separation was not supported by the analysis of the available test data. Pollution definitely has a worsening effect on creepage distances but not on clearances.

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News and Notes

The following material comes from Dave Edmunds of Xerox who has graciously kept the PSN up to date on a variety of newsworthy items.

CDRH RECORD KEEPING

The Federal Register Dated 19 September pages 48374 to 48387 amends the report and record keeping requirements for products covered under CDRH requirements. A majority of the changes simplify or reduce the details required for report and record keeping.

It is anticipated that some additional clarification and correction to this document will be published in the near future.

The products covered are the X-ray; Television Products; Microwave; Lasers; Sun Lamps; Mercury Vapor Lamps; Ultrasonics and Ultrasound.

CDRH ISSUES @ LASER NOTICES (LASER #44, #45)

Laser Notice 44 is related to manufacturers of medical equipment that use a laser; would permit manufacturers to supply information as required by ANSI Z136.1 & Z1356.3 to be acceptable to meet the requirements of 21 CFR 140.10 10 (b) (1) (I).

Laser Notice 45 relates to CDRH accepting the labeling requirements as defined in IEC 825-2. There are differences between CDRH and IEC 825-1 with regard to test, measurement, classification,

accessible limits, and numerical class designation. CDRH has proposed that one label with both CDRH and IEC 825 classifications be marked on the product.

The following material comes from M.A. Lamothe and Associates / Ultratech Engineering Labs "Approvals Review," Fall, 1995, Vol. 7, Number 4. Subscriptions are available by calling 905-569-2550 or 905-877-2203.

REMINDER: SAFETY APPROVALS NEEDED IN MEXICO

All products must be tested in Mexico, even if the application is processed through TUV or UL. Usually the test lab in Mexico will accept most of the testing done by approval houses such as CSA, UL, and TUV, but it [testing] is their option.

You need to remember that the basic requirements for Mexico are still the same - all products entering Mexico must bear the NOM mark and NOM mark is issued only to companies resident in Mexico. This means that you must work with your agent in Mexico since a company located outside of Mexico can't own the approval.

The new Mexican Electrical Code, which is based on the US National Electrical Code, was adopted on Oct. 15, 1994.

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is even more important now that each entity understand the other's basis for its philosophy/strategy if harmonization of standards and free trade are to be genuinely encouraged.

I would welcome an opportunity to exchange thoughts with Mr. Poster if it could help move this vital process along.

Cordially,
Keith Pfundstein

** Vulnerability can be described as: degree of user/bystander susceptibility to injury when exposed to a hazard; likelihood that personal injury will occur once exposure to a hazard has occurred; detectability of a hazard, surprise element, risk assumption, presence of certain environmental or stress conditions, skills and attitudes of those exposed.

Our Author's response:

It was not my intention to write an article on risk assessment but rather one on machinery safety.

Therefore the short paragraph on risk assessment was placed in my article to mention this limited amounts of time to dedicate to regulatory important topic because it is crucial for evaluating the risks originating from machinery.

However, it is certainly true that there are more than the two factors to be taken into account assessing risk and I like to refer to the standard prEN 1050: Safety of Machinery - Risk Assessment for a detailed and important tool for assessing risk. Paragraph 7 refers to the four factors influencing risk as: severity, exposure, probab-

ity of occurrence and lack of possibilities of avoidance. I consider severity and exposure the important ones and not the only ones as mentioned in Mr. Pfundstein's letter. The above mentioned standard together with other applicable EN standards is used by European experts in reducing risks during design, construction and modification of machinery within the scope of the machinery directive.

Sincerely,
Werner W. Paster

Kudos to Technically Speaking

Dear Editor,

I want to thank you [Rich Nute] for the TECHNICALY SPEAKING articles you write. I have been reading them for the last few years. Your column is the first (and usually the only) part of the Newsletter I read.

I appreciate the logical straight forward approach you make in your presentations. It is always fact based and there are no leaps in logic. I have not found this kind of rationale in any kind safety of Safety related literature.

For circuit designers like myself, who have limited amounts of time to dedicate to regulatory issues, the column serves as an important teacher.

You are to be commended....and please keep up the good work!

Dennis Carter ■

Also, the name “pollution degree (PD)” is proposed to be replaced by “Micro Environmental Category (MEC)” and the term “Operational insulation” is proposed to be replaced by a new name “Functional Insulation”. The four columns in table 2 of IEC 664-1 for pollution degrees 1 to 4, are proposed to be replaced by a single column signifying that pollution degree does not change the clearance.

