The Product Safety Newsletter

IEEE

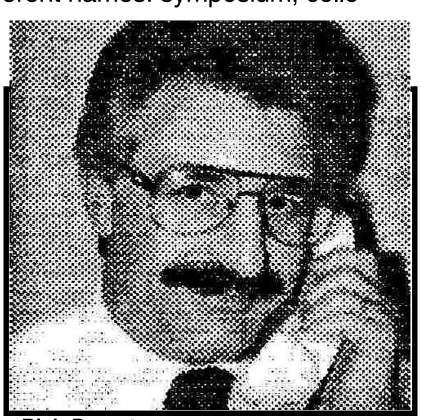
In this issue

Vol. 3, No. 3 May/June 1990

Chairman's Message

Rich Pescatore has asked me to fill in for him this time, since he has been out of the country for about six weeks out of the last eight. I'm sure you will join me in extending our sympathy to this poor fellow who has been forced to spend his time drinking German beer and French wine while touring Europe. What - not even a little sympathy?

Last issue Rich wrote about the Product Safety Newsletter. Previously he has discussed the local groups that regularly have technical meetings on topics of Interest to product safety professional s. Another type of communication we are sponsoring is called by several different names: symposium, colloquium, convention or conference.



Rich Pescatore

This year we are participating for the first time in the IEEE International Symposium on Electromagnetic Compatibility, which is being held in Washington, D.C., from August 21 to 23. This participation takes the form of a "Product Safety Special Session" scheduled for Tuesday, August 21, starting at 2:00 p.m. The EMC Symposium Advance Program describes *it* as follows:

"All electric products have the potential of being a source of electric shock. It is important in the design of electrical products to be aware of the various means for protection to minimize electric shock. The methods Include: grounding, double insulation, shielding, ground fault circuit Interruption and polarization. This tutorial by the Product Safety Technical Committee will provide a brief overview in defining each method and the advantages of each. A more in depth study will be made of one or more of the methods as time allows. .

This year would be an excellent time to attend the EMC Symposium and drop in at the Product Safety Special Session. Just in passing, another time to remember is that of the IEEE EMCS TC-8 (product safety) meeting, which is scheduled for Wednesday, August 22, from 7:00 to 9:00 p.m.. Hope you can make it to Washington!

A cooperative effort like organizing a Special Session requires more than the presence of the presenters, although, of course, that is essential. Those people who devote hours of their time to arranging all the tedious details, who make sure things work without sharing the spotlight on the podium, must be mentioned and praised. Perhaps this sounds a lot like your regular job: to make sure your company's products are safe and radiated emissions "don't bring down low flying airplanes", while the marketeers closing multi-million dollar deals get the glory. Why not ask any space shuttle passenger whether he prefers the glory ... or gaskets that work? Keep up that attention to details!

Sorry about the harangue. It was inspired both by the upcoming

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The Product Safety Newsletter

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

Comments and questions about the newsletter may be addressed to the *Product Safety Newsletter,* Attention: Roger Volgstadt,Loc. 55-53, c/o Tandem Computers, 10300 N. Tantau Avenue., Cupertino, CA 95014. fax no. (408) 285-2553.

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Chariman's Message

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Symposium and by the President's Message in the last issue (Spring 1990) of the EMC Society Newsletter. If you haven_ read it yet, then right now would be a good time. He is urging people to participate, to get involved, which will help the Society and themselves. Does this topic sound a little familiar to readers of this column? And this leads me back to the topic of symposia.

A number of people are contributing to the Product Safety Special Session at the Washington Symposium this year, including the session chairman, John Knecht, from Underwriters Laboratories in Northbrook, Illinois. This kind of participation is great, and we need more of it. But if participating at the international level is a bit too intimidating for a first effort, have I got a deal for you!

The Santa Clara Valley Chapter of the EMC Society is sponsoring a local colloquium to be held on June 12 to 13, 1991. "IEEE SCV 91 EMC: A Product Compliance Colloquium" will include an afternoon session on product safety. Speakers are being sought now for this event. If you are interested, please call Franz Gisin, Adm Systems Inc., at 408-492-3543.

I am hoping that other local product safety groups may take advantage of their association with the EMC Society and participate in local conferences like this one. Any takers?

Best regards

John McBain
Secretary-Treasurer

Technically Speaking

(continued from page 10)

In this article, I have shown that the fuse current rating cannot be selected on the basis of normal-mode current; it must be selected on the basis of fault-mode current.

I have also shown that the fuse current rating must be selected to prevent that overcurrent which would result in unacceptable overheating.

Acknowledgments. References for this article are Bussmann's "Electronic Designer's Protection Handbook," Bulletin EDPH, Littlefuse's "Designer's Guide," Form Number EC 101, SAN-O Industrial Corporation's catalog, UL Standard 198G, and IEC Publication 127.

Your comments on this article are welcome. Please address your comments to the Product Safety Newsletter, Attention: Roger Volgstadt, c/o Tandem Computers Incorporated, 10300 N. Tantau Avenue, Loc. 55, Cupertino, California 95014-0708.

Technically Speaking

Rich Nute

Selecting a Fuse Value

Rich Nute

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Hello from Vancouver, Washington, USA:

Recently, a colleague asked, “How do I select the fuse rating for a new product?”

His cord-connected product has a switching-mode power supply and consumes 170 watts, with maximum normal-mode input current of 2.74 amperes.

One source suggested a rule-of-thumb that the fuse rating should be about 1.5 times the maximum normal-mode input current. If he used this rule, he would use a 4.2-ampere fuse.

On the other hand, he had another, similar product, also with a switching-mode power supply, consuming 180 watts. Its maximum normal-mode input current was 3.2 amperes, and it used a 3-ampere fuse!

Naturally, with this gross difference between two similar products, my colleague was confused. Let’s try to reduce the confusion.

I’m limiting my discussion to “small-dimension” fuses. Generally, small-dimension fuses are those that do not exceed 13/32-inch in diameter and 1-1/2 inches in length. Small dimension fuses include the popular 5 x 20 millimeters and 1 /4 x 1-1 /4 inches dimensions. In the parlance of UL 198G, these fuses are U miniature” and "micro.“

Before you can select the fuse current rating, you must first answer the question, “What is the function or purpose of the fuse?”

The purpose of the fuse is to prevent overheating or fire in the event of a fault on the load side of the fuse.

Electrical heating (power dissipation) is one result of electrical energy transfer. Electrical power dissipation (electrical heating) is of the form E*I or I*I*R or E*E/R.

To control overheating, we must have some means of controlling or limiting power dissipation. To control or limit power dissipation, we must control or limit voltage (E), current (I), or resistance (R).

In most cases, the circuit is a voltage source so we cannot control the value of E.

Since we are dealing with fault conditions in the load, the value of resistance (or impedance) is obviously out of control; so, we cannot control or limit the value of R (or, more generally, impedance (Z)).

To control overheating due to electricat power dissipation, we must limit or control the value of I.

Most overheating is prevented by limiting the maximum value of I in the power equations, E*I and I*I*R.

A fuse prevents overheating by automatically reducing the value of I to zero when the current increases to a value that would cause overheating.

(Current limitation must be automatic because the circuit may not be continuously attended by someone who will manually disconnect the power, and because overcurrent conditions are not necessarily immediately apparent.)

An increase in current to a value that would cause overheating is presumed to be a circuit fault-mode condition. The fuse rating or value is related to the maximum acceptable heating due to fault-mode current.

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Technically Speaking

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The fuse rating or value is NOT related in any way to the maximum normal-mode current of a product.

Before you can select the fuse current rating, you must first have some idea of how a fuse works and what its specifications and ratings mean in terms of reducing the value of I to zero.

A fuse is comprised of a fusible link encapsulated in an enclosure and connected to contact terminals. The link is a metal which melts as a function of current and time.

As with any metal conductor, at normal temperatures the link has a low but finite value of resistance.

Current through a resistance results in power dissipation in that resistance. The power dissipation is directly proportional to the resistance and to the square of the current, as shown by the equation, P = I*I*A. The result of current in the link is power dissipation and heating of the link.

As with most metals, the link is a positive-temperature-coefficient device. That is, the resistance of the link increases with increasing temperature, and temperature increases with increasing current.

Nominally, the current rating of the fuse is the maximum current for which the link temperature is stable with time.

So, then we have our first fuse parameter, the current rating.

For currents greater than the fuse current rating, the link temperature is not stable (i. e., the temperature increases continuously), and, at some time the link will melt. Upon melting, the structure fails, the link breaks, and the current goes to zero.

Electrically, for all currents up to its rated current, the resistance of the link typically is less than 0.1 ohm. At currents greater than its rated current, the resistance of the link increases non-linearly with current and time to a very high value (hundreds of megohms) , which effectively reduces the current to zero.

