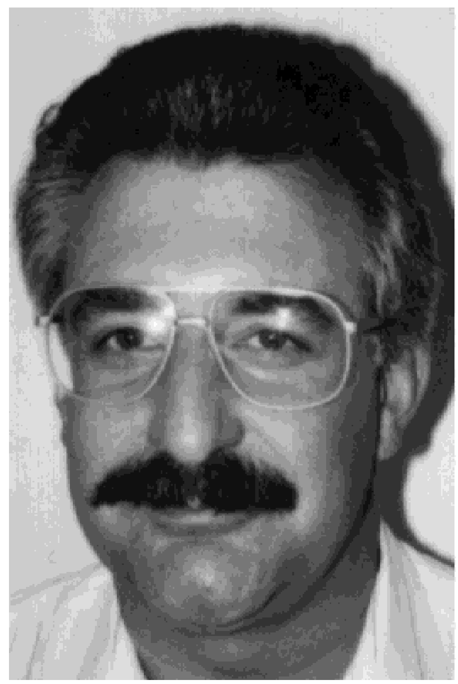
IEEE®

The Product Safety Newsletter

Volume 3, Number 6 November/December 1990

In this issue

Chairman's Message



"PSTC CHAIRMAN HANGS UP THE PHONE!"

Yes, folks, it looks like the time has come to say goodbye. My term is up and others will be working as officers of the Product Safety Technical Committee, starting in 1991.

We are looking for more nominations before the end of January. Those people nominated will write a statement of their goals and qualifications, which will be published in the Product Safety Newsletter, together with a ballot. The names of the individuals receiving the most votes will be presented to the EMC Society BOD to be confirmed as officers of TC-8.

The future officers will have a full agenda, but I think we have given them a good start. More thoughts about both the future and the past of the PSTC will appear in my next (and perhaps last?) Chairman's Message. Here is more information about the upcoming election.

ANNOUNCING ELECTIONS - CALL FOR CANDIDATES!

This is your chance to make a direct contribution to the Product Safety Technical Committee (TC-8) by investing your time and effort as an officer. Please call John McBain at 408-447-0738 for more details. Here is an outline of the procedure for a change of officers of TC-8:

1. Per EMC Society bylaws, officers in a TC have a 2 year term.
2. The present officers are Chairman (Rich Pescatore), Vice-Chairman (vacant), and Secretary-Treasurer (John McBain).
3. Only members of the IEEE who are also members of the EMC Society may be officers of the TC.
4. Officers of the TC are confirmed by the EMC Society Board of Directors (BOD) from the names submitted.
5. The process of choosing names to submit is as follows:
   (a) A call for candidates meeting the requirements (per item 3) is made through the Product Safety Newsletter (PSN). No seconding of nominees is needed.
   (b) Information about and a statement by the candidates, as well as a ballot form, are distributed through the PSN.
   (c) Only members of the IEEE who are also members of the EMC Society may vote.
   (d) The name of the candidate for each position with the most votes is submitted to the BOD for confirmation.

Send your nominations together with the candidate's statement to: John McBain, Hewlett Packard (MS 42LS), 19447 Pruneridge Ave. Cupertino, CA, 95014.

Best regards,

Rich Pescatore
Chairman ❖

The Product Safety Newsletter

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Comments and questions about the newsletter may be addressed to:
Product Safety Newsletter,
Roger Volgstadt (LOC. 55-53)
Tandem Computers
10300 North Tantau Avenue
Cupertino, CA 95014
Fax No. (408) 748-2137

Editor
Roger Volgstadt
News Editor
David Edmunds
Abstracts Editor
Dave Lorusso
Page Layout
Ken Warwick
Subscriptions Manager
John McBain

The European Community and the CE Mark

by Helmut Landeck

[In an effort to keep our readers abreast of the European Community and 1992, Mr. Landeck of Ingenieur Consulting GmbH has written an insightful article on the European- wide safety approval mark, "CE". Although the whole CE mark procedure is in a process of change, the attached does represent the latest information we have available on the subject. - Ed.]

The European Community and the CE Mark Chapter IV, Section 2, Par. 6 of the European Community Directive 89/C267/73 establishes a CE mark that may replace all national approval marks. The CE mark is explained as follows:

The present situation concerning the affixing to products of Community marks in directives is unsatisfactory and confusing. Community directives have provided for a number of different Community marks over the years, which do not always have the same significance. Such confusion is not conducive to an organized market.

With the preparation of the first directives under the new approach, provision was made for a single Community mark and it should therefore be adopted for all future comprehensive Community legislation.

Application of the CE mark should be determined by the following criteria:
- The mark should be reserved exclusively to indicate, for control purposes, conformity to directives which are comprehensive in nature and therefore replace completely all national legislation relating to its scope.
- The mark should signify or indicate that the product and/or the manufacturer comply with the essential requirements and that the manufacturer (importer) or third party has carried out the relevant conformity assessment operations so that the product may be placed on the market without restriction.
- The mark should be affixed on the product, but specific directives may allow the CE mark to be affixed on the packaging or the accompanying documentation.
- The mark should relate to all the essential requirements which concern a given product. If the product is covered by several directives, the affixing of the mark will signify

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Some Safety Ground System Design, Testing, and Certification Considerations

by Bruce Campbell

Ground systems, that is, the collection of electrical and mechanical components which are connected to earth ground typically through the power cord, usually don't command much attention. Just as we rarely think of skin as an organ, even though it is the largest and certainly an important one, ground systems are often taken for granted, as if any design which unfolds as a matter of pursuing other goals will be perfectly adequate. But for any product which utilizes a three wire power cord with an earth ground connection, the performance of the ground system is a genuine matter of product safety. So if we can't get excited about the integrity of the ground system as an engineering exercise, perhaps we should remember that a flawed system could hurt someone. Beyond that, proper design from the beginning could prevent problems later when safety certification testing is required. As we all know, it's a lot easier and cheaper to correct design flaws early, so considering the performance of the ground system from the initial stage of the design cycle just makes good engineering and business sense.

It's certainly not an overwhelming challenge. The ground system has a straightforward purpose - to prevent a hazardous voltage from appearing on any user accessible surface for a hazardous length of time in spite of any fault in any other system which could connect a hazardous voltage to areas it doesn't belong. The ground system does this by shunting fault currents to earth ground and either keeping all accessible fault voltages low or causing a fuse or circuit breaker to open quite rapidly, disconnecting the line voltage. To accomplish this, the ground system must be stout. This means that it must maintain a sufficiently low impedance compared to the hazard voltage source impedance so as to keep accessible voltages low by simple resistive divider action or, if the hazard source impedance is quite low, to allow and withstand the quite high fault currents necessary to insure that the protective fuse or breaker opens very rapidly.

As an example, consider a fault situation in a hypothetical product: an internal power line inadvertently becomes connected to the product chassis by an internal metal bracket which has become loose and has fallen onto the power line. We'll assume that the impedance from the 120 volt mains supply to the internal power line wire is 50 mΩ, and the fallen bracket adds another 10 mΩ. The impedance of the ground path from a user touchable part in the vicinity of the loose bracket to earth ground is also 50 mW. By simple resistive divider action, the user could come into contact with 54.5 volts, which is more than the usual maximum voltage considered safe (30 volts). However, if the device is powered by a mains source protected by a 20 amp circuit breaker, that voltage won't exist for long. A 120 volt source connected to a circuit loop with only 110 mΩ impedance implies a 1,091 amp fault current. The circuit breaker should certainly open quickly under these conditions, normally much more quickly than the time necessary to initiate heart fibrillation.

Let's modify the situation by stipulating that the loose bracket connects indirectly to the chassis through a thin decorative metal alloy trim part which passes from the inside to the outside of the chassis and does wonders for the appearance of the product. The trim part starts with a rather substantial single component impedance of 50 mΩ, but under high current fault loading its impedance rises quickly to 100 mΩ. This impedance is added to the ground system which thus totals 150 mý. The impedance through the bracket and back to the mains supply remains at 60 mΩ. Therefore we have a touchable part carrying 85.7 volts on the product, and that voltage will exist for a longer period of time since the fault current is reduced to 571 amps. Clearly the high impedance of the trim part works against safety design. This situation is more complex than described since the impedance of the trim part is dynamic during the fault, thus causing the fault current to be dynamic as well. The trend direction is the same, however - the trim part has reduced the fault safety margin.

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Comparative Safety Requirements, a Case Study UL vs IEC Line-to-Line Capacitors

by Peter E. Perkins, PE

UL 1414 gives the traditional requirements for line-to-line capacitors that we normally use. Capacitors meeting the European IEC 384 requirements are also available. Can these capacitors be used interchangeably? Will UL allow the European capacitors to replace the UL Recognized Component capacitors? What considerations should be given as a substitution is proposed? What will these requirements tell us about the differences in performance of the components? Review these standards considerately; pick out the requirements carefully and compare them in detail. Noting these differences will allow developing a test regimen that will show equivalence. This is the proposal that we will make to our UL engineer to allow these parts to be used interchangeably.

CONDITIONS FOR SUBSTITUTION:

In summary, the capacitors that meet the requirements of IEC 384 are acceptable substitutes for UL 1414 certified capacitors, providing they meet an additional UL 94 V-0 flammability requirement.

For the most part, the IEC 384 requirements are equivalent to, or more stringent than the UL 1414 requirements.