The above document has received favorable approach from National Committees and will be sent out as a final draft international standard (FDIS) in the near future. Table 1 of IEC 664-1 gives maximum peak value of the transient expected to appear on the mains supply as seen by the equipment. Table 2 of IEC 664-1 has clearance requirements for both inhomogeneous and homogenous fields.

WG6 of TC74 of IEC 950 proposes the following:

- a) IEC 664-1, Table 2 clearances for inhomogeneous fields for functional insulation (formerly operational insulation).
- b) IEC 664-1, Table 2 clearances for inhomogeneous fields with an approx. 33 percent safety margin, for basic and supplementary insulations and with no margin for functional insulation taking into account Table 1 of IEC 664-1 for maximum peak transient voltages associated with the nominal voltage supply systems according to IEC 38.

c) A single table for clearances for all insulations (Which will replace present Tables 3, 4 and 5 of IEC 950).

d) Table 2 of IEC 664-1 for clearances, the manufacturer has an acceptable quality control system i.e., with an acceptable quality control system in place, a 1.5 mm clearance instead of 2 mm for basic or supplementary insulation for 2500V peak mains transients, will still be permitted.

With this new thinking, clearances will be based on the maximum value of the peak impulse voltage, which it can withstand. A single table will replace the present Tables 3, 4 and 5. The same table will be applicable to both primary and secondary circuits. Internally generated transients of a repetitive nature, will also be handled by the same table.

Table 1 of IEC 664-1 gives a maximum transient rating of 1500V peak for voltage systems up to 150V r.m.s. and 2500V peak for voltage systems up to 300V r.m.s. for overvoltage Category II, which is the assumed overvoltage category for IT equipment. IEC 950 has adopted these two overvoltage categories from IEC 664-1

There are two types of voltages generated within the IT equipment as follows:

Case A:

If the peak value of d.c. or r.m.s. voltages or impulse type voltages of a repetitive nature, generated in the equipment, does not exceed the peak value of the main supply voltage, then a clearance will see a voltage not exceeding the maximum transient rating of the mains supply voltage system, i.e., the clearance does not have to be more than required for the maximum transient rating of the mains supply voltage.

Continued

FIG. 1:

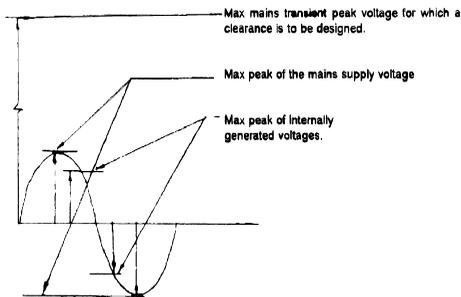


FIG. 1: Maximum peak voltage for determining a clearance, when internally generated voltages will not exceed the maximum transient rating of the mains supply system.

CaseB:

Of the peak value of a d.c. or r.m.s. voltage or impulse type voltage of a repetitive nature, generated in the equipment, exceeds the peak value of the mains supply voltage, then a clearance may see a voltage which may exceed the maximum transient rating of the system. The maximum peak voltage which the clearance will experience, can be calculated as follows:

Maximum working peak voltage =
 Maximum transient rating of the mains supply system + peak value of internally generated voltage - peak value of the mains supply voltage.

FIG. 2:

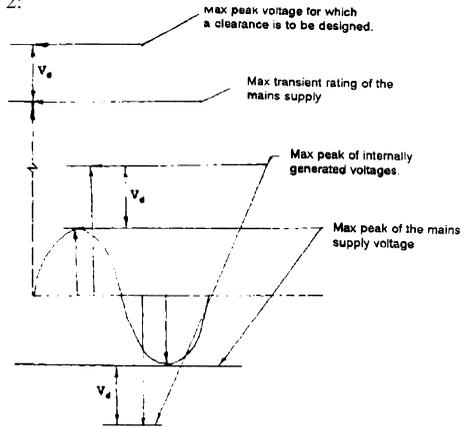


FIG 2: Maximum peak voltage for determining a clearance, when internally generated voltages exceed the transient rating of the mains supply system.