Whenever a circuit is opened, as the conductors separate, an arc occurs. Electrical power of the form E*I is dissipated in the arc. This power heats the ends of the broken link; the ends continue to melt back, thus creating a continuously enlarging distance between the two ends. Eventually, the distance becomes sufficiently large that the voltage cannot sustain the arc and the air becomes an insulator. (Some fuse constructions use a granular insulating material which, after the link melts, fills the space formerly occupied by the link, effectively displacing the air with a solid insulating material, thus quenching the arc.)

Now, in addition to the fuse current rating, we have three time parameters for fuse performance: melting time, arcing time, and total time (which is the sum of the melting time and the arcing time). These three times are a function of the value of the current, I. As users of fuses, melting time and arcing time can be ignored; the parameter we need is total time as a function of current Fuse manufacturers commonly publish 1- T curves for each fuse current rating, where T is the total time. This is our second fuse parameter.

(When the current is very high, the magnetic field, during both melting and arcing periods, imparts energy to the highly mobile molten metal, propelling it to the wall -- enclosure -- of the link where it cools to its solid state. This accounts for the silver, mirror-like deposits on the inside of glass enclosures following a high-current fault.)

Note that the fuse operates by means of heating, over a period of time, of a particular conductor -- the link -- by electrical power dissipation in the forms I*I*R (melting) and E*I (arcing).

Electrical power dissipation over a period of time is thermal energy, and is expressed in watt -seconds, either I*I*R*t or E*I*t We cannot expect a fuse to dissipate unlimited thermal energy; therefore, fuse ratings include

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Technically Speaking

Continued

a maximum current (I) rating which produces the maximum thermal energy which the fuse can safely dissipate. This maximum current rating is known by several names: interrupting rating, breaking capacity, and short-circuit rating.

Now, we have a third parameter, interrupting rating.

The interrupting rating applies to a fuse or other overcurrent device. In Europe, the terms “circuit prospective current” and “prospective short-circuit current apply to the circuit on the supply side of the fuse. These currents are defined as the maximum current available from the supply into a short-circuit.

The fuse interrupting rating must be equal to or greater than the circuit prospective current. More about this later.

The thermal energy dissipation limit for a fuse is established by both its voltage rating and its interrupting rating in the energy equations, I*I*R*t and E*I*t

A few years ago, I had the opportunity of participating in an experiment where we compared the performance of two fuses, both with 10,000-ampere interrupting rating, but with different voltage ratings. One was rated 250 volts, the other rated 600 volts.

We set up a short-circuit (less than 0.1 ohm) and applied 480 volts through about 5 feet of wire from a utility pole-pig transformer. (We did this test at a site belonging to the local electric utility.)

With the 600-volt fuse, the only consequence of applying the 480 volts was the open fuse.

On the other hand, with the 250-volt fuse, three inches of flame shot out of the fuseholder, the fuseholder was destroyed, board conductors were vaporized, and arcs jumped between the load-side board conductors and other unrelated board conductors. In addition, the connections from wires to the unit under test showed signs of significant arcing.

In the case of the 250-volt fuse, since the applied voltage exceeded the rating, the energy the fuse was required to dissipate was twice its rating. The fuse resistance did not increase, but, instead, let the energy through where it was ultimately dissipated by the various circuit components.

When you exceed the fuse voltage rating, the fuse does not reduce the value of I to zero. This failure of the fuse to reduce the current to zero means that electrical energy is continued to be applied to the fault, and the safety of the situation is compromised.

(Note, however, that the fuse voltage rating is related to the fuse interrupting rating. The voltage rating can be exceeded, and still get acceptable fuse operation, when the circuit prospective current is very much less than the fuse interrupting rating. One fuse manufacturer suggests the fuse voltage rating can be exceeded when the circuit prospective current is no more than ten times the current rating of the fuse. Generally, this would be the case for most high-voltage secondary circuits in electronic equipment.)

Now, we have a fourth fuse rating: the voltage rating.

In selecting a fuse, we must consider most of the fuse parameters:

1) Current rating.
2) Current-time curve ratings.
3) Interrupting current rating.
4) Voltage rating.

From the circuit, we know the circuit voltage, so we can readily choose the fuse voltage rating.

Before choosing the interrupting rating, we need to know the prospective short-circuit current of the supply circuit. Fortunately, in North America, at least, for typical supply circuits (120/240 V and 120/208Y) the prospective short -circuit currents do not exceed 10,000 amperes; all UL Listed and CSA Certified fuses -- including 5 x 20 mm fuses -- rated 125

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Technically Speaking

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V or 250 V have 10,000-ampere interrupting ratings at 125 V. So, for the most part, we need not address interrupting ratings as all North American fuses have sufficient interrupting ratings.

However, IEC 5 x 20 mm fuses do not have 10,000-ampere interrupting ratings. IEC 5 x 20 mm fuses are either 1,500-ampere or 35-ampere interrupting ratings.

(Be careful! There are TWO kinds of 5 x 20 mm fuses: some 5 x 20 mm fuses are UL-Listed to UL standards, while other 5 x 20 mm fuses are UL-Recognized to IEC standards. The UL-Listed 5 x 20 mm fuses are 10,000-ampere interrupting rating, while the UL-Recognized 5 x 20 mm fuses are either 1 ,500- or 35-ampere interrupting rating.)

If supply circuits have prospective short-circuit currents up to 10,000 amperes, then what good is an IE C fuse? On the other hand, IEC fuses have been used for years with no history of detrimental operation. Why?

At the load end of an 18 AWG 2-meter power cord, the maximum current is limited by the impedance of the power cord, the plug and socket contact and other wiring contact resistances, and the building wiring impedance back to the distribution transformer, and by the size (impedance) of the distribution transformer. To get 10,000 amperes, the total impedance of the supply and return conductors must be less than 12 milliohms. The contact resistance of each wire termination is of the order of 10 milliohms, with at least 12 terminations in the circuit. Ignoring inductance, the system has 120 milliohms which limits the prospective short-circuit current to 1,000 amperes. (I believe that the inductance is more significant and limits the current to about 100 amperes, but I don't have the references readily available to prove it right now.)

Since the wiring of a practical installation limits the prospective short -circuit current to about 1,000 amperes, the IEC 1,500-ampere interrupting rating is adequate in most cases, and we do not see signs of detrimental fuse operation.

Finally, we come to selecting the fuse current rating and the current-time curve rating.

The fuse current rating selection process is really quite simple:
First, the fuse current rating must be greater than the normal current of the load. Second, the fuse current rating must be less than that current at which unacceptable heating occurs in the load.

The first complication is that of determining the current at which unacceptable heating occurs in the load.

The second complication is that of determining normal current as a function of time.

Let's first look at the current at which unacceptable heating occurs in the load.

Overheating results from electric energy being converted to thermal energy when current exceeds normal current. Since we are dealing with energy, and since energy includes the dimension of time, we are dealing with current exceeding normal current for some period of time. That is, we are not dealing with overcurrent situations of short duration -- say less than a few seconds. Such short durations, from a practical point of view, do not usually result in sufficient energy to cause ignition. So, we are looking for a fault that results in a steady-state value of overcurrent that causes overheating.

In our search for the value of steady-state overcurrent which causes overheating, we must first identify those parts which could dissipate power and which therefore could overheat. Only those parts which can dissipate power can overheat

Parts which dissipate power include resistors, heaters, transformers, and semiconductors. Other parts, such as wire, connectors, line filters, inductors, and switches, which don't normally dissipate power, will dissipate power

Continued

under fault conditions. Both insulation and circuit component faults can cause excessive power dissipation in all of these kinds of parts. Note that the part which overheats is not the part which has the fault.

On the other hand, some parts which incur an internal fault will then dissipate power because of that fault. Capacitors and semiconductors exhibit faults which will cause the capacitor or semiconductor to overheat. Fortunately, such faults are in the range of 0.5 to 1 ohm and therefore can be simulated with a resistor.

Once you identify candidate power-dissipating parts, you must introduce the fault which will cause the part to over-dissipate more-or-less as a steady-state condition. (This is done either with the fuse shorted out, or the highest available rating fuse in the fuseholder.) Then, you measure the “fault-condition” input current. The fuse current rating must be less than this current.

Faults which cause unacceptable overheating are not necessarily short-circuits. In fact, short-circuits often cause some power dissipating components such as resistors and semiconductors to immediately fail open with no consequent overheating.

More often, the faults which cause unacceptable overheating are those that are of IOY/, but finite resistance. For DC circuits, we use electronic loads as fault simulators. For AC circuits, a suitable load is a big 1:1 transformer supplied by a big variable transformer. The output of the 1:1 transformer is connected out-of phase to the AC being subjected to an overcurrent condition. Both of these schemes give a continuously variable load to the circuit under test.

