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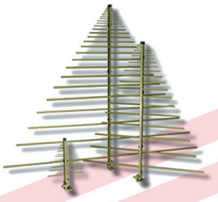

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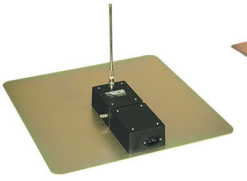

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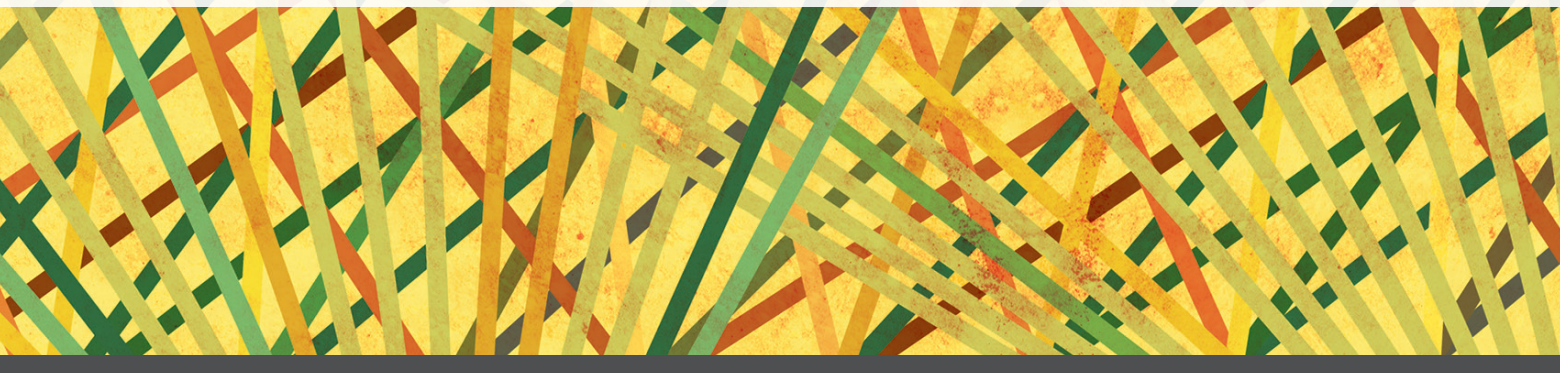

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The ESD Association

News in Compliance

FCC News

FCC Proposes Rules to Foster Text-to-911 Services

Recognizing the widespread use of texting as a primary means of communication, the U.S. Federal Communications Commission (FCC) has called on texting service providers to accelerate the deployment of text-to-911 services.

In a Policy Statement and Notice of Proposed Rulemaking issued In January 2014, the Commission noted that four of the nation's largest wireless carriers have already committed to provide text-to-911 services by May 2014 to those call centers that are technically capable of receiving text messages. The Commission called on all remaining wireless providers and interconnected text providers to work with the public safety community to promptly implement text-to-911 services in order to provide uniform access to 911 services across the country.

According to Commission data, 91 percent of American adults own a cellphone, and 81 percent of cellphone owners use text messaging, making text-to-911 services essential for both public safety authorities and citizens.

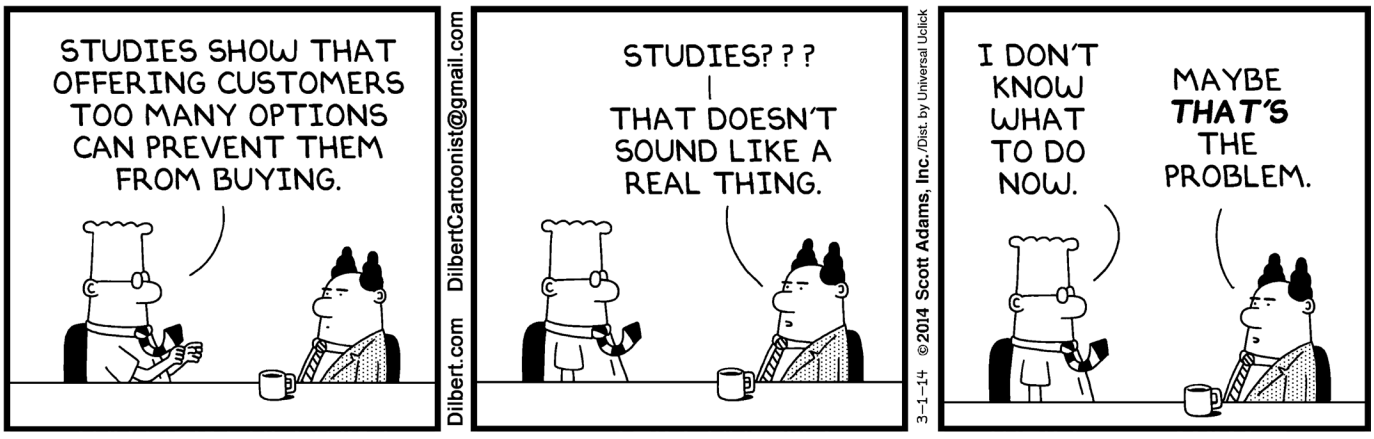
The Commission's Policy Statement and Further Notice of Proposed Rulemaking on text-to-911 service is available at incompliancemag.com/news/1404_01.