ELECTRIC STRENGTH FOR CLEARANCES

After the maximum peak voltage which a clearance should be designed for, has been determined, then the clearance can be verified by applying an impulse voltage test. This test will be contained in another table which will complement (Copenhagen decision to have alternate test permitted) the present Table 18 of IEC 950. The required impulse voltage for verification of clearances will be approximately 1.06 to 1.25 times higher than the maximum peak voltage for which a clearance should be designed. For example, equipment connected to 125V mains supply system having no internal voltage higher than 212V

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Society". Any comments or questions may be directed to: Brian Claes

voice: 510-659-6574

fax: 510-659-6852

October Meeting:

This meeting was the first formal meeting of the new season. Attendees were encouraged to join IEEE to take advantage of the many benefits of membership.

Articles for the Product Safety Newsletter were solicited.

Mr. Jean-Pierre Wolff gave a very entertaining presentation on electrical safety. Various topics covered included Safety Engineering, Safety Essentials, Types of Safety Hazards and a "Cook the Hot Dog via Electrocutation" demonstration. For more information, please contact: Jean-Pierre Wolff

Electro Test, Inc.

voice: (510) 824-0330

fax: (510) 824-0333

November Meeting:

This meeting included Gene Panger, TUV PS, as the main speaker. Gene discussed the CE Marking, particularly in relation to the EMC Directive.

For more information, contact:

Gene Panger

TUV PS

voice: (612) 631-2487

fax: (612) 631-3515

Future Activities:

December 12, 1995: Joint meeting with EMC Society, Test Methodology for EMC Directive.

January 23, 1996: Philosophy of Meeting the Low Voltage Directive from a Manufacturer's Standpoint, Dave Adams, Hewlett Packard.

Northeast Area

No activity in this area for some time now. There is a need to get some interested members in and active to pick up the ball. Anyone interested, please contact: Scott Varner

voice: 360-817-5500 (ext. 55613)

fax: 360-817-6000

e-mail: 4772949@mcimai1.com

Texas Area

September - No meeting

October - Presentation by Bob Hunter.

For more information of future activities contact: Vic Baldwin

voice: 512-990-6145

Southern California Area

September Meeting:

Presentation - Jeff Gray discussed the Machinery Directive.

Announcements- The new Bi-National Standard, UL 1950/CSA Third Edition is now being distributed. ECMA has published the latest edition of the Alphabetical Index for IEC 950. It includes Amendments 1,2 and 3. The document TR/63 (2nd edition) is available free of charge. You can obtain the document by contacting ECMA at: ECMA

voice: 41 22849.60.00

fax: 41 22786.52.31

Continued

It can also be downloaded from file T063-DOC.EXE or file T063-PSC.EXE from ECMANEWS.

UL has published it's Practical Application Guidelines for UL 1950. The Guidelines are available for \$100 (\$80 for Subscribers of UL's Standards Subscription Service) and will soon be available on UL's 1950 Electronic Bulletin Board System.

Elections - Charlie Bayhi was re-elected as Chairman/Secretary and Ercell Bryant was re-elected as Vice Chairman / Treasurer.

October Meeting: Round table discussion regarding product safety.

November/December Meeting: Re-organization discussions to enlist help of new members and generate some enthusiasm.

For more info contact:
Charlie Bayhi
Voice: 714-367-0919

Chicago Area

John Allen of the Chicago Area needs help getting a local Chapter started. Anyone interested in helping John or just getting together to share information should contact:

John Allen
Voice: 708-238-0188

Colorado Area

September Meeting:

The meeting was hosted by Dave Pedersen of the UL Local Engineering Services Office in Boulder, CO.

The guest speaker at the meeting was Greg Rocha, Engineering Team Leader form UL's Santa Cla ra Office. Greg discussed the Bulletin Board

System (BBS) that was being developed for UL 1950. The topics covered included:

1. History of developing the BBS
2. Content of the BBS
3. Service levels of the BBS
4. Annual fees for the BBS
5. Other features such as e-mail, chat, paging, announcements. Greg also gave a brief demonstration of the BBS which was quite impressive.

October Meeting:

The meeting was hosted by Mark Hassebrock, Agency Administrator for Data Ray Corporation. The main topic was CE Marking requirements, Declaration of Conformity for complex components and system level devices. Declarations of Conformity were shared and discussed and it was a lively meeting.

November Meeting:

Richard Georgerian and Kent Shown, Compliance Engineers at Exabyte in Boulder were the hosts for the meeting.