This process applies to both primary and secondary circuits and to both linear and switching-mode power supplies. In some cases, you will need both primary and secondary fuses.

For many switching-mode power supplies, the parts which can fault do so with relatively low impedance or resistance. For example, the forward resistance of a bridge rectifier diode is usually 1 ohm or less. Such fault impedances result in very high currents; under such conditions, the value of the fuse current rating is not critical.

However, there usually is one power resistor in the primary circuit of a switching-mode power supply. It is the resistor in the snubber circuit. Often, it is in series with a capacitor. Often the capacitor is prone to short-circuit.. In such an event, the power supply continues to operate, but the power resistor must dissipate excessive power, and may cause overheating of nearby materials. The fuse current rating should be selected based on the current that occurs with the snubber capacitor shorted.

In general, for a switching-mode power supply, the fuse current rating should be selected at the next convenient current greater than the maximum input current of the switcher.

For some circuits - usually low-power circuits — the difference between normal current and and fault current is less than the increment of available fuse current ratings. Transformers rated 50 watts and less, when subjected to fault conditions, often will overheat without increasing the current sufficiently to cause a fuse to protect the transformer. In such cases, a thermal switch is called for.

Now, let’s first look at the problem of determining normal current as a function of time.

Most loads have turn-on currents that are higher than the steady-state current. The ideal way of selecting a fuse would be to measure the load current as a function of time from turn-on to steady-state. Using this curve, we would overlay candidate fuse curves until we found one that everywhere, from turn-on to steady-state,

Continued

Technically Speaking

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TABLE 1
CURRENT-TIME CERTIFICATION POINTS
Small-dimension fuses

		Standard	UL 198G, CSA 59				IEC 127					
		Interrupt Rating	10,000 A				1,500 A		35 A			
		Time Rating	Fast		Slow		Fast		Fast		Slow	
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Percent Current Rating	Rating Range Min.	Rating Range Max.										
110%	0	30	4h		4h							
135%	0	30		1h		1h						
150%	.032	6.3					1h		1h		1h	
200%	0	3		2m	5s	2m						
	3.1	30		2m	12s	2m						
210%	.032	6.3						30m		30m		30m
275%	.032	.100					.01s	2s	.01s	.5s	.01s	10s
	.125	3.9					.01s	2s	.05s	2s	.6s	10s
	4	6.3					.01s	3s	.05s	2s	.6s	10s
400%	.032	.100					.003	.3s	.003	.1s	.04s	3s
	.125	6.3					.003	.3s	.01s	.3s	.15s	3s
1000%	.032	.100						.02s		.02s	.01s	.3s
	.125	6.3						.02s		.02s	.02s	.3s

(h = hours; m = minutes; s = seconds)

Continued

TABLE 2
INTERRUPTING RATINGS
Small-dimension fuses

Standard		UL 198G, CSA 59	IEC 127		
Dimensions		1/4 x 1-1/4 in. 5 x 20 mm	5 x 20 mm	5 x 20 mm	
Time Rating		All	Fast	Fast	Slow
Voltage Rating	Current Rating				
125	All	10,000 A			
250	0 - 1	35 A			
	1.1- 3.5	100 A			
	3.6-10	200 A			
	10.1-15	750 A			
	15.1-30	1,500 A			
	All	10,000 A @ 125V	1,500 A	35 A	35 A

Dimensions		13/32 x 1-1/2 in.
Voltage Rating	Current Rating	
125	All	10,000 A
250	All	10,000 A
300	All	10,000 A
500	All	10,000 A
600	All	10,000 A
	All	50,000 A
	All	100,000 A

Continued

Technically Speaking

Continued

was just greater than the load curve.

There are two major problems with this technique. First, the conventional means of making time-dependent measurements is with an oscilloscope. The scope measures peak currents, while the fuse responds to rms currents. Second, electronic loads are usually non-linear; that is, the current is zero during a significant portion of the voltage cycle. This means that the current peaks are not in the ratio of 1.41:1 peak-to-rms as would be the case for a linear current waveform. Therefore, it is difficult to relate the measured time-current curve to the fuse time-current curve.

Since all fuses are thermal energy-operated devices, typical fuse time-current curves indicate the 10-millisecond current at 5 to 10 times the steady-state current. Typical time-delay or siow fuse time-current curves indicate the 10-millisecond current at 10 to 50 times the steady state current.

Let's *now* look at "crowbar" circuits. The crowbar circuit I'm familiar with is an electronic short-circuit across the power supply output terminals. The circuit deliberately blows a fuse when the voltage of a power supply output goes too high. It's purpose is to protect IC's from catastrophic failure from high voltage in the event of a short-circuit of the series-pass transistor in the voltage regulator circuit.

I'm a bit uncomfortable with deliberately creating an overcurrent situation -- but I can't justify my position with an engineering explanation. If the crowbar circuit is designed to carry the circuit prospective short-circuit current, then the crowbar should be okay.

Another anecdote: The original crowbar circuit worked as designed. Then, the circuit layout was changed and the SCA was relocated. As a part of the change, a connector was added to the circuit, and the wire size reduced. When the series-pass transistor shorted, the SCA fired, but the fuse did not blow. The reason: too much resistance had been added to the SCA circuit with the connector and the smaller wire. As a result, the crowbar circuit caught fire!

Some caveats:

Be aware that the world has TWO small-dimension fuse rating schemes: (1) the North America (read UL and CSA) scheme, and (2) the IEC scheme. To get the same performance from either scheme, you would need to specify two different fuse rating values, one for a UL-CSA fuse, and the other for an IEC fuse. See Figure 1, Table 1, and Table 2.

Be aware that a fuse is a temperature-dependent device; its ratings are for nominal room temperatures. A fuse should be physically located in the equipment at a point where there is little temperature rise. Or, select a larger current rating using the manufacturer's temperature de-rating curves.

Be aware that a fuse is a temperature-dependent device; time-current curves change with physical size and, within the same physical size, with link constructions. Time-current curves are not of constant shape within fuse types. The curves will also change as a result of the heat-sinking of various kinds of fuseholders.

Be aware that the typical slow" fuse has a minimum time rating at 200% of its current rating, whereas the "normal" fuse has no minimum time rating at 200% of its current rating. A "slow" fuse will not blow in less than 5 seconds at 200% rating for up to 3 amperes, and will not blow in less than 12 seconds at 200% rating for fuses rated greater than 3 amperes; all other characteristics are the same as a normal fuse. See Figure 2.

Be aware that most electronic product input current waveforms are non-linear; to measure input current for the purpose of deciding a fuse value, you must measure the current with a true RMS current meter.

Well... I hope this gives you some guidance for selecting a fuse value.

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News and Notes
Dave Edmunds

Dave Edmunds

TC 76 Plenary

A plenary meeting of TC 76 (Laser Safety) is planned for Boulder CO the week of June 4th. The major documents for discussion relate to changes to I EC 825 to incorporate Fiber optics and high power material processing laser.

IEC 950 Second Amendment/ Edition

The 2nd amendment of IEC 950 is planned to be published and available late 1990. This amendment will include approximately 13 Central Office documents.

The 2nd Edition of IEC 950 is planned for late first quarter 1991 and incorporate approximately 26 Central Office documents. There has been speculation this 1991 date is optimistic.

CBEMA had circulated list of IEC TC76 documents, the clause it affects and the CO document number.

Electromagnetic Fields

Several articles on the possible health hazards of Electromagnetic field which may be of interest are:

Occupational Health & Safety News, February 8, 1990 - Some Scientific Concerns over possible Health Hazards of Electromagnetic Fields"

PC magazine, January 1990 "The Dangers on Your Desktop" U.S. Department of Energy, Bonneville Power Administration, Portland, OR, "Electrical and Biological Effects of Transmission Lines: A Review"

Telecommunication

CENELEC has called for a vote, to its members, on document PREN 41003 dated January 1990 entitled "Particular electrical safety requirements for equipment to be connected to telecommunication network." This document build on the requirements of EN 6950.

EN 60950

All European countries will withdraw IEC 380 & 435 by 1 September 1990, and replace it with EN 60950. All countries have established a date after which the sale of equipment evaluated to the IEC 380/435 will not be permitted.

CSA 950

CSA has several documents for use with CSA 950. One is a checklist, the others are a side by side comparison documents. One of these compares CSA 950 and UL 1950, then compares CSA 950 to UL 1950 to IEC 950. The format and structure of the CSA checklist is similar in and layout the ECMA checklist for IEC 950. However, the CSA list has an explanatory statement for each clause. Mr. L Bahr of the Rexdale office has issued these documents and requested comments.