Review Table 1. Note the similarities: spacings and life tests. Note the more difficult requirements from IEC 384: dielectric strength and initial resistance. The UL dump test of 5kV is slightly tougher than the 4kV test from IEC 384. There is no flammability requirement in IEC 384.

It is more difficult to show the converse, that capacitors that meet UL 1414 are equivalent to IEC 384 certified parts. There are several IEC tests that are substantially more severe.

SUMMARIZING THE KEY POINTS:

1) The lack of a flammability test by IEC 384 is the most important difference between these two standards.
2) All other requirements are similar.

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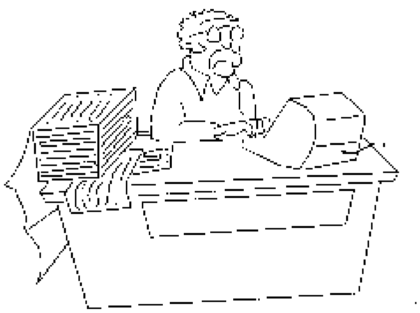
Table 1. UL 1414 Compared to IEC 384

UL 1414 (ref)	(ref) IEC 384
Across the line, antenna coupling and line-by-pass capacitors...	Fixed capacitors for use in electronic equipment Part 1: Terminology and methods of use. Part 14: Fixed capacitors for radio interference suppression. Selection of methods and test and general requirements
Spacings (6.0) 3.2 mm @ 250 V	(14-10.1) 3 mm @ 250 V
Discharge test (9.0) minimum 5 kV dump test	(14-4.3) minimum 4 kV dump test
Dielectric (11) 1 kV leads to body	(14-11.1) 2 kV leads to body 1.1 kV lead to lead
Initial Resistance (13/19) 480 MOhms @ 250 V	(14-11.3) 6000 MOhms minimum
Life test (15) 1008 hours 250 V rated operated @ 440 V plus 880 V x 0.1 pulse each hour subjected to: -dielectric voltage withstand test -discharge test at end of life test	(14-12.11) 1000 hours 250 V rated operated @ 440 V plus 1 kV x 0.1 pulse each hour subjected to: -capacitors value comparison (within 10% of initial values) -insulation resistance test (>3000 MOhms) -dielectric withstand test @ 1233 V minimum at end of life test
Enclosure (4) UL 94V-0 or flame test as equivalent.	No equivalent test

News and Notes



Flame Test for Cables
In the September/October issue it was reported that CSA has a new category for flame spread of cables. ETL, Cortland N.Y., has the equipment to perform the test for FL4 and FL6 and the results are acceptable to CSA.

Laser Standard Revision
IEC has issued Amendment 1 to document 825. Copies can be purchased from ANSI offices in N.Y.

UL Training Courses
Underwriters Laboratories (UL) has announced a seminar on UL 1950 to be held in San Francisco Jan 29-30, 1991, Orange County March 10-20 and Boston May 22-23. For more details, contact the Northbrook office, Ms. Sandy Collins (707) 272 8800, Ext. 2837.

Product Information from CSA
CSA has announced an electronic data base of Certified Products. This data base is accessible by modem, computer terminal or Telenet. For more information, contact Cameron MacDonald, Information Center CSA, 178 Rexdale Blvd., Rexdale Ontario M9W 1R3, phone (416) 747 4058.

IEC General Meetings
The Spanish National Committee will host the 55th General meeting of the IEC. It is to be held in Madrid 30 September - 12 October, 1991. The TC that will meet at this time has not been determined.

The 56th General meeting of the IEC will be held in Rotterdam, Netherlands, 28 September - 10 October, 1992.

San Francisco Passes Tough New VDT Law
Santa Clara Valley chapter members will follow with interest the recent passage of legislation effecting the VDT workstation. Provisions of the new law require the following:

VDT workers must be provided with adjustable chairs and work stations, and, if requested, arm rests and foot rests.

Keyboards must be detachable.

Glare must be eliminated through a variety of methods, including use of anti-glare screen and careful lighting.

VDT workers will be provided with a 15 minute break away from the terminal and do other work after every two hours of performing repetitive keyboard motions.

Violators may be fined up to $500.00 per day. ❖

READER DIRECTORY

We have prepared an address directory, organized by name and postal code, to help put readers in touch with each other. To order a copy, please send a check for $15.00 payable to the Product Safety Technical Committee. (Please contact us if you want your address deleted from the directory)

BACK ISSUES

We have a two year (1988 and 1989) collection of past Product Safety Newsletters, with an article index. To order a set, please send a check for $20.00 payable to the Product Safety Technical Committee.

Please send your requests to The Product Safety Newsletter at the address given on the rear cover page.

Designing for Physical Stability

by Thomas Arno

[Thomas Arno, Product Safety Engineer at Compliance West, presents a discussion of physical stability and provides simple guidelines designers can use to help them be sure their designs are compliant. Mr. Arno notes that the details of shape, size, and weight distribution of the product are surprisingly unimportant. - Ed.]

Essentially all of the safety standards currently in use have some requirement regarding physical stability. In general, the desire to minimize the potential for accidental tipping has been standardized into two tests. One is the 10° tip test, and the other is the push test with 20% of the product's weight.

Designing the ability to pass these tests into floor standing products would seem to be a rather difficult task without a prototype unit available that closely simulated the details of the size, shape, and weight distribution of the actual device. This is not a desirable situation, however, since confidence in a mechanical design can only be achieved after metal-work has been fabricated. Once a particular product has been designed and built, overhauling the mechanical packaging is generally a tough job. In addition, given a product with a stability problem (perhaps one originally designed for and sold in a market where agency approval was unnecessary), it is often nearly impossible to modify existing units, whether in the field or in the warehouse, to make them comply with the standards.

Surprisingly, an analysis of the test procedures leads to a few simple, useful, and very general conclusions regarding what equipment might have stability problems. It is hoped that this article will give designers a couple of simple rules of thumb to help design in stability when a product is still on the drawing board.

As can be seen in Figure la, any size or shape of equipment can, for the purposes of our stability analysis, be reduced to three important points: the push point, the pivot point, and the center of gravity. There are also two important distances: the height of the equipment, and the horizontal distance between the pivot point and the center of gravity. If a horizontal force is applied at the top of the equipment, the equipment will start to tip at the moment that the torque about the pivot point due to the force is equal to the torque about the pivot point due to the weight of the unit. See Figure lb.

In order for the device to pass this test, the height of the unit can be at most 5 times the horizontal distance between the center of gravity and the edge of the unit. This result is completely general, involving no assumptions about the weight, shape or size of the product at all.

Notice that the weight of the unit and the height of the center of gravity are both completely irrelevant. This leads us to our first conclusion. If a product does not pass this test, shifting weight down or adding ballast to the bottom is going to be useless. The only solution is to increase the width of the base.

We now come to a basic rule of thumb. Note that the first half of this rule assumes that the weight of the unit is distributed symmetrically in the horizontal direction (which is close to true for most actual products). In this case, the distance from the edge of the unit to the center of gravity is one-half the total width of the unit.

The first rule of thumb, then, is this: *When designing a floor standing*

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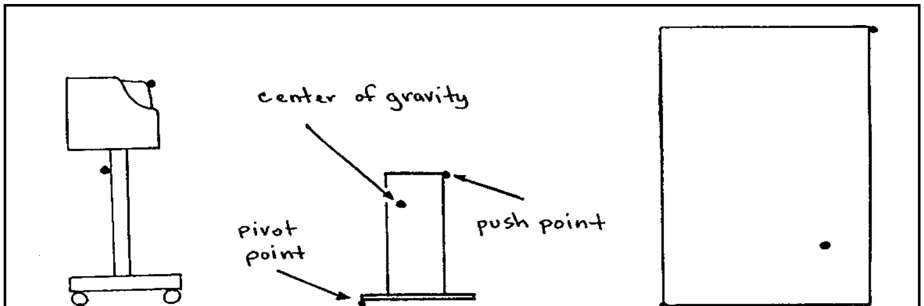
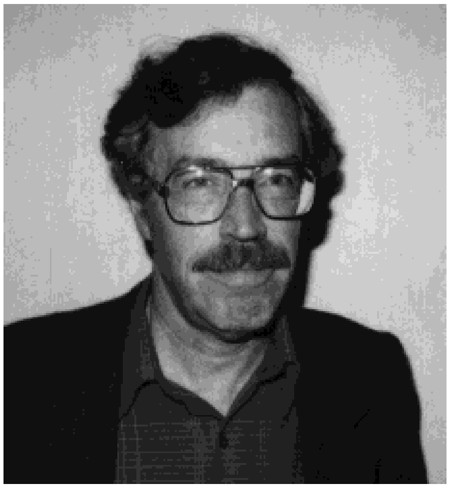


Figure 1a

Technically Speaking



SOME THOUGHTS ABOUT INTERLOCKS

Recently, I've had occasion to consider the subject of interlocks. I thought I would share some ideas with you.

What is an interlock, and exactly how does it serve the purposes of safety? I suppose first we should list some common examples of interlocks. Some of these examples may not be interlocks, but are situations similar to interlocks and should be considered.

Microwave oven: When the door is opened, the microwaves are shut off.

Copy machines: When a door is opened, the motion is stopped and the heaters are turned off.

Television: When the back is removed, the power is disconnected (at least on older tube-type TV's).

Self-cleaning oven: When the oven is self-cleaning, the door is locked during the cycle or until the temperature is below a prescribed level.