This was the last 'business' meeting of the year. Richard Georgerian was elected to serve as chairperson for another year and Dave Pederson of Underwriters Laboratories was elected to be activities leader. Ideas for next year are tours of nearby facilities, bi-monthly meetings and more varied topics for discussion.

For more information, contact
Richard Georgerian
voice: 303-417-7537
fax: 303-417-7829
e-mail: richard@exabyte.com

That's it for this issue. Remember to send in your comments and Area information!

Best Regards
Kevin Ravo ■

peak, will be required to withstand an impulse test voltage of 1750V peak instead of the maximum 1414 V peak or d.c., required at the present. Same way equipment connected to 250V mains supply system having no internal voltage higher than 424V peak, will be required to withstand an impulse voltage of 2959V peak instead of 2121 V peak or d.c. required at the present. These higher peak values may be taken care of when designing clearances in the equipment. But components used in the IT equipment are not evaluated to these higher peak voltages, and might pose a problem. They may not be able to withstand these higher voltages as they are designed to the present requirements. There is no major move ahead to change requirements for component standards to withstand higher electric strength voltages. Therefore the present electric strength test as given in IEC 950, 2nd Edition will still be permitted as an alternative.

As proposed, there are five choices given for conducting the electric strength test as follows:

- a) 10 impulses of alternating polarity using 1.2/50 s impulses;
- b) 10 impulses of alternating polarity using 10 ms d.c. impulses;
- c) An a.c. r.m.s. voltage test but for a minimum of 5 cycles only;
- d) A d.c. voltage test for a duration of 60 seconds.

The above four use a higher peak value when conducting the test.

- e) Present electric strength test with voltage values as given in 5.3 of IEC 950, 2nd Edition is an alternative to “a”, “b”, “c” and “d” above.

CREEPAGE DISTANCES

Creepage distances Table 6 of present IEC 950, 2nd Edition, is proposed to be kept the same. However, for MEC 1, the table will refer to the clearances table which has been modified. Therefore, creepage distances will change for MEC 1 only.

In the document no. 28A/100/CDV SC28A is also proposing lower creepage distances than presently required. When accepted, WG6 may introduce these lower creepage distances to IEC 950 in the near future. ■

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for three-phase, three-wire (“delta”) and single-phase, two-wire distribution systems where there is no common point. (The USA National Electrical Code uses the term “grounded conductor” rather than neutral conductor.)

(In the National Electrical Code, the grounded conductor is also designated as the “identified” conductor. The neutral conductor is “identified” by means of insulation color. In the USA and Canada, the color is white. In Europe, the color is blue.)

Impedance means an impedance is connected in series between the neutral conductor and the ground rod. I have heard that the value of this impedance is from 1000 to 10000 ohms.

Combined means that the function of two conductors is performed by (combined into) one conductor.

Separate means that the function of two conductors is performed (separately) by each of the two conductors.

The power system designations use two letters, TN, TT, and IT. The first letter indicates the means of grounding of the neutral conductor. The second letter indicates the means of grounding of the protective conductor.

Now we can define the three major power distribution systems:

TN: The TN system has its neutral connected to a ground rod, and has its protective conductor connected to the neutral.

The TN system is the predominant system in the USA and Canada.

The advantage of the TN system is a very low impedance between the protective conductor and the neutral conductor, thus assuring operation of the overcurrent device.

The disadvantage of the TN system is that at,

the point of a ground fault, there is a voltage drop across the protective conductor. This raises the potential of accessible grounded parts with respect to the earth, which could result in a shock.

A disadvantage with the USA TN system is that the neutral is grounded at two or more places, one being at the bulk power source and the other at the service entrance. This means that the earth is in parallel with the neutral, and that some of the neutral current will flow in the earth.

In turn, signal grounds between buildings (or even between parts of buildings) can also carry part of the neutral current (which has accounted for fires in some products).

TT: The TT system has its neutral connected to a ground rod, and has its protective conductor connected to its own, separate ground rod.

The TT system is the predominant system in the U.K.

The advantage of the TT system is that it overcomes the disadvantage of the TN system. Because the protective conductor has its own, separate earthing, accessible grounded parts of the system are always at earth potential, even in the event of a fault.

The disadvantage of the TT system is that the impedance between the protective conductor and the neutral conductor is not necessarily low, thus compromising operation of the overcurrent device.

IT: The IT system has its neutral connected to an impedance which is connected to ground, and has its protective conductor connected to its own, separate ground rod. (The impedance is 1000 ohms or greater.)