FCC Acts to Help Emergency Responders Locate Wireless 911 Calls

The U.S. Federal Communications Commission (FCC) has taken steps to increase the indoor location accuracy of systems used by public safety officials to locate the source of 911 calls made from wireless phones.

In a Third Further Notice of Proposed Rulemaking issued in February 2014, the Commission notes that consumers are rapidly replacing landline phones with wireless phones for use indoors. As evidence, the Commission notes that nearly 73 percent of 911 calls placed in California are made from wireless phones, and that approximately 80 percent of all smartphone use occurs indoors. Hence, the need for increased accuracy in locating emergency calls made from wireless phones indoors.

The Commission has proposed interim indoor location accuracy metrics to be adopted by wireless providers, and has also proposed that wireless providers deliver vertical information location to enable first responders to identify the floor level for emergency calls originating in multi-story buildings. Over time, the Commission says that it would also like to implement highly specific indoor location accuracy standards that would enable first responders to identify room-specific source information for wireless 911 emergency calls.



FCC News

The complete text of the Commission's Third Further Notice of Proposed Rulemaking is available at incompliancemag.com/news/1404_02.

FCC Speed Test App for iPhone

The U.S. Federal Communications Commission (FCC) has announced the release of a new iPhone app designed to help the Commission collect data on mobile broadband access speeds.

The new iPhone app allows users to test their cellular and Wi-Fi network performance, including upload and download speeds, latency and packet loss. However, the Commission says that no personal or uniquely identifiable information is collected. A similar app for Android smartphones was unveiled by the Commission in November 2013.

The smartphone apps are part of the Commission's Measuring Broadband America program, a private-public partnership developed to improve the broadband service marketplace. According to the Commission, testing data supplied by the apps will provide important and valuable information on the deployment of broadband networks throughout the U.S.

The FCC's Speed Test App for the iPhone is available at incompliancemag.com/news/1404_03. The Commission's Speed Test App for Android phones is available at incompliancemag.com/news/1404_04.

News in Compliance

CPSC News

Visonic Recalls Personal Emergency Response Kits

Visonic Ltd. of Westford, MA has announced the recall of about 1700 of its Amber SelectX-brand personal emergency response system kits manufactured in Israel.

According to the company, the base station can fail to operate or detect an emergency signal from the personal pendant following a system reboot or reset. The company has not received any reports of incidents or injuries related to the recalled kits, but has initiated the recall to prevent future such incidents.

The recalled personal emergency response kits were sold through Visonic distributors and professional alarm installation firms nationwide from April 2012 to April 2013 for between $220 and $240 each.

Additional information about this recall is available at incompliancemag.com/news/1404_05.

Visonic previously recalled about 24,000 of the Amber personal emergency response system kits in September 2013 in connection with their failure to detect a low or dead battery in remote pendants. The company received one report of a pendant failure related to those kits, but no reports of injuries.

Dehumidifier Recall Expanded

Gree Electrical Appliances of China has expanded its September 2013 recall of more than 2 million dehumidifiers to include an additional 350,000 GE-brand dehumidifiers sold in the U.S. and Canada

The company says that the dehumidifiers can overheat, smoke and catch fire, posing fire and burn hazards to consumers. Gree says that is has received reports of 16 separate incidents related to the recalled GE dehumidifier units, including 5 reports of fires and about $430,000 in property damage.

This is in addition to the more than 71 fires and $2.75 million in property damage associated with previously recalled Gree-manufactured dehumidifiers. There have been no reports of injuries.

The recalled dehumidifiers were sold through Sam's Club, Walmart and other stores nationwide, and through Amazon.com and eBay.com, from April 2008 through December 2011 for between $180 and $270.