Motor-operated paper cutter: In high school I worked part-time in a print shop. We had a huge motor-operated paper cutter, which could easily cut through an arm. To actuate the cutter mechanism, you had to operate two levers at opposite edges of the machine. The two handles were mechanically linked so both had to be moved simultaneously. This required you to stand in front of the machine and spread your arms across the front, which effectively barred nearby persons from the blade and kept your own body parts away from the blade.

Printer: When a cover is opened, the motion is stopped.

Garage door openers: When an object or body part is intercepted during downward motion of the door, the motion is reversed.

Robot: For large robots, when an object or body part gets within the robot's working space, the motion is stopped.

Home and auto alarm: When an object or body part enters the home or car, an alarm is sounded.

Electrically-operated car window: When a body part enters the open window while closing, the operator must let go of the control and then the motion is stopped.

Let's see if we can define exactly what an interlock is. Let's start by considering a typical or generic interlocked system: a box with a cover.

For functional purposes, we sometimes need or expect to insert a body part into the box, and, for safety purposes, we sometimes must exclude any body part from the box. Thus, there are two operating modes, one of which requires access to a space which, in the other operating mode, is hazardous.

When the cover is closed, we presume that something hazardous is within the box, and that the cover is necessary and effective at keeping a body part from coming into contact with or otherwise being injured by the hazardous thing.

When the cover is opened, a sensor detects the opening of the door, and de-energizes the hazardous thing. The body part can then safely enter the box.

Hopefully, we can all agree that this is a valid and common example of an interlock.

The system is one in which we have a space (the box) which, under normal operation, contains a hazard-

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Area Activity

Santa Clara Chapter

The November meeting of the Santa Clara Valley Chapter was a joint meeting with the EMI section of the Santa Clara Valley IEEE Society. Approximately 100 people heard the speaker from Keytronics, Mr. Mike Hopkins, talk of EMI and transient susceptability. Handouts were provided.

The next meeting will be in January, 1991. Tentatively, NEMKO will be speaking. Local members should consult with the Santa Clara Valley chapter newsletter for the date of the meeting.

Southern California Chapter

The December meeting was an open discussion that covered new European requirements for capacitors, VLF and ELF emission issues, new test equipment and UL's new Q PLUS management program.

Northeast Chapter

The most recent issue of the Northeast Chapter Newsletter indicates that this chapter has voted to organize as a private society, separate from the IEEE. It has yet to be determined if information will continue to be exchanged between the Product Safety Technical Committee groups and the Northeast Chapter.

The most recent meeting covered Dennis Karr of Airpax discuss Thermostats: Design and Application for Power Supply Thermal Protection. The next meeting of the chapter will be held on Wednesday, January 23. Jeff Tuttle of NSAI will discuss European Testing and Certification.

Northwest Chapter

No meeting was held in the Portland or Seattle areas in December.

San Diego Chapter

The during the November meeting, committee officers, plans and future business were all discussed. ❖

ANSI Meeting Notes

[Everyone has heard of ANSI Standards, but how many people have attended an ANSI meeting? What is discussed and decided there might affect you! - Ed.]

An ANSI member meeting was held in San Francisco, California, on 10/9/90 with Manual Peralta, President of ANSI, and Russell Bodoff, Vice President, to discuss ANSI's performance and current issues. The following items were among those discussed.

Manual Peralta, ANSI President -

- Manny discussed the organization structure of ANSI. He said they are now reviewing the by-laws to make them enabling instead of disabling, and making them conform to the laws of the state of New York.
- Peter Yurcisin, from the Department of Defense, will be joining ANSI and focusing on Testing and Certification.
- The priorities set up by the ANSI Board of Directors are:
  . Set up a Blue Ribbon Panel to develop partnerships with government and standards developing organizations.
  . Communicate agreements with CEN/CENELEC on standards, testing, and certification to member companies.
  . Address ISO/IEC voting and funding relevancy. At this time there is no apparent block voting.
  . Expand membership and improve services.
- ANSI is advancing a U.S. candidate for President of ISO in 1992: John Hines, AT&T International. ANSI has the support of the State Department. Since the present Vice President is from Europe, he feels John's candidacy will be successful.
- JTC1 is setting up a model program to streamline the standards development process. The improvements under consideration:
  . Commitment to dates
  . Industry agreeing that they want the standard
- ANSI will be setting up a program to train people in standards activities next year. Fran Schrotter is now working on a training program for people on

JTC1 committees.

Russell Bodoff, ANSI Vice President -

- He introduced a book providing detail information on the NIST hearings held in April.
- He suggested we put middle managers (Division Managers, or people who make decisions on standards activity) on his profile for ANSI distribution, particularly for information on EC92. He also suggested that Corporate Librarians be added on ANSI distribution if they are not already.
- The major problem ANSI is having with ASTM, IEEE, and ASME involves their income from standards publications.

Manual Peralta

- Recommendations of the study group on testing and certification are:
  . Establish cooperative public/private relationship
  . ANSI serve as a catalyst for private sector interests
  . Aim for an equivalent and competitive market access
  . Avoid duplicative testing for U.S. products
  . ANSI act as an information resource
  . Have notified bodies accept data from qualified bodies outside the EC
- Decisions of the ANSI Board on testing and certification (9/13/90)
  . Higher priority for ANSI Accreditation program for third party certification programs
  . Proceed to organize a facilitating structure for U.S. interests to be represented to the EOTC
  . USNC may proceed to secure membership in IEC system for conformity assessment (IECEE)
- The European "Code of Good Practice (government guarantee)" results in government control of standards and committees. The U.S. is now isolated from Europe on this.
- ANSI now has access to European standards. We need to use it!
- Industry should make its voice heard through the Department of Commerce to the EC on directives. In the area of subcontracting test and certification, Qualitative requirement testing cannot be subcontracted, but quantitative requirement testing can.
- ANSI is now moving into a focal position on testing and certification.
- The next meeting with CEN/CENELEC will be in April, 1991.
- Plans include defining standards on new technologies (definitions, etc.). ANSI will inform constituency on technology trends.
- ANSI General Meeting will be held April 9-11, 1991. Some topics are:
  . U.S./Far East
  . U.S./Canada/Mexico
  . ISO/IEC seminar on environmental standards
  . Speeding the standards developing process. ❖

SES Meeting Notes

[The IEEE recognizes the importance of standards; after all, it writes quite a few! Product safety engineers are often found discussing standards or using them during certification investigations. Did you know there is a society devoted to Standards? These notes from a recent meeting may show some concern with topics that interest you! - Ed.]

NOTES OF THE STANDARDS ENGINEERING SOCIETY ANNUAL MEETING
September 24-26, 1990

Donald Mackay, President of SES, gave the Welcoming Address. John Woods, Executive Director, Standards Council of Canada, gave the Keynote Address. He discussed metrification, environmental protection, and the need for all present to become standards advocates.

- Metrification provides a competitive advantage in a vastly metric world.
- Environmental protection is an area where standards can make a large difference, now and in the future.
- We need to become standards advocates. We should:
  . Always make the best case for standards.

. Tailor information for the audience we are addressing.
. Point out that Standards save time and money, promote quality, resolve conflicts, stress safety and certification, increase customer demand, and provide good sales tools.
. Promote international standardization.
. Recognize that a lack of awareness leads to a lack of commitment.

SESSION I -
STANDARDS PROFESSIONALISM

Patricia Smith, ASME - Where do Engineers come from?
- In the engineering community, one out of six is female.
- Engineering public relations needs to begin at the 7-8th grade level and even lower.
- In the U.S., there is one engineer to ten lawyers; in Japan, there is one lawyer to ten engineers!
- National Engineer's Week is a good time to promote standards.

George Lucin, ASTM - Structure and role of ASTM
- ASTM has 34,000 members, 34 committees, and 1400 subcommittees. Most committees meet twice a year.
- Committees are controlled by a staff manager. There are 21 staff managers in ASTM Headquarters in Philadelphia. One staff manager will normally handle 4-8 committees. The staff manager does not perform technical duties, and does not take minutes of the meetings.
- ASTM deals mostly with materials and tests for materials. They participate in TAGs (Technical Advisory Groups) in ANSI. They are coordinated with ANSI and accept ANSI as the U.S. national standards organization.

Mike Morrell, John Deere Company - Standardization at John Deere
- John Deere is spending about 5% on R&D. This is the largest percentage for their industry. Standards are responsible for the success of their R&D program.
- Standardization policy reflects external, international, national and industry standards. They rely heavily on standards developed by external standards bodies.
- The Corporate Standards Professional is responsible for corporate standards, proliferation control, common parts, standards information, common function coordination, and coordinating metric transition. They use electronic mail for responses, which provides a considerable reduction in standardization time compared to previous methods.
- The Unit Standards Professional is responsible for developing unit standards and promoting all standards.
- A successful standards program needs formal policy. They have guidelines for participation on external standards committees, but provide no formal training. Participation on committees is an individual activity - there are no formal company positions.
- They have 23 full time standards people at the corporate level. There are seven standards writers on ISO and ASME committees. At least one person per factory is serving on an external standards committee.
- They are using electronic storage of standards, also paper and microfiche. They are written in Interleaf format for CAD work stations.
- To keep management interested in standards activities, management must see the 'fruits of their labors'.
- They are training standards people on part-proliferation control, documentation, etc.

Nancy Taylor, Manager of Libraries, Fluor Daniel, Inc. - The role of standards librarians
- Fluor Daniel provides engineering, construction, maintenance, and technical services all over the world. They have 12 libraries worldwide.
- Their standards collection exists in print, on microfilm, and on CD- ROM, but they are tending toward more CD-ROMs because of storage space.