The IT system is the predominant system in France and Norway and other countries. It is also

One advantage of the IT system is that it overcomes the disadvantage of the TN system. Because the protective conductor has its own, separate earthing, accessible grounded parts of the system are always at earth potential, even in the event of a fault.

Another advantage of the IT system is that in the event of an earth fault, the system intentionally remains operational, i.e., the overcurrent device does not operate until the second earth fault.

(Often, the system employs an earth-fault monitor such that an alarm is activated when an earth-fault occurs and corrective action can be taken.)

The disadvantage of the IT system is that, when an earth-fault occurs, the voltages with respect to earth change. For example, consider the various voltages with respect to ground in a three phase distribution system having 220 volts phase-to-neutral and 380 volts phase-to-phase:

Phase	Normal conditions	Earth-fault conditions
N - Ground	0 volts	220 volts
A - Ground	220	0 (fault to earth)
B - Ground	220	380
C - Ground	220	380
A - N	220	220
B - N	220	220
C - N	220	220
A. - B	380	380
A. - C	380	380
B - C	380	380

where N, A, B, and C are Neutral, Phase A, phase B, and Phase C, respectively.

(Note that the phase-to-neutral and phase-to-phase voltages do not change. Since all equipment is connected either phase-to-neutral or phase

to-phase, all equipment continues to operate normally even though the system has a ground fault.)

Let's now look at the variations of the TN system.

TN-S: The TN-S system has separate neutral and protective conductors throughout the system.

This is the normal system in the USA and Canada.

TN-C: The TN-C system has combined neutral and protective conductors throughout the system.

TN-C-S: The TN-C-S system has part of the system with combined neutral and protective conductors and part of the system with separate neutral and protective conductors.

This is normal for USA households where plug-and-socket connected dryers and ranges have the neutral connected directly to the frame of the dryer or range.

Note that, no matter the system, TN, TT, or IT, the scheme of grounding the neutral largely has no impact on the design of the product.

Some authorities do tend to be concerned about the voltage rating of mains-to-ground-connected components where the equipment is intended to be connected to an IT system. They are concerned about those components being subjected to the higher phase-to-ground voltage occurring during a system ground fault.

Some authorities also tend to be concerned about the magnitude of leakage current where the equipment is intended to be connected to an IT system. Again, they are concerned about the higher phase-to-ground voltage occurring during a system ground fault.

Some authorities tend to be concerned about the electric strength and hi-pot test voltage of the mains circuits where the equipment is intended to

Continued

be connected to an IT system. Note, however, that the magnitude of transient over-voltages does not necessarily change due to a phase-to-ground fault.

Let's now turn to polarization. For the purposes of this discussion, polarization is the identification of one or more terminals of a supply system, whether the neutral terminal or a phase terminal. As we have seen, all the conductors of a power distribution system are identified.

For the most part, the neutral conductor — even though it is usually grounded — is treated as if it were a phase conductor.

As mentioned, the TN-C system combines the neutral conductor with the protective conductor. In TN-C systems and equipment, it is essential for safety that polarization be observed, i.e., that the neutral in the equipment be connected to the neutral in the supply system. Consider the home electric dryer which has its metal enclosure connected to the neutral terminal of the supply cord. For prevention of electric shock, it is imperative that the dryer neutral only be connected to the supply neutral. Polarity must be observed.

In the USA, lamps employing Edison-base sockets are required to be provided with a polarized plug. The neutral terminal of the plug is connected to the screwshell of the socket. This means that the screwshell, being accessible, is at ground potential. This improves the safety of the Edison-base socket.

Polarization can be used to improve the safety of equipment where both poles of the supply are not treated equally.

Polarization via socket outlets is not consistent in various power distribution systems. In the US and Canada, polarization is maintained in the 120-volt, 15-amp outlets by one blade being wider than the other. The wider blade is the neutral

conductor. (Note that the grounding terminal does not provide the polarization.)

In the U.K., polarization is maintained in the 13-amp socket -outlet by the three L, N, and E blade positions. The wiring is indicated by markings on the plug. Note that two-wire plugs require a dummy grounding terminal for both polarization and for activating the shutters in the socket-outlet.

In Australia and New Zealand, polarization is maintained by the angled blade orientation. The wiring is indicated by markings on the plug.

Polarization is not maintained by the European Schuko, French, Danish, and Swiss socket outlets. Note that the French, Danish, and Swiss plugs can only be inserted one way. But, polarity of the wiring to the socket-outlet is not maintained.