VDE 950 Checklist

VDE has a document titled "IEC 950 Test Report". This document is similar in format to the ECMA IEC 950 checklist with these differences: a) explanatory statement has been added for each clause, b) Parts 3 & 4 have been incorporated into appropriate clause, c) the Summary of Test check sheet has been removed.

IEEE Spectrum

A special issue of Spectrum is planned which will survey the status of consolidation efforts, the major corporate players and implications of the EC plan for a single market as well as the political changes in Eastern Europe.

Trade Associations Compared

The May 1990 issue of I EEE Spectrum has an article comparing two leading US electronic trade associations EIA (Electronic Industry Association) and AEA (American Electronic Association). This article briefly reviews the goals and history of each and how they aid the electronic industry.

ANSI/IEC

To facilitate the coordination of ANSI/USNC and IEC, ANSI now has an individual in the IEC office.

Send your news items to:
Dave Edmunds (MS 843), c/o *Xerox Corp.,* 800 *Phillips Rd., Webster,* NY, *14580* *(or fax* 716-422-7841)

CSA Compliance
Nick Maalouf

PRODUCT COMPLIANCE, IS THERE A BEST APPROACH?

Many questions are now being raised about the various approaches used by certifying agencies for ensuring product compliance. In a changing world, all these questions are valid. But, in order to appreciate the different ways of achieving product compliance and be able to answer these questions, we must first understand the manufacturing process itself.

A manufacturing process follows the steps shown in Fig. 1.

Idea_____
Specifications___
Design____
Development___
Production____
Outgoing Product

FIG. 1

First, a need is recognized from market research or customer demand. Then, specifications are created which incorporate customer's as well as other requirements. A design is conceived to meet these specifications; and after experimentation and development, a product is developed. A production process then manufactures the item, and finally, the product is delivered for customer use.

Given such a process, the question is: How can we ensure that the product delivered to the market complies with the applicable codes and standards?

There are basically three ways to control product compliance in the manufacturing process:

1. By controlling the outgoing product; or
2. By controlling the system that produces the product; or
3. By controlling both; the product and the system.

Which approach is best? Before we answer this question, let's examine what each approach entails, and think of the advantages and disadvantages of each of them.

CONTROL OF THE PRODUCT ONLY - THE FOLLOW-UP APPROACH

This approach focuses primarily on controlling the outgoing product and does not concern itself with the system that produced the item. Control is achieved by the following means:

o First, compliance is assessed by testing and evaluating one or more samples of the population, and by documenting the construction of the conforming product;

o The manufacturer then confirms that the item will be manufactured in a manner so as to ensure that the outgoing product is same as that tested;

o Following which, formal certification is granted by the certifying agency for the entire production line;

o And the actual control of continuing compliance is achieved by conducting unannounced follow-up inspections at the factory. During such inspections, a sample of the outgoing product is examined, and its construction Is compared to that of the tested sample.

Does this approach assure continual compliance of the outgoing product at all times? An interesting question top be kept in mind.

CONTROL OF THE SYSTEM - THE SYSTEM APPROACH

This type of compliance control is practiced in Europe under various forms. The "manufacturer's declaration" approach is the one variation most widely used.

The concept borrows from Quality Assurance fundamentals, and is based on the premise that compliance of the product can be assured by effective control of the system that produces it. In simple terms, this is accomplished by ensuring that the following criteria are met:

o All related standards and code requirements are referenced in design specifications of the product in question;

o An acceptable Quality Assurance System is implemented at the factory;

o The product Is tested by the manufacturer who issues a declaration confirming that it meets the applicable requirements.

o If an agency is involved, the agency carries out an annual audit if the QA system, and mayor may not perform a field product audit.

Continued

CONTROL OF THE SYSTEM AND THE PRODUCT: THE CSA CATEGORY CERTIFICATION APPROACH

Category Certification is a CSA concept of certification that assures continual product compliance by controlling the product as well as the system.

This concept was pioneered by CSA twenty years ago with an implacable safety record.

The superiority of the "Category Concept" is based on the fact that it takes the best elements from the "product/follow-up approach" and combines them with the best from the "system approach". The result is a unique concept that integrates both: cure and prevention.

This seemingly impossible mission can only be accomplished by serious dedication and commitment to this objective and to product safety by the two parties involved: CSA and the Manufacturer.

Why commitment is important? Because, as mentioned earlier, continual compliance of the product under Category Certification is achieved not only by controlling the outgoing product, but also by controlling the system that produces the product. Here is how this is done.

First, the manufacturer's track record and experience in codes and standards is evaluated. Only those with a proven track record in product safety are considered further; and, in order to qualify, they must meet strict requirements that only the most responsible of manufacturers can fulfill. One such requirement is that they must affirm their commitment to Quality and Product Safety by implementing a formal and documented compliance control system spanning the entire manufacturing cycle; from design conception, all the way through to shipment of the final product

Assurance of continual compliance is achieved by frequent CSA Audits, and by the active involvement of CSA Staff in each and every step of the manufacturing process not only as controllers, but also as trainers and educators of manufacturer's staff. Let's now retrace these steps and see how they are controlled.

At the specification and design stage, control is achieved by:

- Ensuring that all pertinent safety requirements are incorporated in the specs;

- Ensuring that product designers are familiar with the applicable codes and standards;

- CSA Staff reviewing all initial designs and also approving all future design changes.

- As the design concept translates into a prototype, control at this stage of development is achieved by:

- CSA Staff evaluating the construction and recommending the appropriate tests;

- Ensuring that the manufacturer has an acceptable testing facility and qualified staff with experience in product safety and testing to safety standard;

- Performing the required tests;

- Ensuring that all records and documentations of product construction and testing are maintained and controlled;

During production, compliance is maintained by:

- Effective control of purchased components;

- Verifying production methods and procedures to ensure that the process is capable of producing the product with a high degree of consistency;

- Verifying that the applicable production tests are carried out as required;

- Effective control of drawings and changes;

- Actual inspection of the outgoing product by CSA Staff at the factory.

- Field audits of the product by CSA's Corporate Audits & Investigations Group. This Group also works closely with the Inspection Authorities by monitoring and acting on incidents in the field.

It is by now quite evident that the CSA "Category Certification" approach not only provides very effective control of the product, but it also stresses prevention. The concept reflects a philosophy and a fundamental quality engineering principle that safety cannot be ensured by

Continued

testing and factory follow-up inspections alone. Safety must also be designed into a product by designers familiar with the applicable standards and the safety concerns expressed in them. In addition, a quality management system must be put in place to ensure continual commitment to, and understanding of product safety. Only then can we speak with confidence about product compliance.

Now back to the question posed earlier: Which of the three approaches provides the best compliance control?

Rather than answer the question, here is a comparison table between the CSA "Category Certification" Approach, and the "Product/Follow-Up" Approach which is the most common. You, the readers and experts in this field, be the judge. Your comments and input will also be appreciated.

Nick Maalouf, P. Eng.
Director
Engineering, International and Quality Assurance
CANADIAN STANDARDS ASSOCIATION
(416) 747-4236

TWO APPROACHES:
CSA CATEGORY CERTIFICATION VS. PRODUCT/FOLLOW UP

Deals with prevention and cure	Deals with cure only.
Provides assurance that safety is designed into the product.	No assurance.
Initial certification of product category is granted by certifying agency.	Initial Certification of tested model is granted by certifying agency.
Continuing involvement of agency in product design and development.	No involvement.
Frequent audits of product during development.	No audits.
Formal (Quality) Control Program required.	Not required.
Total documentation control from design to delivery	Descriptive report of product.
Legal contract with agency and formal commitment by Mfg's Senior Management to a total system of control.	Contract only.
Team approach to safety (Mfg & Agency) resulting in ongoing training of Mfg's Staff .	No training.
System & Product audits.	Product audits only.
Authorized Mfg's staff verify compliance of product variations within Certified category.	Not allowed.
Follow-up expert staff.	Follow-up by generalists.
Third party certification.	Third party certification.
Maximum confidence level in product compliance.	Minimum.

For Your Information

A new specification, IEC 950, presents a major change in suppression capacitors safety requirements. European safety agencies, including VDE, SEV and SEMKO, specify that office equipment manufacturers seeking approval to the new IEC 950 specification must use either X-2 capacitors with SEV approval, or the heftier X-1 capacitors. This change affects all equipment, including computers and computer peripherals, telephone equipment, copiers, fax machines, etc.

Although IEC 950 does not specifically spell out the requirements for suppression capacitors, it references IEC 384-14 which does. Two interpretations of 384-14 presently exist among the European Safety Agencies because of a vague description of surge voltage requirements. However, a new version of 384-14 clearly defines those requirements.