Bill Woolcott, Director of ASME Codes and Standards - Do's and don'ts of standards development participants from a legal standpoint

- "Standardization is a useful servant but a bad master." If improperly used in a rigid uncompromising way, standardization may obstruct progress. If properly used, it is a reliable and valuable aid to industrial advancement.
- Developers will have conflicts of interest, but differences will not conflict since the action impelled by each interest to a specific matter is the same. Developers must refrain from participating in decision-making when a competing interest inhibits their professional judgment.
- To justify the provisions of a standard, the developer must ask several questions:
  . Does the standard have a proper objective?
  . Is the form the standard takes suitable for the industry?
  . Is the standard based upon valid and objective criteria?
  . Is the standards group broadly based, and potential conflicts of interest considered and publicized?
  . Are the procedures followed in developing or referencing a standard fair?
- A list of don'ts for a standards body participant (anti-trust issues):
  . Don't attend meetings without a fixed agenda of matters to be covered.
  . Don't take part in any "rump" sessions at which matters properly before a committee as a whole are to be discussed.
  . Don't discuss prices of competing or potentially competing products, and don't disparage any particular product — whether or not it meets standards.
  . Don't participate in the work of a group without making your company's interest in that work clear to other members of the group.
  . If any company may be harmed because of a standard or written interpretations of a standard, bring it to the attention of the group's officers or staff immediately.
  . Don't attempt to influence standards writing activities to benefit your business activities in a manner not available to the public.
  . Don't discriminate against non-members of the group.

Diane Thompson, SCC (Standards Council of Canada) - Nature of standards professionals at SCC
- She manages the Information Division of SCC.
- Standards professionals are developed, not hired.
  . They must be able to differentiate between standards and regulations.
  . They must have good technical knowledge.
  . They need good research skills.
  . They need bilingual capabilities in Canada.
  . They should have knowledge of computers and standards.
  . They should be organized.
  . They should be dynamic, adaptable, and versatile.
- Professional development
  . Use on-the-job training predominantly
  . In-house language training

SESSION II -
METRIFICATION, DOES IT MAKE A DIFFERENCE?

Alan S. Whelihan, DOD, Acting Director of Office of Metric Programs - Status of metrification at DOD
- There is a budget crunch at the Department of Defense. They still don't have metric capability.
- The burden of non-metrification is greatest on smaller firms.

Joseph Langenstein, Caterpillar, Inc. - metrification at Caterpillar
- Caterpillar sales - $11 Billion, 50% international, 28 countries, 60,000 employees.
- They must have a decision from the top for metrification activity.
- Reasons for going metric:
  . Improved design (drill selection, fractional vs. metric)
  . Reduced cost (fewer required choices)
  . Worldwide availability
  . Improved standardization (reduced number of choices)
  . More salable product

Jim Merideth - President, American National Metric Council - ANMC efforts in metrification
- The obstacle is not government, but industry.

- We cannot stop the trend! It's moving ahead.
- Why U.S. companies are moving to metric:
  . Foreign trade, international operations
  . Productivity
  . Design time
  . Error reduction
  . Taught quickly
- His group is providing a liaison to government - it keeps us informed about what government is doing in metrification. Congress and the Department of Commerce are serious about metrification.
- American National Metric Council:
  . Provides forum for industry to plan.
  . Acts as clearinghouse for metric information.
  . Represents to government the metric interests of private sector.
- By October 1, 1992, government procurement will be all metric.
- People are too apathetic about metric conversion.

Lorelle Young, President, U.S. Metric Association - Metrification in education
- Congress has approved standards week, starting October 14.
- Metric measurement is the best kept secret in education.
- They are making video tapes for metrics to be used in education.

John M. Tascher, Chairman, Defense Metric Transition Management Group, DOD - DOD efforts in metrification
- All new designs will be metric. Existing designs will not be converted.
- New equipment purchased must be dual-measurement scaled (DODD4120.18).
- Many current programs are hybrid.
- Cost of conversion is considered negligible.
- There are negligible impacts on reliability, availability, and manufacturability.
- July 1, 1991 is the target date for determining when metrification will be implemented.
- They are presently developing a metric handbook. Draft copies are now available (Contact John Tascher).

SESSION III - ENVIRONMENT

Diane Jensen, Co-Director, Clean Water Action, Minnesota - Problems in clean water
- They do not take account of cumulative effects of water pollution. They cannot keep up with the chemical industry.

Donovan Bohn, Vice President of Operations & Engineering, NRG Energy, Inc. - Standardization in power plants
- Standardization in power plants is necessary to get:
  . Repeatability
  . Lower engineering costs
  . Lower operations and maintenance costs
  . Higher quality
  . Minimized capital costs
  . Minimized project schedules

Stephen Gutmann, Ergonomic Standards Department, Suffolk County, NY - ergonomic efforts
- People working over 20 hours/week get free eye examinations.
- Basic concerns are:
  . Breaks during the day
  . Ergonometric furniture
  . Use of proper lighting

Ray Throne, Director, Environmental Health Division, Minnesota Health Dept. - Standardization in Minnesota
- There is a strong need for standards in the home.
  . Disease prevention
  . Health promotion
  . Environmental protection
- Building codes are generally available but need to be improved.
  . Electrical, plumbing, & structural
  . Energy efficiency
  . Product standards
- Standards are lacking for point-of-use water treatment, lead-free home plumbing, other

plumbing, water wells, and kerosene heaters (Carbon Monoxide problem).

SESSION IV - GAINING LONG TERM SUPPORT AND COMMITMENT OF SENIOR MANAGEMENT

James Teal, Du Pont, Standards Manager, Engineering Services Division - Du Pont's efforts to make standardization pay

- He is in process of determining the value received from the large number of standards and the large amount of effort going into standardization.
- They are spending $5 Million on standards activities. They have 12 full time employees. Fifty percent of their time goes to customer service. His engineers are becoming administrators.
- Standards provide significant value:
  . Save time and effort
  . Useful in directing contractors
  . Help to insure quality
- The criteria of the Malcolm Baldrige Quality Award deals with standards. The Deming criteria (plan, do, check, act) deals with standardization.
- He is looking for ways to speed up the standardization process.

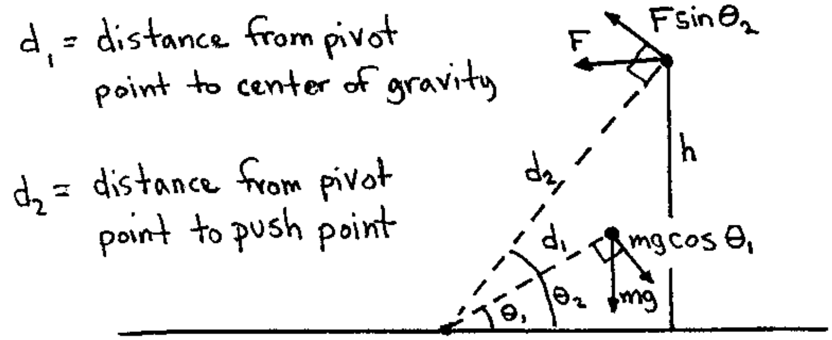
Ashweni Sahni, Quality Manager, Medtronic, Inc. - standardization in quality control

- Consistency and uniformity are the two major goals of his company.
  . Quality - meets expectations
  . Standards - provide a clear definition of requirements.
- There has been an evolution of quality control activities, ranging from inspection and process control to design improvement.
- They are using ISO 9000 as a standard for total quality management.
  . ISO 9001 - Model for QA (design, production, installation, service)
  . ISO 9002 - Production and installation
  . ISO 9003 - Final inspection and test
  . ISO 9004 - Quality management and quality system elements
  . ISO 9004.5.1 - Quality loop
  . ISO 9001,2,3 are between the customer and vendor
  . ISO 9004 is an internal quality program
  . ISO 9000 emphasizes the total quality program in a company
- Standards are:
  . A statement of customer requirements
  . Not written with specific cases in mind
  . Dictated by regulatory requirements
  . Used for buyer and seller to agree with fair exchange. (Knowledge and common language needed.)
  . Evolving, dynamic

Bob Walsh, ANSI, External Relations - ANSI issues

- ANSI has a detailed report available on the NIST hearings in April.
  . 96% want ANSI to remain
  . 2% want a change
- A cut-back syndrome is emerging in almost all industries.
  . Standards are a deadly word, which is a misconception.
  . Many people have no fixed opinion.
- The key to changing the perception of the value of standards activities is communications. The ANSI monthly newsletter will emphasize ROI (dollars), major opportunities, and problems.
- He suggests that companies change standards activity funding from expenses to costs. A fixed amount should be dedicated to standards efforts that doesn't affect the profit and loss statement.
- Duplication of identical standards from different organizations is a tragic waste.
- We need to get involved in both strategic standards and anticipatory standards activities. This may involve a mindset change in some areas.
- Some areas may require a change in relationship to be more involved in standards activities.
- ANSI is working on a standards course on how to discuss standards activities with top management. ❖

Continued from page 6



Torque due to force = Torque due to weight

$$F*\sin\Theta_2*d_2 = mg*\cos\Theta_1*d_1$$

but:

$$\sin\Theta_2 = h/d_2, \quad \cos\Theta_1 = s/d_1, \text{ and } \quad F = .2*mg$$

therefore, to pass push test: $h < 5*s$

Figure 1b

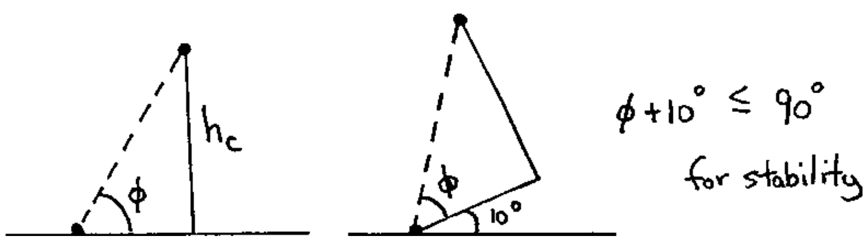


Figure 2

width of the base, the stand, the feet, the casters, or whatever, is at least 2/5 of the total height.