A complete list of the specific GE-brand dehumidifier models affected by this recall is available at incompliancemag.com/news/1404_06.

LED Flashlights Recalled

Lucent Ace Manufacturing, located in City of Industry, CA, has recalled about 3000 of its LED flashlights manufactured in China.

The company reports that the battery powering the flashlight can short, causing the flashlight to rupture and posing a burn hazard to consumers. Lucent Ace has received one report of a flashlight canister rupturing in a consumer's hand, but no reports of injuries.

The recalled LED flashlights were sold exclusively at Academy Sports + Outdoor stores nationwide from October 2013 through November 2013 for about $3.

Additional details regarding this recall are available at incompliancemag.com/news/1404_07.

Recalls have been issued for Amber SelectX-brand personal emergency response kits and Lucent Ace Manufacturing's LED flashlights. Also, the September 2013 recall of GE-brand dehumidifiers has been expanded to include an additional 350,000 units, sold in stores nationwide and online.

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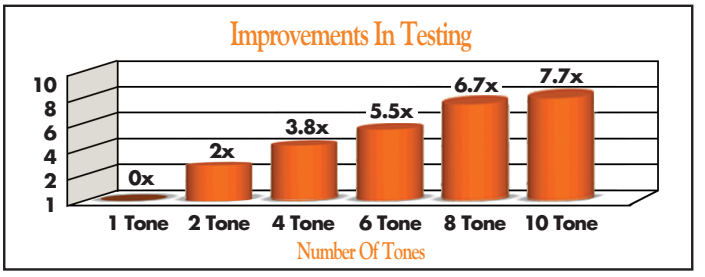

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News in Compliance

European Union News

EU Sets Eco-Design Requirements for Ovens, Ranges and Range Hoods

The Commission of the European Union (EU) has issued a Regulation implementing new eco-design and energy efficiency requirements for domestic cooking ovens, cooking ranges ("hobs") and range hoods.

The Regulation, which was published in January 2014 in the *Official Journal of the European Union*, is considered an implementation measure under the EU's Eco-Design Directive, 2009/125/EC. That directive gives the Commission the authority to establish minimum efficiency standards for those "energy-related products representing significant volume of sales and trade, having significant environmental impact and presenting significant potential for improvement in terms of their environmental impact without entailing excessive costs."

The new eco-design and energy efficiency requirements for ovens, ranges and range hoods come into effect beginning in January 2015, and are detailed in Annex I of the Regulation. Annex II of the Regulation defines the methods for the measurement and calculation of energy efficiency, while Annex III details the procedures to be used by authorities in EU member states for verifying compliance with the Regulation's requirements.

The complete text of the Commission's Regulation regarding the eco-design and energy efficiency of domestic ovens, ranges and range hoods is available at incompliancemag.com/news/1404_08.

EU Commission Publishes Revised Energy Labeling for Ovens, Ranges and Range Hoods

Continuing efforts originally begun in November 2010, the Commission of the European Union (EU) has issued new regulations regarding the requirements for the energy labeling of domestic cooking ovens, cooking ranges ("hobs") and range hoods.

The revised energy labeling requirements for ovens, ranges and range hoods were published in January 2014 in the *Official Journal of the European Union*, and complement the eco-design requirements supplement the

You Can't Make This Stuff Up

Cancer Cures from Smartphones?

Players of a new smartphone game may provide scientists with important information on genetic indicators for cancer.

The new game, "Play to Cure: Genes in Space," has been created by the charity organization Cancer Research UK (CRUK) with the hope of identifying which genes are faulty in cancer patients. The game requires players to guide a spaceship through a hazardous intergalactic course. The patterns established by players actually provide an analysis of various patterns in genetic data, enabling scientists to more quickly zero in on those genes that may be faulty in cancer patients, and potentially speeding the development of drugs to target specific genetic defects.

According to Professor Carlos Caldas of CRUK, scientists generally use computers to assess huge amounts of data, but that computer processing is often not accurate enough. "Computers are very good, but they're not perfect," Caldas told Reuters News Service. "The human eye is still the best technology we have for picking up these patterns."

CRUK used a similar approach for assessing data in 2013 with a smartphone game called CellSlider. Using that game, researchers were reportedly able to reduce the time need for analyzing breast cancer samples from 18 months to just three.

labeling requirements previously published in Directive 2010/30/EC.