As it stands now, VDE says that X-2 suppression capacitors are acceptable for IEC 384-14 compliance if also approved by SEV, the Swiss Safety Agency. Sweden and other Scandinavian countries, on the other hand, say that X-1 types must be used. But a unified position among the European Safety Agencies is expected with the release of the new version of IEC 384-14 because the surge voltage requirements, now precisely stated, can only be met with X -1 capacitors.

As currently written, IEC 384-14 states that an X capacitor must withstand a surge voltage of 2500 V AC but it does not state the number of times that surge voltage is to be applied to the capacitor. SEV requires 3000 VAC surges applied three times, which some agencies say meets the current IEC 384-14 specification. But the new 384-14 requires at least three pulses of 2500 VAC per hour for 1000 hours, which means the X capacitor must withstand a total of 3000 applications of the surge voltage. This is much more severe than the SEV requirement and can only be met with X-1 types.

Once the new version of I EC 384-14 is issued, manufacturers of office equipment seeking new approvals to IEC 950 will have to use X-1 types may involve repacking because X-1 types are substantially larger than the equivalent X-2 type. In addition, X-3 types with SEV approval are available up to 2.2uF, but the highest capacity X-1 capacitor is 1.0uF.

These suppression capacitors are used in power supplies to filter RF interference (AFI) from either entering or exiting the equipment via the power lines. Government agencies, including the FCC, require filtering any RFI to prevent its conduction through the power lines. Suppression capacitors and other components aid in meeting this requirement.
A typical suppression application uses one X and two Y capacitors. X types, called across-the-line capacitors, are used across the equipment's power line input. Y capacitors connect from each side of the power line to ground; they are known as line-to-ground capacitors.

Power supply designers must be aware that R FI suppression is a function of more than just the capacitance value.. There is no guarantee that a 1.0uF X-1 can replace the same value X-2. Successful AFI suppression depends on part size, lead length and distance between the leads. Therefore, designers must allow time to test and evaluate circuits using X-1 capacitors.

- Chuck Robertson, Roderstein Electronics, Inc. [Reprinted with permission from "Power Conversion and Intelligent Motion., March 1990.]

Calls for Papers

Two groups have issued a "Call for Papers" for conferences to be held in 1991, one in California and one in Texas. Both involve safety of electrical products and may be of interest.

The Santa Clara Valley Chapter of the IEEE EMC Society will host It IEEE SCV 91 EMC: A Product Compliance Colloquium" from June 12 to 13, 1991, in San Jose, California. The emphasis is on EMC, but one complete session will be devoted to product safety, as well as part of the introductory compliance process overview.

For more information about attending or participating, call Franz Gisin at Rolm Systems, (408) 492-3543.

The System Safety Society is holding its "Tenth International System Safety Conference" from July 18 to 22, 1991, in Dallas, Texas. The theme emphasizes society objectives of contributing to the advancement of safety and disseminating state-of-the-art knowledge about safety engineering practices. Request more information from the Tenth International System Safety Conference Committee, P.O. Box 292455, Lewisville, Texas, 75029-2455. Tel. (214) 492-9005

What Do You Think?

WHAT? STANDARDS?

Question: What is the most often quoted reaction to the apathy and short attention span shown by some government bureaucrats. senior management. designers. manufacturers and marketers. towards standards and standardization?

Answer: "THEY" don't understand.

Maybe "THEY" don't understand because the word" standard" has never been explained to THEM". (I chose the word "standard" instead of standardization because it is shorter. It should be obvious that standardization is the development and implementation standards.)

"Standard" is made up of the following:

St: This is the recognized standard abbreviation for "saint". One has to be a "saint" to work on standards. It requires a dedicated discipline, a charitable attitude, self-denial and patience, patience, patience and most of all, recognition from above.

and: This is the written symbol for "addition" . It signifies that something else is coming, another work, another phrase, another clause, another standard. It is a clear Indication that work on standards Is never finished, it is a continuing commitment.

rd: This is the recognized abbreviation for third". It may signify the next step to the two legal actions" on the one hand....then on the other hand" which Imply a "third" hand, namely: by the way, what standard does the product comply with? Some say it also means that standards come third, after design cost and profitability, in "THEIR" mind.

The astute observer will have noticed that the second" a" is missing. It has fallen between the proverbial cracks. It may signify the beginning, the "alpha", of many other cracks that will open up if "THEY" continue to deny adequate support and dedicated resources to standards and standardization.

All that remains is to find out if "THEY" now understand. Apply the standard test for "understanding": ask for "THEIR" commitment. "THEY" all ready know "THEY" have ours.

R.C. Maheux

Ask Doctor Z

Doctor Z

In the world of Product Safety and Certification, there are many pitfalls for the unwary. If you have a problem that seems insoluble, then it's time to ask Doctor Z! He has the answers, derived from his many years of training and experience in the Science of Product Safetiology. Pitfalls hold no fearers for Dr. Z, since he is on a first name basis with most of them. Any resemblance to persons, places, products, agencies, or good advice is purely coincidental, but don't let that stop you. Write to Dr. Z today!

[Dr. Z is presently on sabbatical. He recently has been tarred ... that is, tired with his busy schedule and decided to take a trip by train. At least he said something about riding out of town on the rails. Anyway, his faithful assistant Fred is standing by to answer any questions sent in (or even some that aren't). The standard set by Dr. Z for irrelevant, Incomprehensible and Irritating answers is sure to continue to be met. - Ed.]

Guest Editorial
John McBain

John McBain

You may have noticed something a little different about this issue of the Product Safety Newsletter. No, not that it Is a month or two late. Unfortunately, that is not different, although someday... The difference is that we have not had the assistance of the Tandem Computers Graphics Department this time, and boy do we miss it!

Now don't stop reading Just because you suspect the next item is a plea for help from our readers. You may be perfectly correct, in fact you are perfectly correct, in your suspicion, but we do need help. And the more people who offer some of their time, the less of their time is needed. But the best part of participation is that it is a rare example of "something for nothing" because you can get out more than you put in.

Besides the various tasks with editors already involved, we have several other possible jobs. If none of these seem attractive, invent your own position and we will see how It works.

1) Institutional Listings, 2) Issue Layout and Graphics, 3) Word Processing, 4) Mailing List Updates, 5) Back Issues and Reader Directories, 6) Area Activities and Calendar, 7) Reproduction and Mailing

If I picked my top three they would probably be numbers 2, 4 and 6.

So please get in touch with the editor, Roger Volgstadt, as soon as possible, or even sooner. Or give me a call at 408-447-0738. Thank you for your support.

Letters
(Continued from page 24)

Damage to the components precluded reuse of anything except the fuses.

What should the Consulting Engineer do? Obviously, use only combinations that have been fully tested. These combinations are listed in the UL Yellow Book, "RECOGNIZED COMPONENT DIRECTORY"
under "Circuit Breakers - Series Connected" .

William E. May, P .E.

Correction:

Dear Sir,

The withdrawal dates of products given by Helmut Landeek in his letter published in the Nov IEEE 1989 issue (Vol. 2, No.5, page 20) are identical to those given by me in the TUV seminar 1992 ONE. EUROPE held in Dallas. Your reporter, Ercell Bryant, quoted me incorrectly in his article on that seminar published in the July - Oct. issue (Vol. 2, No.4, page 17). I hope that this sets the record straight.

Dr. Steven Kraemer
TUV Rheinland

Area Activity Reports

SANTA CLARA VALLEY

The March 27th meeting had a presentation by Mr. Jim Howard and Mr. Bob Cameron of American Seating Company.

We were given a brief history of the company; Founded in 1886 making classroom furniture, by 1892 had the world market, and then went on to other types of seating. They have been using ergonomics since 1886 to design the most comfortable and most useful seating available. A number of sample chairs were demonstrated. They were designed to fit 90% of the population.

The April 25th meeting hosted a presentation by Mr. Josef Kirchdorfer of Weber Limited.

We were given a presentation and handouts that covered in detail the design of circuit breakers. The topics covered were the following:

1. An introduction.
2. The basics of protection.
3. The means of protection.
4. Protection by fuses.
5. Overload protection by circuit breakers.
6. Short circuit interruption by a single breaker.
7. Short circuit interruption by a cascade of CBs.
8. Comparison of protective devices.
9. The selection of circuit breakers based on performance requirements.
10. Protection against electric shock.
11. The differences in product standards.
12. Definitions according to IEC 934.

All very interesting material for design engineers and other.

The May 22nd meeting hosted a presentation by Mr. Grant Schmidbauer of Canadian Standards Association, Pacific Region.