If, during the design of the product, it appears that the center of gravity will be shifted to the front, rear, or side of the product, then estimate the amount of the shift, and make sure that the distance from the shifted center of gravity to the closest pivot point is at least 1/5 of the total height .

As an interesting example, lets look at a 19 inch cabinet, designed to hold some rack mounted EDP equipment. Assume that the base is 22 in. in width, and consider the side to side stability. The above analysis shows that if the cabinet is more than 55 in. tall, it can never pass the 20% weight push test. It is impossible to have a 5 ft high, 22 in. wide cabinet that won't fall over (one way or the other) if it is pushed on with 20% of its own weight. A unit such as this must be provided with an additional base.

What about the 10° tip test? A floor standing unit will just begin to become unstable during a 10° tip test if the 10° tip puts the center of gravity just over the pivot point. Therefore, per Figure 2, the angle of the line joining the pivot point and the center of gravity must be less than 80° (in normal orientation) in order for the product to pass the 10° tip test. See Figure 1c.

Figure 1c shows once again a completely general result, irrespective of the size, weight, or shape of the product.

At this point, we can draw another conclusion. If the unit passes the previously discussed push test, we know that the height of the unit is less than 5 times the distance between the center of gravity and the pivot point. To fail the 10° tip test, the height of the center of gravity must be at least 5.67 times the same distance. Since the height of the center of gravity can be at most equal to the total height of the unit, we have discovered that it is physically impossible to build a product that will both pass the push test and fail the tip test.

So, the second rule of thumb is this: *Design the height/width ratio to pass the push test and don't worry about the tip test.*

It should be noted here that the standards do have limits regarding the height and magnitude of the horizontal push force to be used. IEC 950 says that the maximum height is 2 meters and the minimum force is 250 newtons. Though without these limits the above statements are true for all equipment, for safety agency approval concerns they only strictly apply to equipment that is less than about 6-1/2 feet tall and weighs less than about

$$\tan\varphi = h_c/s = \tan 80° = 5.67$$

therefore, to fail tip test

$$h_c > 5.67*s$$

Figure 1c

280 lbs.

Some additional conclusions can be drawn considering the fact that there is a limit to how hard and how high to push. One is that if the center of gravity of the unit is 40 cm (horizontal distance) or more from all possible pivot points, the unit will pass the push test regardless of size, shape, height, weight, or anything.

In addition, for those large products that fall outside both the 6-1/2 foot and 280 pound limits you can deduce that to pass the push test:

s > 112/ (weight in pounds)

It is important to keep in mind at this point that in those cases where the height and/or weight limitations are exceeded, the 10° tip test must be considered separately. For a large piece of equipment, passing a 2 meter high, 250 newton push test does not guarantee a passing result for a 10° tip test. It remains true, however, that if the shortest horizontal distance between the center of gravity and any pivot point is 1/5 the total height, you are guaranteed to pass both tests.

The last thing to remember is that these requirements do not apply to products that are meant to be secured to the floor, the wall, or other pieces of equipment. In these cases, stability can be provided in the installation. ❖

CE Mark

Continued from page 2

conformity to all the directives involved. The person responsible for affixing the mark must ensure that all the directives have been complied with. (These two requirements considerably reduce the problems of overlapping between directives).

- The mark should not indicate the directives and or standards to which a product conforms. The test reports and certificates should contain such information (in an appendix, where appropriate).
- The CE mark should not signify conformity to a particular conformity assessment procedure, even though it has to be affixed at the production phase of the assessment procedure only and not at the design phase.
- Although the CE mark will indicate that a particular procedure has been followed, it is advisable that when a third party is involved in one of the modules of the production phase of a conformity assessment procedure, that the third party should affix its stamp/mark/seal next to the CE mark to so indicate.
- The mark should also be accompanied by the last two digits of the year in which it is affixed.
- Since the CE mark is a sign of conformity to legislation, the national marks of conformity to European or national standards thereof remain compatible. These national marks of conformity to standards cannot, however, indicate conformity to Community legislation.
- The CE mark is therefore the only mark which can indicate conformity to the comprehensive Community directives which replace all national regulations on the subject.

This means that the CE mark replaces all national marks indicating conformity to national regulations, which are no longer allowed (such as the GS mark in Germany).

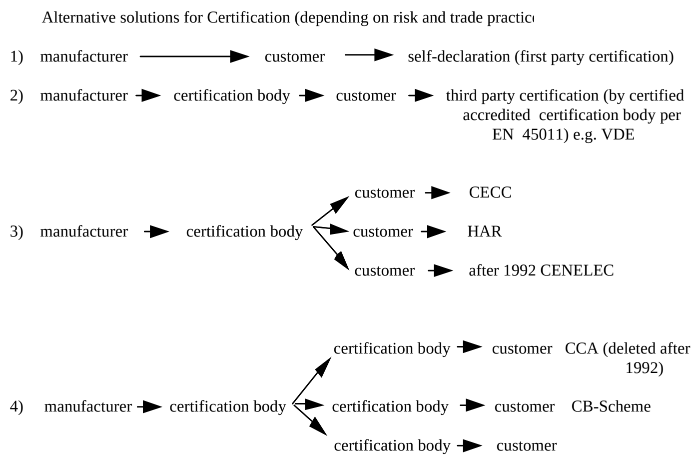
The Commission intends to propose a directive to the Council which will set down the conditions governing the use and protection of the mark and which will clear up some of the confusion which has crept into recent legislation of this issue.

It will also closely monitor market developments in connection with the coexistence of the CE mark and voluntary national marks which eventually would lose their reason to exist if they did not provide a further element of quality in addition to that provided by Community legislation.

NOTE: The material presented about the CE mark is used in R & L Ingenieur Consulting GmbH day-to-day work. What is correct today may only be partially correct tomorrow. Consequently, the reader must take action to verify the accuracy at the time of his vital interest. This can be best accomplished by direct contact with the test agencies of concern, or contact: Helmut Landeck, Tel. 011 49 61 42 43676, FAX 011 49 6142 41721.

Explanation to the alternate solutions for certification inside European Community:

Procedure 1: The manufacturer a self-declaration, ensuring on his own risk, that the product does meet the applicable product safety requirements (first party certification).

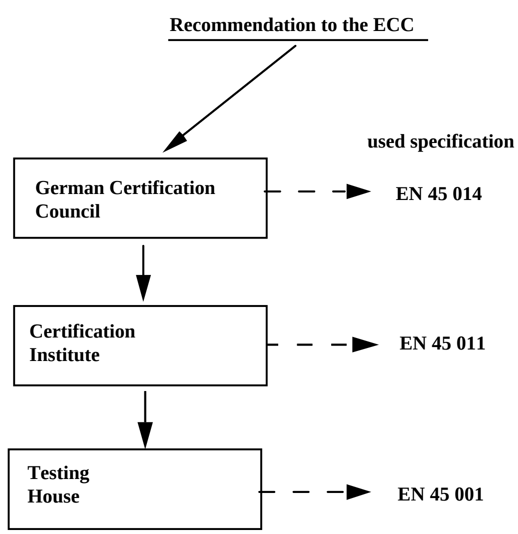


For the CE-Mark the procedures 1, 2 and 3 are applicable.

However, the CE-Mark always is a self-declaration (first party certification), procedures 2) and 3) only certify via an additional approval mark (e. g. VDE-mark) that the product does meet all "the essential requirements which concern a given product".

Ill. 1

Procedures for accreditation of test laboratories and certification bodies:



Testing House and Certification Institute need to be separated by Jan 1st, 1990, as for example already done in France (LCIE = Testing House, UTE = Certification institute).

Procedure 2: The manufacturer submits his product to a certification body with a certificate from the third party (independent test house). He can prove that the product does meet the applicable product safety specification (third party specification).

Procedure 3: Depending on product category the manufacturer submits the product to an independent test house for third party certification (for electronic components the procedure CECC exist, for power cords and cables the procedure HAR exist, for end items the CE mark does apply).

Procedure 4: International agreements have been established such as CENELEC-certification agreement, CB-scheme, and Copenhagen-procedure (see description on next pages).

The CB Scheme

In order to facilitate trade among member countries, and to limit the work of the testing stations, the CEE has established a Certification Body (abbreviated CB). The body issues CB Certificates confirming that the equipment in question has been tested and found to be in accordance with the CEE requirements (including endorsed IEC specifications). When a CB Certificate is obtained national approval will, in most cases, be obtained more quickly and cheaper and without further testing in the other member countries.

Since 1970 there have been two

procedures for obtaining a CB Certificate, see Ill. 2..