Be careful not to assume that just because a plug can only be installed one way in a socket-outlet that it is polarized.

ACKNOWLEDGEMENTS

Ron Wellman of HP Corporate Product Regulations suggested this topic.

The TN, TT, and IT systems are defined in IEC 364 and repeated in IEC 950.

For more information on neutral grounding, see the Standard Handbook for Electrical Engineers, Donald G. Fink and H. Wayne Berry, Editors. Published by McGraw-Hill Book Company. ISBN 0-07-020975-8. ■

1 Do your research. Read the actual EMC Directive. If you don't have a copy of the Directive - get one. Make a list of questions and/or concerns. There are many resources available to you. The U.S. Department of Commerce is a source of information and there are many consultants and Competent Bodies to utilize. If you are in a government regulated industry, talk with the agency that works with your product.

2 Interview enough consultants. Competent Bodies and test labs until you feel comfortable about what the real requirements of the Directive are. Remember, the better you understand the requirements, the less chance you have of making costly mistakes. Learn to communicate with the people in your company that are responsible for the funding of the activity. Help them understand what the requirements are, and why the work is critical. Make sure you have enough money and technical resources to do the job right. It will be much easier to hand back the money in December than to miss the deadline due to lack of dollars or resources.

3 Understand the different routes to compliance for EMC. If you have more than one product, sort them by which method of compliance you are going to employ. Some of the questions you should consider as you use the "standards" route or the "Technical Construction File" route are:

1. Does the product exist in more than one version?
2. Are modifications to the products likely?
3. Are there existing test results?

4. Will the products be hard to test due to physical size or intended use?
5. Is the life-cycle of the product greater than 5 years?
6. Is the product technically complicated? Does it mix several technologies or have different applications?

If the answer to any of these questions is yes, it makes good sense to employ the Technical Construction File route to compliance.

If the answer to these questions is no, and you feel confident that the product will meet the standards, it may be appropriate to use the Standards route.

4 Choose and establish a good working relationship with a European Competent Body. With the deadline looming nearer, this decision could be critical to your success. Make sure you are comfortable with the company. Clearly document what role they will play, and what you expect from them.

5 Make a list of products that you are dealing with. Prioritize them in order of importance. Maybe the priority is based on projected sales volume for 1996 in the EU. Maybe it is based on a critical customer account in Europe. However it is decided, make sure that everyone in the management team understands what the order is and why it was set up that way.

6 Draft a process flow chart for the compliance work. What is the acceptance criteria that will be used to determine if your company is ready to declare compliance and apply the CE Marking?

Continued

How will your company incorporate product changes if they are required? Do you have a good closed loop engineering change process to ensure on-going compliance and maintenance of the CE Marking? Create a document that outlines the procedure that will be used to declare compliance to the Directive. Identify your company's signatory for the Declaration of Compliance. Ensure that the signatory understands the process and their liability. Review your process with the Competent Body. Ensure that the process meets the requirements.

7 Gather all customer literature and product documentation. This should include the Operations Manual, any technical specifications and descriptions of the equipment and it's operating environment. If the previous testing has been done, obtain the test reports.

8 Meet with the Competent Body. Ask them to review your list and rationale for the routes you have chosen. Review the technical documentation and product manuals. Discuss which products will require testing, which can declare compliance based on previous testing, and other information unique to the product. Detail a plan and time line. Set the milestones, and then meet them.

9 Do the work. Arrange the test time as required and assess the products' ability to comply to the standards without modification. If you identify products that pass the standards, use the test information as a basis for claim to compliance. If you are using the TCF route, document the test results, complete the Technical Construction File and have it assessed. If you are using the standards route, compile a Technical

File including the standards applied and test details. If your product requires modification, consult with the Competent Body and the chosen test lab. Use their expertise to help determine the minimum amount of modification to meet the requirements. Determine if you need to rethink your method of compliance.

10 If extensive modification is required, reassess your priority list. If you spend the resources required on this product, it will mean not meeting the deadline on other products. Ensure that the management team understands the impact of their decisions.

11 When the Technical Certificate is issued, draft the Declaration. Remember, the Declaration is the legal document required to claim compliance. When the Declaration is signed, link the CE Marking label to the product.