We were given a presentation and handouts that covered:
1. An Overview of CSA's structure, activities, and operations.
2. A time table for the implementation of CSA Standard C22.2 No. 950. The key dates are 9/93 and 3/2000. After 9/93 submittals must be to 950 and 154 production must end. After 3/2000 the D3s may not by used for new products.
3. A listing of some of the major differences between CSA 220 and 950 covering the more stringent construction, marking, and test requirements.
4. A copy of Certification Notice No. 671 covering 950 vs 220 differences in detail. 5. A copy of the new CSA draft report for 950 products.

The meeting ended with a question and answer session on the new standard. For more information on the activities of the Santa Clara Valley chapter, please contact David McChesney at 408-985-2400, extension 2771 or John Reynolds at 408 942-4020.

SOUTHERN CALIFORNIA

Charlie Bayhi opened the meeting. Four members were in attendance.

The May meeting featured a fantastic Magic Show presentation by one of our own members, Mr. Gabriel Roy, aka" Gabriel" . The Great Gabriel provided a wonderful evening of entertainment with his professional repertoire. I am still trying to figure out how he enticed me to "donate" a dollar bill, cut it in half, burn half, and then reach into his pocket and pull out the "burned" half!! Thanks again, Gabe, we all enjoyed it!

Meetings are held the first Tuesday of each month at MAI/Basic Four Corp. The next meetings are scheduled for 6:00 PM Tuesday June 5, July 10 (2nd Tues.), and August 7, 1990. the June meeting will be a test equipment demo by Dean Marxer of Valhalla Scientific. The programs coming up are a UL presentation of ISO 9000 series quality specifications, medical standards by Konrad Kobel of TUV America, and pitfalls in EN60950 by Ed Spooner of TUV Rheinland.

The EMC Society meetings are held on the third Tuesday of the month. Meetings are held at LeChuga's Fine Foods of Mexico in Los Alamitos. Call Michele at 714-732-5691 for reservations. For details about the Southern California chapter meetings, please contact Paul Herrick at Gradco Systems, Inc., 7 Morgan, Irvine, CA 92718, phone 714-770-1223, 714-768-6939 FAX

NORTHEAST

The most recent meeting of the Northeastern Chapter of the Product Safety Technical Committee was held on Wednesday, April 25, 1990 at the Sheraton Boxborough Hotel in Boxborough, Mass. Charles Kolifrath of Dash, Straus and Goodhue chaired the meeting in Bill von

Continued

Area Activity Reports
Continued

Achen's absence.

Committee Reports:

Constitution Bylaws Committee: Tony Nikolassy continued his discussion from last month concerning the relationship between the local Chapter and the Product Safety Technical Committee of the IEEE EMC Society. According to Tony, his contact with Rich Pescatore and Dr. Schindler (Chairman of IEEE in Boston) indicates that a structured affiliation would prove beneficial.

Technical Presentation Committee: Tony Nikilassy stated that more help is needed in this area. Tony asked that anyone having ideas for technical presentations, including topics and / or speakers, submit these either to him or at the May meeting.

Legislative Committee: Nancy Araway and Fred Grund discussed the issue of mutual acceptance of test data between U.S. and European safety agencies, especially concerning flammability of plastic materials. Their report stated that this data exchange is currently minimal, at best. For example, UL flame ratings for plastics may be sufficient to obtain some National safety marks in Europe, but several European agencies will not accept this data. Furthermore, even if the data is accepted by one of the European National safety agencies, that data cannot be used in obtaining other National safety marks, as would data actually compiled by one for the European National safety agencies.

Liaison Reports:

UL: Doug Kealey reported that a February 1990 bulletin from UL concerning the standards for power supplies, battery chargers and direct plug-in transformers will allow for a reduction in electrical spacing requirements for these product categories. Doug also reported that an upcoming UL bulletin will discuss supplies to be tested in accordance with the standard to which the end product will be approved. Further discussion by attendees of the meeting revolved around similarities between this upcoming bulletin and CSA Bulletin 1402C,

CSA: Paul Smith reported that CSA will be offering a seminar on June 25-27, 1990 dealing with various issues which are pertinent in today's manufacturing industry. Paul pointed out that one major segment of this program deals with assisting manufacturers in the quality management process. Further information about this program can be obtained by contacting CSA at (416) 747-4128.

Paul also reported that Alan Knight of CSA would like to conduct a focus group locally to discuss those technical services most required by exporters of computer equipment. Those interested in participating in the focus group should contact Alan at CSA (416) 747-4128.

EIA: Bruce Langmuir posed the question as to whether the major safety agencies allow for equipment connected to a branch circuit to rely on the branch circuit protection (i. e., circuity breaker) for protection of that equipment. Several different opinions on this subject were offered by various attendees. Bruce also expressed an interest in gathering data which might prove useful in new designs for circuit breakers. In our next meeting, Bruce will issue a form for gathering data relating to the relationship between in-rush current and steady-state current of the equipment which is produced by the various companies represented at our meetings.

CBEMA/NEMA/NFPA: Jeff Tuthill reported that there is currently an effort to form a common body for safety testing and approval in Europe. This body will be known as the European Organizational Testing Committee (ECTC). This committee will consist of a signatory from each of the European countries involved, and is expected to be in full operation some time during 1993, after several introductory and experimental stages.

IEC: Fred Grund reported on several CENELEC amendments to various European safety documents and distributed copies of the summary of these changes at our meeting.

Technical Presentation:

Mr. Roy Clay of Rod-L Electronics gave a presentation "Critical Factors of Hi-pot Testing." Mr. Clay discussed the reasons for performing hi-pot and ground continuity testing, and outlined the specific listing agency requirements mandating hi-pot testing parameters, and highlighted factory safety and economic considerations for performing hi-pot testing.

The presentation was followed by a brief question and answer period.

Continued

For more information please contact:

William von Achen
Chairman, Northeastern Chapter
(508) 263 - 2662

CHICAGO

Our last meeting was held on May 15. The subject was Product Safety - Its Impact on Computer Software. The speaker was Joseph Faitler, Interactive Systems Corp., and Paul A. Phillips, Argonne National Laboratory.

The previous meeting was held on 3/20/90. Mr. Tony Tutins, Perma Power Electronics, Inc. spoke on Transient Voltage Surge Suppression. As you are aware, many of the product safety issues we talk about relate to other Societies in the IEEE. The Reliability Society, in Chicago, has expressed an interest in combining efforts regarding meeting topics. Although we will not revolve all meetings around Reliability, we will pursue this matter to see what can be done and if it will be beneficial to our Chapter and the PSTC. It should be noted that our next meeting is being co-sponsored by six (6) societies (Computer, Reliability, Communications, Medicine and Biology, Engineering Management, and the Industrial Electronics Societies). This shows that product safety is a concern of all disciplines, and should be taken advantage of to gain exposure and increase membership and awareness.

The Chicago Chapter will not meet again until September, 1990.

NORTHWEST

The Portland Section held its last meeting on May 15 at the Portland General Electric Company building. The featured speaker was Walt Hart. Walt is Product Safety Manager at John Fluke Mfg. Inc. and has been involved in product safety standards for the past 15 years. He participated in development of UL 1224, ANSI/ISA S82 (formerly ANSI C39.5). CSA C22.2 No. 231, IEC 990, and IEC 1010. Walt's talk was on Clearance, Creepage Distance and Test Voltage for Equipment as called for in IEC 664 and 664A. Of particular interest was methods for clearance reduction under conditions where "controlled overvoltage" and "homogeneous field construction" techniques are employed in the equipment. These methods will receive final review for test, measuring, process control and laboratory equipment (IEC 1010 Amendment 1) at the October, 1990 IE C SC66E meeting in Beijing, China.

In April, Bob Wersen of Panel Components Corp. tad us about the new power connector standards and the importance of the using the IEC 320 connectors on exported electrical products. As an active European traveler and importer for the last 20 years, Bob gave his forecast of the changes that will occur with European unity in 1992.

The March meeting featured Debbie Tinsley from UL She explained how UL Is working with CSA and VDE to provide a coordinated testing service for U.S. manufacturers wanting recognition by all three agencies. This should substantially reduce the cost. The discussion with Debbie was very interesting.

Want a trip to Washington, DC? Provide a paper for 1990 IEEE International Symposium on Electromagnetic Compatibility. Contact John Knecht at Underwriters Laboratories 708-272-8800. The Portland Section will have its meeting on Tuesday, June 19, 1990, at 7:30 PM at the Portland General Electric Co. building (14655 SW Old Scholls Ferry Road, Beaverton at the south end of Murray Road).

The featured speaker will be Bob Cogan, a transformer design engineer with MultiComp of Beaverton, Oregon. Prior to MultiComb, Bob was involved with transformer design and development at Western Transformers and for many years at Tektronix, Inc.

Bob's topic will be "Product safety as it relates to transformers". Construction t recognized insulation systems, testing and the certification process are some of the topics Bob will cover in his presentation.