Procedure I requires that the equipment is tested at two recognized testing stations in two different member countries of the CB, one of them being the country in which the equipment is manufactured. This is of course, not possible for manufacturers outside the CB countries. In this case the CB Secretary selects the two testing stations. A national approval in member countries upon the basis of a Procedure I certificate must be issued after examination of the certificate and visual inspection of the equipment. Thus renewed examination is not required. The national licensing authorities must accept the certificate unless the equipment by the inspection is found not to comply with the requirements or the certificate.

Procedure II requires that the equipment is tested at one CB testing station only (in the country of manufacture) prior to issuing the CB Certificate. However, the various member countries have the right to carry out extra testing prior to issuing a national approval. Thus, Procedure II certificates may only be issued to manufacturers having their factories in CB member countries.

Extra test is not normally carried out.

Following is a list of the CB members (National Certification Bodies, (N.C.B.).

NOTE: At its meeting in Istanbul in October 1988, the IEC Council approved the extension of the IECEE to cover the following categories of equipment:

- Measuring instruments
- Low-voltage switchgear and control gear
- Switches for appliances and automatic controls

AT, Austria
Österreichischer Verband für Elektrotechnik

Eschenbachgasse 9
A - 1010 Wien
Telephone: + 43 222/578 63 73
Telex: 613222603 = OEVE
Teletex: 232/3222603 = OEVE
Telefax: + 43 222/567408

BE, Belgium
Belgisch Electrotechnisch Comité CEBEC

Rodestraat 125
B - 1630 Linkebeek
Telephone: + 32 2 380 85 20
Telex: 62834 (CEBEC B)
Telefax: + 32 2 380 61 33

CH, Switzerland
Schweizerischer Elektrotechnischer Verein (SEV)

Prufstelle ZH
CH - 8034 Zürich
Postfach
(for parcels:
CH - 8008 Zürich
Seefeldstrasse 301)
Telephone: + 41 1 384 91 11
Telex: 56047 (SEV CH)
Telefax: + 41 1 55 14 26

CS, Czechoslovakia
Elektrotechnicky zkusebni ustav

Post Office 71
CS - 171 02 Praha 8 - Troja
Telephone: + 42 2 84 06 41
Telex: 122880 (EZU C)

DE, Germany
VDE-Prüfstelle

Merianstrasse 28
D - 6050 Offenbach (Main)
Telephone: + 49 69 83 06 222
Telex: 4152796 (VDEP D)
Telefax: + 49 69 83 06 555

DK, Denmark
DEMKO

Lyskaer 8
Postbox 514
DK - 2730 Herlev
Telephone: + 45 2 94 72 66
Telex: 35125 (DEMKO DK)
Telefax: + 45 2 94 72 61

RD, Spain
Asociacion Electrotécnica y Electronica Espanola

Avda. Brasil, 7
E - 28020 Madrid
Telephone: + 34 1 456 76 64
Telex: 27626 (UNESA E)
Telefax: + 34 1 270 49 72

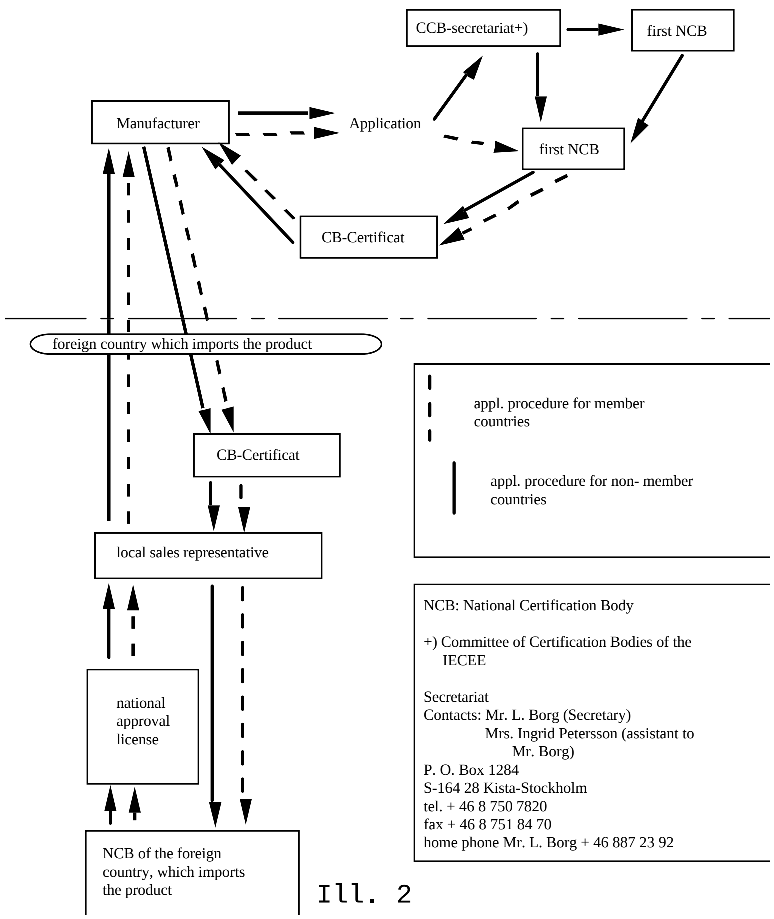
FI, Finland
Electrical Inspectorate

Sårkinlementie 3
P.O. Box 21
SF - 00211 Helsinki 21
Telephone: + 358 0 696 31
Telex: 122877 (SETI SF)
Telefax: + 358 0 69 2 54 74

FR, France
Union Technique de l'Électricité

12, Place des Etats-Unis
F - 75783 Paris Cedex 16
Telephone: + 33 1 47 33 72 57
Telex: 620434 (CEFUTE F)
Telefax: + 33 1 47 23 68 60

Flow chart of application processing of the CB-Procedures:



Ill. 2

	Agreement	Countries Covered	For Product manufactured	Remarks
EMCO	Copenhagen Procedure	"Nordic Countries"	In a non-Nordic country	
CENELEC	CCA	EC and EFTA countries	In one of the member countries	Free choice of country for testing
	HAR-Agreement			Only for cables and cords
IEC	CB-Procedure I	EC and EFTA countries + CS, H, IS, PL and Japan	In any country (with exceptions) +)	
	CB-Procedure II		In the member countries	

GB, United Kingdom
British Electrotechnical Committee
c/o British Standards Institution

2 Park Street
London W1A 2BS
Telephone: + 44 1 629 90 00
Telex: 266933 (BSILON G)
Telefax: + 44 1 629 05 06

GR, Greece
The Hellenic Organization for Standardization (ELOT)

Didotou 15
GR - 10680 Athens
Telephone: 360 95 17
Telex: 219621 (ELOT GR)

HY, Hungary
Hungarian Institute for Testing Electrical Equipment

Vaci ut 48/a-b
Pf 441
H - 1395 Budapest XIII
Telephone: + 36 1 49 55 61
Telex: 224931 (MEEI H)

IE, Ireland
The National Standards Authority of Ireland
(NSAI)

Ballymun Road
IE Dublin 9
Telephone: + 353 1 37 01 01
Telex: 32501 (IIRS EI)
Telefax: + 353 1 37 96 20

IL, Israel
The Standards Institution of Israel (S.I.I.)

42, University Str.
IL - Tel-Aviv 69977
Telephone: + 972 3 54 54 154
Telex: 35508 (SIIT IL)
Telefax: 972 (3) 41 96 83

IT, Italy

Instituto Italiano del Marchio de Qualitá, IMQ

Via Quintiliano, 43
I - 20138 Milano
Telephone: + 39 2 507 32 16
Telex: 310494 (IMQ I)
Telefax: + 39 2 507 32 71

JP, Japan
IECEE Council of Japan
c/o Japan Machinery and Metals Inspection Institute

1-9-15, Akasaka, Minato-ku Tokyo, 107
Telephone: + 81 3 583 41 31
Telex: 2423301 (JMI J)
Telefax: + 81 3 582 33 09

NL, Netherlands
N.V. KEMA

Utrechtseweg 310
P.O. Box 9035
NL - 6800 ET Arnhem
Telephone: + 31 85 56 28 53
Telex: 75132 (KLTI NL)
Telefax: + 31 85 51 56 06

NO, Norway
NEMKO

Gaustadalleen 30
P.O. Box 73, Blindern
N - 0314 Oslo 3
Telephone: + 47 2 69 19 50
Telex: 77260 (NEMKO N)
Telefax: + 47 2 69 86 36

PL, Poland
CBJW, Central Office for Quality of Products

ul. Swietokrzyska 14
PL - 00-050 Warszawa
Telephone: + 48 22 27 70 71, + 48 22 26 67 65
Telex: 816196 (ZNAK PL)

SE, Sweden
SEMKO

Torshamnsgatan 43, Kista
Box 1103 S - 164 22 Kista-Stockholm
Telephone: + 46 8 750 00 00
Telex: 8126010 (SEMKO S)
Teletex: 2401-8126010 = SEMKO
Telefax: + 46 8 750 60 30

SU, USSR
USSR State Committee for Standards

Leninsky Prospekt 9
117049 Moskva M-49
USSR
Telephone: 236 40 44
Telex: 411 37B (GOST SU)

Committee of Certification Bodies
IECEE-CCB Secretariat

P.O. Box 1284
S - 164 28 KISTA-STOCKHOLM
Telephone: + 46 8 750 78 20
Telex: 17109 ELNORM S
Telefax: + 46 8 751 84 70

Committee of Testing Laboratories
IECEE-CTL Secretariat

Särkiniementie 3
P.O. Box 21
SF - 00211 HELSINKI 21
Telephone: + 358 - 696 31
Telex: 122877 SETI SF

IECEE
c/o Central Office of the IEC

3, rue de Varembé
CH -1211 GENEVA 20
Telephone: (+41 22) 34 01 50
Telex: 28872 CEIEC CH
Telefax: (+ 41 22) 33 38 43

Denmark, Finland, Iceland, Norway, Sweden

Copenhagen Procedure

This procedure is for the benefit of non-Nordic manufacturers and according to this agreement the manufacturer only has to submit his product to any one of the Nordic testing laboratories for full testing.