There, you're finished, or at least you have begun. With the 1996 deadline drawing close, it's imperative that you begin as soon as possible. At this late date, there is no guarantee that you will meet the deadline. But if you start now, you will be 5 months closer by December! ■

HELP WANTED!!

The Product Safety Newsletter Committee is looking for someone interested in writing the News & Notes column.

If interested contact
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at (408) 285-2540.

Chairman's Message
Continued From page 1

2. Within the IEEE, there are small pockets of product safety focus:

- Our organization in the EMC Society (TC-8)
- CPMT Society (shown by their Technical Interest Profile item)
- Social Implications of Technology Society (electrical safety technical committee)
- TAB's Environment, Health and Safety Committee

However, taken as a whole, we believe the IEEE is overlooking this segment of engineering.

3. The EMC Society's TC-8 began as a group of product safety engineers in the Santa Clara Valley in the mid-80's. Many of the original group were also members of the IEEE and EMC Society and were active in both product safety and EMC engineering. Within a year or so, membership had increased enough that 200 of us planned to petition the IEEE for Society status. We were told there already were too many Societies and that we were too inexperienced and *few* in number. However, it was suggested that we could join the IEEE as a Technical Committee of one Society, grow to a Technical Council supported by several Societies, and eventually petition for Society status. So about 8 years ago, we joined the EMC Society as TC-8, or the Product Safety Technical Committee.

4. Some of TC-8's activities include:

- sponsoring Workshops and technical paper reviews at International Symposia,
- publishing the Product Safety



Newsletter, which regularly contains technical articles in addition to reports on developments in areas of interest. (We have published the newsletter since our inception. Circulation has exceeded 1000 for several years and presently is about 1300.),

- sponsoring local area groups and their regular meetings which include technical presentations, done in conjunction with local EMC Society chapters.

5. In conclusion, we believe the IEEE needs to provide a better focus for product safety, because:

- Thousands, perhaps tens of thousands, of engineers are involved in product safety work world-wide, but there is no focus for coordinated activity within the IEEE.
- Outside the IEEE there is no other organization that meets the product safety engineer's professional needs and interests. Professional organizations such as System Safety Society, ASSE, Semiconductor Safety Association at best occasionally address product safety issues and then frequently only tangentially.
- There are several other IEEE Societies besides the EMC Society interested in the safety of electrical and electronic

Continued

products. We have already received inquiries from another Society whose product safety interests are not being adequately met (CPMT). A Technical Council will serve as a focal point for interested groups within IEEE Societies.

- TC-8 is presently the largest group for product safety in the IEEE and we want to continue to expand our present activities. We would like to be an IEEE Society, but we're not ready. We believe a Product Safety Technical Council will increase visibility for product safety and attract members.

Our next step is to approach the Societies to assess their level of interest. At the President's Forum, I was approached by the leaders of two societies who expressed keen interest in such an association. In a more formal vein, I will send all the presidents a letter outlining the proposal to form a Product Safety Technical Council.

The most aggressive timetable for accomplishing this goal is 12 to 15 months.

In the meantime, we are continuing our cooperation with the IEEE TAB EHS Committee which also is assessing its future growth plans. Those of you who are members of other IEEE Societies that have product safety related interests, please share this proposal with your leadership. We will continue to keep you posted on our progress.

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News & Notes
Continued From page 8

WORK ON MRA'S

From the ITI "Washington Letter," dated Nov. 17, 1995, it is noted that a meeting between US and European CED's at the Transatlantic Business Dialogue in Seville discussed adoption of the principle of "tested once, accepted everywhere" through Mutual Recognition Agreements for telecom and ITE by January 1, 1997. Acceptance of this objective will hinge on a Dec. 3rd meeting between President Clinton, the European Commission President Santer and European Union Prime Minister Gonzalez in Madrid.

The following material comes from Art Michael, Editor, Int'l Product Safety News (amichael@safetylink.com).

SAFETY LINK IS ONLINE!

The Safety Link (<http://www.safetylink.com>) serves as a jumping-off point for those interested in product safety compliance and related topics. Due to the comprehensive set of links found here, it is likely that this is the only "product safety link" you will need.

Links to many worldwide product safety resources are included as well as one to "International Product Safety News" (the sponsor of the site).

Product safety professionals can easily access the test labs & safety agencies, standards bodies, government resources including the FCC, OSHA and NIST as well as links to related areas of expertise such as EMC, Ergonomics, Quality, Telecom, Newsgroup, and the Northeast Product Safety Society.

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