Come and visit with Bob at the no-host dinner at the Cattle Company Restaurant (3800 SW Cedar Hills Blvd., Beaverton) at 5:30 PM. Everyone (including spouses) is welcome to join us. We've had substantial turnouts the last two months but the more the merrier.

This will be the last meeting until September. Have a good Summer.

Please call Art Henderson if you want to be deleted from his mailing list.

Letters to the Editor

[The opinions expressed in these letters are those of the authors only and are presented as *such. We welcome letters of comment but reserve the right to edit them. - Ed.]*

Circuit Breaker Safety article rebuttal:

I have had the opportunity to view the video tapes that Mr. Franklin referred to in his "Product Safety Newsletter" [article]. and I have followed his writings for the past several years. What I see and read is a collection of uncontrolled experiments conducted to prove the author's contention that all residential circuit breakers should have 5 times instantaneous trip levels.

One does not need to have this familiarity with Mr. Franklin's work to spot some of the more obvious flaws. On page 10 of the Newsletter, Mr. Franklin has 100 Amperes flowing through a 14 gauge copper wire for over an hour. I have tried to duplicate this test to no avail. The insulation melts completely off of the wire after about 35 seconds!

Likewise, fires caused by overcurrents are called a myth by Mr. Franklin. There is no data or studies offered to back up this statement, and it is in direct conflict with published reports of actual field studies. I refer the reader to the January / February 1990 "Fire Journal" article titled "What Causes Wiring Fires in Residences".

Finally, there is never any Information presented on the European electrical systems which are cited as having superior circuit protection means. Surely the reader is curious as to the differences in systems voltages, wiring methods, plug protected cord sets, etc. According to the author, ignorance is the answer. "As of this writing, the Europeans are not aware that their 5X circuit breakers prevent arcing short circuit fires so well, because apparently no one there has ever measured the current in household short circuit arcs either."

I know that the author has been challenged before on the above points. It is disappointing to see the same presentation again and again without some effort to clear up the questions which surety must impact the credibility of the work.

William E. May, P.E.

The author's response:

In his letter, Mr. May wants to argue about some minor points, but fails to address the major issue, which is that most present American circuit breakers are not sensitive enough to prevent 20 percent of the fires in this country, in my opinion. Mr. May's immediate supervisor is the chairman of the NEMA task force which for four years has been studying my recommendation that American circuit breakers be changed. His name is John Halferty, and at a meeting at NEMA in Washington D.C. on May 18, 1990, Mr. Halferty stated that all American 15 and 20 ampere circuit breakers will be redesigned to trip magnetically at 150 amperes, +/- 20 percent. I believe this result speaks for itself.

Sincerely,

Frederick F. (Rick) Franklin, P.E.

Technically Speaking questions:

I have a comment on Richard Nute's article on the use of overcurrent protection in plug and socket connected equipment.

Rich states in the beginning of the article that plug and socket connected Class 2 transformers do not comply with IEC 950 clause 2.7.1 because they do not have a fuse in the primary. His entire article is based on this premise. However, then I read clause 2.7.1 I found that it states that the protective device may be part of the building installation. As a matter of fact, the second paragraph of clause 2.7.1 specifically states:

"Where single-phase equipment is to be connected to standard supply outlets, the building installation shall be regarded as providing this protection in accordance with the rating of the wall outlet. ...".

My reason for my writing is not to criticize Rich Nute's article but rather to find out if I may have missed something in my interpretation of clause 2.7. 1.

Best Regards,

Gabriel R. Roy

The author's response:

In my Technically Speaking column in the March-April Newsletter, I implied that IEC 950 and IEC 601-1 require fuses in the product. Mr. Roy points our that IEC 950, Sub-clause

Continued

2.7.1 states that

"... protection devices shall be included either as integral parts of the equipment or as part of the building installation..."

Mr. Roy therefore questions whether IEC 950 requires a fuse in the product.

My point in citing Sub-clause 2.7.1 and 2.7.3 was that IEC 950 requires a fuse — regardless of the site of that fuse.

The direction of this article was to show that, for some kinds of construction, the required fuse — regardless of site — cannot and does not provide the intended protection against overheating.

The column identifies what building fuses protect, what equipment fuses protect, and shows that for some lowpower kinds of equipment, a fuse does not provide any protection — yet the standards require a fuse.

With best regards,

Richard Nute

More Tech/Speak questions:

The article by Rich Nute uses the terms I*I*E and E*I to represent heating losses in a transformer. I don't understand what the difference is. Does one refer to conductor resistance and the other to iron losses (eddy current and hysteresis) in the core? I would think that both could be characterized as an equivalent resistance. Am I missing something or is this just a convenient way to distinguish between loss in a conductor and loss in a component?

I'm pleased I discovered a safety group within IEEE and look forward to looking at the past newsletters.

Sincerely,

Robert O. Diedrichs, P.E., C.S.P.

The author's response:

Dear Mr. Diedrichs:

Roger Volgstadt forwarded your letter to me for response to your technical question regarding the terms I*I*E and E*I to represent heating losses in a transformer.

The paragraph in my article was: "Two kinds of output terminal loading simulate the worst -case transformer overheating. One load is the output short...circuit. This maximizes I*I*E heating within the transformer. The other load is the output maximum power. This maximizes the E*I heating within the transformer."

Looking back into a transformer's output terminals, we can create a Thevenin equivalent circuit of a voltage source with a series resistor. The objective is to load the transformer output terminals such that the power, P, in the Theveriin series resistor is maximized. We don't need to know whether the power dissipation is in conductor resistance or in iron losses.

I agree with your statement that all of the transformer losses" could be characterized as an equivalent resistance." Indeed, the Thevenin equivalent circuit was what I had in mind when I wrote the article.

Interestingly, in considering your comment, I drew the Thevenin equivalent circuit and wrote the power equations for the Thevenin equivalent resistance for both the short-circuit case and the maximum power transfer case. The equations are:

$$P = \frac{E^{**}2}{R}$$ for the short-circuit.

$$p = \frac{(E/2)^{**}2}{R}$$ for the maximum power transfer.

where E is the Thevenin equivalent voltage source, and R is the Thevenin equivalent resistance.

Note that the condition of short-circuit ALWAYS create the worst-case power dissipation in the transformer.

The only reason for not testing with the transformer output short-circuited is when the winding is either protected by a fuse or other overcurrent device, or the winding opens. In these cases, we would want to load the transformer to the point just before such an event occurs. which likely has no relation with maximum power transfer.

Sincerely,

Richard Nute

Even more about Tech/Speak:

Continued

In this issue's Technically Speaking column, Rich Nute claims that the inductance of a branch circuit and power cord is significant and limits the fault current to about 100 amperes. His claim that fault current is in the vicinity of 100 amperes may be correct, but it is not due to circuit inductance.

I have measured the resistance and inductance of several branch circuit components with the following results (the reactance is computed from the measured level of inductance):

[See Table 1 *below. - Ed.]*

It seems from these results that the fault current is limited primarily by resistance rather than by inductance.

In the last issue of the Product Safety Newsletter, the Technically Speaking column states that .Operation of a fuse in the event of an insulation fault to ground necessarily requires the ground return circuit impedance to be about the same as the supply circuit impedance. I n North America, the ground wire and the neutral wire are the same size... This gives reasonable assurance that the ground circuit return impedance is about the same as the supply circuit impedance..

It is clearly the intent of the National Electrical Code that the ground circuit return impedance [should be] about the same as the supply circuit impedance, II but it was not always so, and many installations (both commercial_ and residential) still are in use where the ground impedance may be significantly higher than the supply impedance.

As recently as 1958, a cable assembly did not contain a ground wire but it may have had a very thin layer of lead impregnated into the woven outer covering. When the cable was clamped into a metal autiet box, the box was considered "grounded". Unfortunately, this outer covering did not always remain conductive (it sometimes flaked off in handling and was sometimes attacked by mice - it was, after all, impregnated into natural fiber), nor was it a particularly low impedance. I n either case, the grounding system1s integrity became suspect. Later revisions of the code no longer permitted this type of wiring to serve as the ground system.

Later (ca. 1964), a 12 AWG Type NM cable assembly was commonly built with a 14 A WG ground. The resistance of a 14 A WG wire is 1.6 times the resistance of a 12 AWG wire.

More recently, the NEC has required that the ground wire be sized to match the circuit conductors, if it exists at all. Metal conduits of various types, cable trays, and other forms of grounding enclosures are also accepted as grounding conductors. When properly installed and not subjected to damage, these generally do provide a good low-impedance path, but there has never been a clear specification of what constitutes proper installation, and hence there may be a wide variation of grounding system impedances. Furthermore, the ground wires (when used) are often connected with crimp-on or slip-on connectors (which can loosen over time) whereas the circuit wires are connected with screw-on connectors or solder.