Approving in the first country may be the basis for application for approval in the other Nordic countries. Supplementary testing may be necessary if any of these latter countries has deviations from the standards which could not be checked in the first country.

When the initial application, if made to SEMKO, documents and specimens shall be submitted in the same way as for national approval in Sweden only, just with the addition that the testing should be made in accordance with the Copenhagen Procedure. The same applies for NEMKO, DEMKO, and SETI.

When approval is applied in the other Nordic countries based on the testing in the first country, a set of photographs is required in addition to the copy of the approval issued. Application is made to the testing laboratories of the countries concerned.

Four sets of photographs are obtained from first test house (e.g. SEMKO); one set of photographs should be mailed to the remaining three other certification bodies SETI, NEMKO, DEMKO and Iceland Certification body, RER. ❖

Ground

Continued from page 3

Another situation we should consider involves a much more substantial limitation to the fault current. In this case the fault connection is not a direct one to a heavy line voltage conductor, but rather to some later point which, though it still carries a hazardous voltage, has a much higher source impedance. For this example let's say the bracket falls onto a component in the product's high efficiency power converter. That component is connected to line voltage through a maze of circuitry that altogether inserts a full 6Ω of impedance into the fault loop. Now our trim piece is only carrying about 20 amps - not quite enough to trip the mains breaker - and with this lower current its impedance has risen to, we'll assume, only 60 mΩ. This results in an exposed voltage of only 2.2 volts (remember the 50 mΩ in the chassis to earth ground path), and the situation can be considered safe.

But now let's consider the new model XB product with a revised front panel made of plastic rather than metal. In this case the trim part is no longer grounded directly to the chassis on its opposite end by a front panel mounting screw. To reestablish the ground connection it was decided to attach its mounting screw to a circuit board run which was eventually connected to ground. But close quarters on the circuit board layout encouraged the selection of a modest run width. Considering the same fault as in the previous example, the 20 amp fault current proves more than the trim part's grounding run can gracefully handle. After 20 seconds that run has become very hot and its impedance has risen to 2Ω (and will continue to rise as it begins to disintegrate). At the 2Ω point, a 30 volt accessible hazard exists on the product and that hazard voltage rises with time. The mains breaker will never trip since the fault current is declining, and ultimately the full line voltage may appear on the trim part if the grounding run fails completely. If the user touches the trim part while trying to figure out why the product is behaving oddly, he or she could get hurt. And to add to the misery, the product manufacturer and others could also get hurt by the following onslaught of attorneys.

The moral of these examples is to keep the ground system stout throughout. The lower the ground system's impedance, the safer the product will tend to be.

One would like to think that the last situation would never be allowed to get to market since the grounding integrity of the trim part and all other exposed conductive components would be thoroughly tested during the design cycle and verified by certification testing. At least we hope so. But there is that tendency to ignore the ground system. The sequence of events described in the last example may be more likely than we might think, and we dare not take such safety issues lightly. In addition, modern products are often of complex electrical and mechanical design, occasionally incorporating an intermix of conductive and nonconductive controls and panels. Under these circumstances it's not hard to imagine that one of many ground paths could be insufficiently stout, especially where circuit board runs are a connection means. Without occasional design testing, problems might not be noticed until certification testing, when correction might be quite expensive, or, worse, even get past certification and make it to the customers hands. A review of ground system integrity at regular intervals in the design cycle, verified by testing, would seem an appropriate investment to prevent this possibility.

These reviews should include all aspects of the ground system. In addition to the grounding integrity of exposed conductive parts, ground guards should also be examined. Ground guards are barriers, usually internal to the product, between a hazardous voltage and any other conductor that ultimately connects to anything the user could touch. Their purpose is to prevent a hazardous fault voltage from ever being able to arc to the accessible lines by shunting the currents associated with the arc safely to earth ground. Ground guards may be incorporated between primary and secondary windings of transformers or different functional areas of circuit boards for example. And like the touchable grounded cabinet parts discussed earlier, the ground guards must be stout - stout enough to carry away high fault currents, without breaking down, until the mains breaker or fuse opens (if it ever does).

Exact ground integrity performance requirements are a matter of design conservatism, but at the least the requirements of the most stringent safety certification required for the product must be met. Which certifications apply depends of course upon the product and the marketplace. However, it's common for the certification specs to require all exposed conductive areas to have an impedance to the earthing terminal of no more than 100 mΩ when tested at 25 or 30 amps. The test must be made under high current conditions to insure that the ground path maintains a sufficiently low impedance and retains its physical integrity under fault conditions. Depending upon the certification sought, internal ground guards may only have to show that they won't physically degrade when carrying a current of 25 or 30 amps for one minute so as to demonstrate that they can be relied upon to trip the circuit breaker.

UL 1950 is a popular certification to consider. It requires an impedance of 100 mΩ or less from parts required to be grounded to the grounding terminal. Compliance is checked with a test current whose value is 1.5 times the capacity of the possible fault source, but not more than 25 amps (ac or dc). IEC 601 is similar but allows up to 200 mΩ if the product has a non-detachable power cord, and in all cases requires a 50 or 60 Hz test current with a lower limit of 10 amps (the upper limit remains 25 amps, as in UL 1950), and specifies that the test current be applied for at least 5 seconds.

In practice, the required certifications are usually known early on, generally near product conception. The quantitatively expressed ground integrity test requirements can easily be found in the standards booklets, so finding the performance requirements is generally straightforward. What has often been awkward is making the tests in a design and development environment. One must measure impedance typically in the 100 mΩ or less range, and must do so while simultaneously applying a current of typically 25 or 30 amps (which is sometimes required to be an alternating current at the line frequency as we've seen). Normal bench instruments just won't do the job, and it's no small inconvenience to round up (if they're available in house at all) a high current source, an ammeter with at least a 30 amp range, and a voltmeter. But if all that is found, one must still apply the current with one set of leads, simultaneously measure the induced voltage with another set of leads, then calculate the impedance from the voltage and current readings, and do all this for every point to be tested. If the natural tendency to ignore the ground system during development didn't dissuade us, the tendency to overlook testing which is so cumbersome to accomplish might.

There exist ground integrity testers that can make these measurements in a straightforward manner, but most are designed primarily for production line environments, lack versatility and accuracy, and are too expensive for many design and development areas to justify. However, because creating and maintaining overall ground integrity is so important for product safety, it is worthwhile searching for an instrument that is designed specifically for this job. Appropriate parameters would include a fully adjustable test current with a minimum range of zero to 30 amps at the line frequency, selectable readout of the test current, and direct readout of impedance with a minimum zero to 200 mΩ range. Basic accuracy of 3% for the reading of both test current and impedance would be reasonable. An important consideration for ease of use would be that only two connections should be needed to make a measurement, just as with any simple DMM. Finally, automatic test time and test fail alert features would not be needed for design and development environments.

But whatever the choice, be sure your ground systems are solid. Check them early in the design cycle and at regular intervals through development. With the right instrument it's a quick and easy task. Just as there's an unfortunate tendency for designers to assume that ground systems will be just fine without any special attention, there's also a tendency for users to assume that any ground system is inherently safe - and that kind of thinking invites trouble. As we've seen, there is no inherent safety guarantee. As engineers we must actively design and verify systems to be safe.

Many thanks to Rich Nute of Hewlett Packard Company. His technical analysis of ground system performance was a crucial resource in the preparation of this material.

[Comments and questions about this article may be sent to the Editor of the PSN or the Author at Hypatia Inc., Route 2, Box 977, Hillsboro, OR 97123-9626- Ed .] ❖

Capacitors
Continued from page 4

3) Testing this major difference should qualify an IEC capacitor to UL requirements.

LOOKING AT THE LARGE PICTURE

This review illustrates how to compare technical specifications on a component.

The technical safety requirements here in North America and those in Europe have been developed quite independently of one another. Although they are considered to be technically equivalent, they are not exactly the same.

The European IEC requirements have been developed in concert with all IEC standards that have a focus on preventing electric shock. Conversely, the North American, UL or CSA, safety standards have focused on fire prevention. These differences exist because of the respective long term experience with each electrical system. The key differences are the higher European line voltage (240V rather than 120V) and the twice larger current that flows in North American products at the lower voltage to do the same work.

These small differences in safety requirements and their accompanying certifications are a stumbling block to product safety engineers in recommending substitutions of components from competing manufacturers.

Current product designs must, more and more, deal with EMC regulations that sometimes seem to be in conflict with safety requirements. The use of EMI filter capacitors, which shuttle current to ground, are a more significant factor in design. In recent years, EMI capacitor manufacturers have only been slowly meeting the worldwide requirements in each size cap in a line. This differentiation, having only UL or IEC certification, has caused designers, and then product safety staff, to review capacitors from a variety of manufacturers for equivalency in safety performance.

A worldwide point of view will eventually bring the technical requirements together. In the short run, however, the separate point of view developed over a century of use of electrical power has led to the two approaches shown. Appreciation for this basic difference allows a rational look at the requirements with a view to meeting the most stringent combination.

Harmonization of requirements is moving along well at the equipment level. Now IEC 950 and the American UL 1950 show how harmonized requirements can be developed. This harmonization will move into the component standards with time.

MAKING LIFE EASY:

Our goal is to know when an IEC certified cap can be substituted for a UL certified EMI cap. What is the difference? Under what conditions can equivalent safety performance be claimed?

By reviewing the requirements, pinpoint the specific test differences between UL 1414 and IEC 384. Testing these differences will show equivalence, if it exists. The differences are stated in each standard. Read them carefully.

Other product safety staff, that needs to determine equivalency will be interested in this. We'll need a clear understanding to sell our UL engineer, too.

Product safety engineers want to give the maximum freedom possible to designers in choosing components for their design. Knowing how to cross qualify components expands the choices.

After learning the technique explained here, this should be more straightforward. We need to be able to easily substitute equivalent parts as needed.

Capacitors that meet UL 1414 are usually specified in an application. Capacitors that meet IEC 384 are similar, but have some differences, too.

Similarities are: spacings, dump test, dielectric (IEC 384 is more stringent by a factor of 2), initial resistance (again IEC 384 is more strict

GETTING RESULTS:

This technique will help product safety engineers see, by example, how to compare specifications and assess the equivalency of requirements. Only those components with equivalent safety performance specifications may be easily substituted one for another.

COMPARING THE REQUIREMENTS:

IEC 384 is the key European standard. UL 1414 is the American requirements. They are summarized in Table 1.

READY TO MEET THE CHALLENGE?

After a thorough review, you can see the differences in performance and recommend additional testing to qualify one set of capacitors under the other standard.

If one doesn't want to go to all the work to tear and compare, then stick with the old, comfortable source - even if the parts are hard to come by.

But, once the evaluation is done, it will be possible to rate the alternate source and then substitute knowing that the parts are equivalent.

LINE TO GROUND CAPACITORS:

Additionally, in the IEC all Class Y (line to ground) capacitors must comply with IEC 65 clause 14 requirements. These are: 0.5 M ohms to 4 M ohms resistance for capacitors with shunt resistance; 50 each l0kV discharge cycles surge test; 1500 hours life test; and 21 day humidity.

In this specific application (line to ground capacitors) there are additional requirements because of the line surges that these capacitors are expected to withstand.

These surges arise from either lightning strokes or from switch gear or motor starters or other impulse generating equipment on the line. This large, but quick, line voltage variation stresses any line to ground insulation, including that within these capacitors.

WRAP UP:

Component engineers and designers are interested in these results, too. The proposal for substitution quite often comes from these folks.

Component substitutions are quite often requested by component engineers that are apprised of a supply problem or some technical problem that providing a similar component would fix. We like to find a good general solution that increases choices for the manufacturing line.

We were convinced that these parts could be used interchangeably once the IEC certified parts passed a UL 94 V-0 flammability test. Interestingly enough, our UL engineer accepted these IEC certified parts after they wrapped them in foil and performed a dielectric test. We knew that they would pass, the 2 kV IEC 384 requirement was more stringent than the UL 1414 1 kV test. We controlled the flammability of the parts by only submitting those parts for UL evaluation that passed our own 94 V-0 tests. We always wondered why flammability wasn't an issue when we had used it as our major argument for acceptance testing.

We were pleased that a straightforward review presented the differences plainly. This allowed us to make a direct proposal for inclusion of these alternate parts in our products. We hope this review will help you with a similar problem in the future. ❖

Technically Speaking

Continued from page 7

ous thing. When an attempt is made to enter that space with a body part (which requires opening of the door), the space is automatically "de-hazardized" when an attempt to enter is initiated.

We then can define an interlock as: A device which automatically "de-hazardizes" a hazardous space when an attempt is made to insert a body part into that space.

Now let's examine the examples, and see if they fit the definition:
We can see that, in the cases of the garage door opener and the robot, the space that contains the hazard need not be defined by a physical enclosure. Therefore, our definition is valid for these two situations.

But, we have two situations for which the definition does not hold: the self-cleaning oven, and the motor-operated paper cutter. The electric car window is eliminated because it requires intervention by the operator and is not automatic.

Most of us would agree that automatic locking of a self-cleaning oven is an interlock. So, we need to fix the definition to include such a situation.

The revised definition: A device which automatically "de-hazardizes" or prevents entry into a hazardous space when an attempt is made to insert a body part into that space.

Now, the definition fits all the examples, including that of the motor-

Microwave oven:	Yes.
Copy machine:	Yes.
Television receiver:	Yes.
Self-cleaning oven:	No. It prevents entry until the temperature is at a safe value.
Motor-operated paper cutter:	Sort of. If either operating control is let go of as if to insert a body part into the hazardous space, then the space is automatically de-energized.
Printer:	Yes.
Garage door opener:	Yes. If the garage door touches something in its path (space), it reverses direction (de-energizes).
Robot:	Yes. If something enters a predetermined space, the robot stops (de-energizes).
Home and auto alarm:	Yes. An alarm is sounded when an attempt is made to invade the space.
Electric car window:	No. The operator must de-energize the window when the space is invaded by a body part; the de-energization is not automatic.

operated paper cutter.

We can see now that, with the exception of the electric car window, all of these are examples of interlock systems. Interlocks are not necessarily electrical; they can be mechanical. They don't necessarily obviate the hazard; they may also prevent entry under hazardous conditions.

Let's explore a bit further an idea mentioned earlier: For each of the product examples, there are two operating modes. One operating mode requires access to a space, while the other operating mode requires exclusion from that same space. Note that each of these situations is a normal situation, and that there is no equipment fault. Note further that the equipment or situation is safe both before and after the interlock is actuated.

The interlock applies to a product where there is more than one normal operating mode for a particular space, where one of those operating modes requires the space to be non-hazardous, and where the other operating mode requires the space to be hazardous.

The interlock plays a role in both operating modes.

When the space is in the non-hazardous mode, the interlock must maintain that condition regardless of product operating controls.

When the space is in the hazardous mode and an intrusion attempt is made, the interlock must override product controls to either de-energize the space or prevent entry to the space until the space is non-hazardous.

(The home or auto alarm is an interlock. The interior space of a home or car has two operating modes, one which allows access to the space, and one which prevents unauthorized entry to the space. The interlock is intended to deter entry when the main lock is defeated or bypassed in an unauthorized manner.)

So, the elements of an interlock are: (1) applies to a space which has two operating modes, hazardous and non-hazardous, (2) has automatic intrusion detection, and either (3a) prevents energization of the space, or (3b) de-energizes the space, or (3c) prevents entry into the space until the space is non-hazardous.

Let's try re-writing the definition:

An interlock is a device or system which is applied to a space which has two operating modes, one hazardous and one non-hazardous. The interlock automatically detects the operating mode.

During the non-hazardous mode, the interlock prevents energization of the space.

During the hazardous mode, if an intrusion is attempted, the interlock either de-energizes the space, or prevents entry into the space until the space is non-hazardous.

Now, let's look at some characteristics of the interlock device or system.

For some kinds of hazards, we traditionally require two safeguards, one for normal operating conditions, and one for a fault in the first safeguard. IEC standards for electric shock are of this type: they require both basic insulation and some means for mitigating the failure of basic insulation.

Therefore, when the space involves electric shock, the interlock device or system should assure safety both with the interlock working normally and with a single failure within the interlock. For electric switches as interlock devices, we presume that the switch fails in the open position; therefore, the non-hazardous detection must be with the switch contacts open. For optical-path detection devices, we presume the absence of a light source is the principal failure; therefore, the non-hazardous detection must be the absence of light.

For other kinds of hazards, we traditionally require one safeguard. High- temperature parts and moving parts traditionally are provided with one safeguard (probably because the safeguards are not subject to failure). If an interlock for a moving part is not electrical in nature, then usually it need not be of a fail-safe design.

Interlock systems should be in their non-energized, or relaxed, or normal, or resting state when the space is in its non-hazardous mode. ❖

The Product Safety Newsletter needs you!

Please send comments or questions to:

The Product Safety Newsletter
Roger Volgstadt (Loc. 55-53)
Tandem Computers
10300 North Tantau Avenue
Cupertino, CA 95014
[fax: (408) 748-2137]

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Austin Bob Hunter (512) 250 6878	Call for information	
Chicago Dick Hagadorene (708) 505 5722	Call for information	
Northeast Sheraton Routes 111 and 495 Boxborough, MA Bill Von Achen (508) 263 2662	Wedsneday, January 23, 1991 "European Testing and Certification" by Jeff Tuttle of NSAI	
Portland Location to be determined Fran Pelinka (503) 641 4141	January 15 "Hazards in the Industrial Environment" by John Brecunier of Telemekinic	
San Diego HP Cafeteria 16399 West Bernardo Rd. Rancho Bernardo, CA Scott Bonnet (619) 592 4571 Ray Jimienez (619) 729 9303 Jim Dykema (619) 573 6295	Wednesday, January 9, 6PM "Safe Computing" by Dave Mackenzie of Mircosafe Systems	
Santa Clara Valley Apple Computer Inc 20705 Valley Green Drive Cupertino, CA John Revnolds	Tuesday, January 22, 7 PM "Testing by Manufacturer" by a representative of NEMKO (tentative)	Tı

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c/o Tandem Computers Incorporated
10300 North Tantau Avenue, Loc 55-53
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