We, as product safety professionals, need to be careful to avoid putting too much faith in the integrity of the building ground system to which our products are connected. There are too many variables of components, installation methods, and aging for us to reasonable expect very low grounding impedances in all installations.

Ray Corson, P. E.

TABLE 1:

Component	Resistance	Inductance	Reactance (60 Hz)
1 00 feet of 12-2 (w/gr) Type NM cable	0.32 ohm (loop)	14 uH	0.053 ohm
2 meter 18-3 power cord	0.15 ohm (loop)	1.6 uH	0.006 ohm
20 A circuit breaker	0.0 ohm	0.2 uH	0.00075 ohm
	0.05 ohm	0.2 uH	0.00075 ohm
	0.22 ohm	0.2 uH	0.00075 ohm

Support/General Comments:

At the recent TUV Rheinland seminar in Boston [Nov., 89], you approached

Continued

me with the suggestion to publish my paper, IEC 950 - Safety of ITE, in the Product Safety Newsletter. I have no objection to this as long as you send me a draft for approval before publication.

If you are interested in the formation of a Toronto area Chapter, let me know, as I am sure this can easily be set up.

I think that you are doing a good job and the newsletter is an interesting forum. In order to avoid misunderstandings, I suggest that, if anyone is quoted, you send them a copy of the article for approval before publication.

Regards,

Dr. Steven Kraemer
TUV Rheinland

Series Combinations of Circuit Breakers and Fuses:

Several technical papers were presented at the IEEE's Industrial Applications Society meeting in San Diego last October that advocate a potentially dangerous practice. I'm referring to, what has come to be called, the Up-Over-and-Down" method of sizing fuse and circuit breaker series combinations.

Series combination of short circuit devices is not something that can be taken lightly. Basically, the engineer is relying on the upstream protective device to limit the energy in a fault to such a level that a lesser rated down-stream protective device can be used. This is usually done for reasons of economy. UL recognizes the seriousness of this application by requiring all such proposed combinations to be short circuit tested and witnessed.

The "Up-Over-and-Down" method, proposed by fuse manufacturers, tells the engineer that through comparing let-through energies that are expected in a down-stream device's operation, the up-stream current limiting fuse can be chosen analytically. This method is detailed in several manufacturers' catalogs and brochures.

The IEEE papers referred to above, and these brochures, are presented to unsuspecting consulting and application engineers who, considering the IEEE framework of the forum in which the papers were presented, or the assumed reputation of the fuse manufacturers, accept what is presented as truth. This can be a potentially dangerous mistake.

Modem Molded Case Circuit Breakers use repulsion contact designs to increase opening speed and thereby increase interruption levels. A simple comparison of these interrupting levels available 15 years ago, to what the present day products are capable of doing, will prove the point. Today' s MCCB's are dynamic short circuit interrupting mechanisms. Interruption times as low as 2 - 4 milliseconds are common, and the let-through energies are reduced accordingly. It is these characteristics which must be taken into account when proposing a series combination with another MCCB or a fuse.

Consulting Engineers cannot be expected to be expert in the design, or even the testing, that goes into these products. In fact, even the engineers involved in the actual design are hard pressed to accurately predict the performance of an untested product. That is why UL insists on controlled, witnessed testing on the discrete devices, and especially on series combinations of these devices. This testing must be successfully done before the devices can be labeled or listed.

Up to this point, this letter should have no more credibility than the questioned papers or brochures. However, we have taken the only step that should matter. We have been testing these combinations. Successfully tested combinations are submitted to UL and are listed in the Yellow Book.

Using one fuse manufacturer's step by step application guidelines, several unlisted fuse-breaker combinations were selected which, according to the fuse manufacturer's application literature, should have been vallexx. These combinations were applied on a three phase, 65 KA, 480 V short circuit. All failed. In fact, the same three fuses were used on four different tests without ever melting. In all cases the Molded Case Circuit Breakers interrupted the current even though it was significantly above their published ratings.

Continued on Page 17

Institutional Listings

The Product Safety Techincal Committee of the IEEE EMC Society is grateful for me assistance given by the firms listed below and invites applications for Institutional Listings from other firms interested in the product safety field.

An Institutional Listing recognizes contributions to support the publication of the Product Safety Newsletter of the IEEE EMC Society Product Safety Technical Committee. Minimum rates are $100.00 for listing in one issue or $400.00 for six consecutive issues. Inquiries, or contributions made payable to the Product Safety Technical Committee of the IEEE EMC Society and instructions on how you would like your Institutional Listing to appear, should be sent to:

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Calendar

The Product Safety Technical Committee of the IEEE EMC Society

Chicago Activities

There are no meetings planned for the Chicago product safety group until September.
Contact: John Allen
(708) 827-7520

Los Angeles Activities

Monday, July 9, 1990
Subject Technical Services for Exporters
Speaker: Allen Knight, CSA
Time: 6:30 pm
Location: Harman Electronics
8500 Balboa Blvd.
Northridge, CA
Contact: Rolf Burckhardt
(818) 368-2786

Monday, August 6, 1990
Subject Quality -ISO 9000
Speaker: Rich Lee, UL
Time: 6:30 pm
Location: Harman Electronics
8500 Balboa Blvd.
Northridge, CA
Contact: Rolf Burckhardt
(818) 368-2786

Portland Activities

There are no meetings planned for the Portland product safety group until September.
Contact: Art Henderson
(503) 635-8445

Seattle Activities

There are no meetings planned for the Seattle product safety group until September.
Contact: Art Henderson
(503) 635-8445

Northeastern Activities

Wednesday, July 25, 1990
Subject: To be determined
Speaker: To be determined
Time: 7:00 pm
Location: Sheraton
Routes 111 and 495
Boxborough, Mass.
Contact: Bill Van Achen
(508) 263-2662

Wednesday, August 22, 1990
Subject: To be determined
Speaker: To be determined
Time: 7:00 pm
Location: Sheraton
Routes 111 and 495
Boxborough, Mass.
Contact: Bill Von Achen
(508) 263-2662

Wednesday, September 26, 1990
Subject: To be determined
Speaker: To be determined
Time: 7:00 pm
Location: Sheraton
Routes 111 and 495
Boxborough, Mass.
Contact: Bill Van Achen
(508) 263-2662

Santa Clara Valley Activities

Tuesday, July 24, 1990
Subject: How to Handle UL Projects More Efficiently
Speaker: UL Santa Clara Staff
Time: 7:00 pm

Continued

Institutional listings

Continued

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This could be your business card!
See page 25 for details.

Calendar

Continued

Location: Apple Computer
20705 Valley Green Drive
Cupertino, CA
Contact: Hugh Hagel
(415) 962-9400 x619

There are no other meetings planned for the Santa Clara Valley product safety group until September.

Orange County/Southern California Chapter

Tuesday, July 10, 1990
Subject: Technical Services for Exporters
Speaker: Allen Knight, CSA
Time: 6:00 pm
Location: MAI Basic Four
14101 Myford Rd.
Tustin, CA
Contact: Paul Herrick
(714) 770-1223

Tuesday, August 7, 1990
Subject: ISO 9000 (not finalized)
Speaker: Rich Lee, UL
Time: 6:00 pm
Location: MAI Basic Four
14101 Myford Rd.
Tustin, CA
Contact: Paul Herrick
(714) 770-1223

Tuesday, September 11, 1990
Subject: Med GV & IEC 601 - Medical
Speaker: Mr. Konrad Kobel, TUV America,
Time: 6:00 pm
Location: MAI Basic Four
14101 Myford Rd.
Tustin, CA
Contact: Paul Herrick
(714) 770-1223

Tuesday, October 2, 1990
Subject: Summary of September CBEMA Meeting
Speaker: Charlie Bayhi
Time: 6:00 pm
Location: MAI Basic Four
14101 Myford Rd.
Tustin, CA
Contact: Paul Herrick
(714) 770-1223

PSN READERS -

We need your help to make this newsletter complete! The items in "News and Notes", the articles in PS Abstracts", the events in the "Calendar", and the letters in "Letters to the Editor", must come from you. The better the input the better the output. So, the next time you find an article, news item, or conference with an aspect relating to product safety, tell us about it. Then we can pass it along to our colleagues through the pages of the Product Safety Newsletter. Thanks for your help!

The Product Safety Newsletter

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[if you want your address deleted from the directory, please contact us.]

BACK ISSUES

The Product Safety Newletter's first issue, Vol. 1, No.1, was ten pages published in Feb. 1988. We now have available two years (1988 and 1989) *of* past PS Newsletters, with an article index, for those who missed them. To order a set, please send a check for $20.00 payable to the Product Safety Technical Committee to the add ress given above for the PS Newsletter.