Energy labeling requirements for a variety of home appliances and electronic devices have been promulgated by the Commission in an effort to increase consumer knowledge about the actual energy consumption of comparable household appliances, thereby creating incentives for manufacturers to improve the energy efficiency of their respective products. In recent years, the Commission has issued revised energy labeling requirements for refrigerators, dishwashers, washing machines, television, air conditioners and vacuum cleaners.

The Commission's revised energy labeling requirements for ovens, ranges and range hoods is available at incompliancemag.com/news/1404_09.

EU Commission Releases Updated Standards List for EMC Directive

The Commission of the European Union (EU) has published an updated list of standards that can be used to demonstrate conformity with the essential requirements of the EU's directive on electromagnetic compatibility (also known as the EMC Directive, 2004/108/EC).

The EMC Directive applies to "any apparatus or fixed installation," and regulates the "ability of equipment to function satisfactorily… without introducing intolerable electromagnetic disturbances to other equipment."

The provisions of the EMC Directive do not apply to telecommunications terminal equipment, which are covered under the essential requirements of Directive 1999/5/EC (also known as the R&TTE Directive).

The updated list of CEN, CENELEC and ETSI standards that can be used to demonstrate compliance with the EMC Directive was published in February 2014 in the *Official Journal of the European Union*, and replaces all previously published standards list for the Directive.

The complete list of standards can be viewed at incompliancemag.com/news/1404_10.

REALITY Engineering

A Wreck of a Story

BY MIKE VIOLETTE

When I was a kid and found out that my dad was an 'engineer,' the vision of him driving a train popped into my head for the word engineer *was firmly associated with the word* locomotive*. It was a few years until that image became disassociated as I learned the reality that engineers do all kinds of things entirely unrelated to trains. But the connection between engineers and trains never completely went away. This month's Reality Engineering explores a train incident due to a failure of judgment—and one man's ultimate sacrifice.*

The development of steam-powered locomotives grew rapidly in the early and mid 1800s. By the turn of the twentieth century, these machines, fired by wood, oil or coal, were used to transport goods and people across the globe. Often, the technology, materials, design and construction were pressed beyond their limits. As a result, steam-engine explosions were not rare—and were often violent.

Locomotives were also used for back-woods work in the clearing of mighty forests, where we join two loggers whose fates are cast by the catastrophic failure.

[North of Waterville, ME. Fall, 1899] The day's duty was to clear slash from the previous weeks' cutting and make clear the way to begin hand-skidding felled trunks from the edge of a steep incline down to the river. This meant moving the smaller trees and brush and laying them so the logs could be moved to the main road. It was dirty and difficult work. The skidding team used a combination of horses and steam-powered donkey engines to pull the logs out and collect them onto the skid tracks that led down to the water's edge, where the logs were floated out and to the mill, fifteen miles downstream in Waterville.

The locomotives were loaded by workers known as *wood hicks*, wielding *peavey* poles, or cant hooks which were lever tools with a pivoting, hooked arm and metal spike used to gig the log and, using the leverage at the end of the long handle, roll the logs onto the flat bed of the locomotive. The trains themselves weighed 30 tons, driven by split wood fed into the firebox of the train. The most popular type of train were the Shay-geared locomotives that were developed for use in the logging camps. The loads were large and the track hastily constructed, and often uneven and bent. The Shays powered all the wheels of the large engine via a central shaft and gear distribution to the locomotive trucks, greatly increasing the traction of the rig over the rudely built tracks.

The Shays were slow but strong and could pull some of the largest loads up steep grades while not pounding the track to pieces, unlike other locomotives of the time. The machines were hardy, but the harsh conditions in the winter made maintenance difficult and camp bosses, attuned to the costs of idle labor and lost opportunity of blue-sky days, pushed the men and equipment past their physical and mechanical limits.

Steam locomotives were built of thick steel in a bottle-shape with a firebox—lined with firebrick—on one end of the bottle. The plate above the firebox that separated the fire from the boiling water—called the *crownsheet*—was one-half of an inch thick. The job of the fireman was to maintain the fire to keep the steam pressure available for the cylinders, which, in the Shay, consisted of a triad of push-pull cylinders, the steam sent alternately to the top and bottom of the cylinder, providing motive force at each half-cycle of the piston travel. Maintaining the level of water in the boiler was critical, for if the crownsheet were uncovered, the steam would become super-heated and the crown would fail, with catastrophic results. This most often happened as locomotives crested hills under full power. If the water level was not carefully monitored and was allowed to drop too low, the water would flow away from the crown. Thus, the driver was constantly monitoring the level of water in the boiler through a sight glass in the cabin.

Maurice and Dragos, fellow loggers with an unexpected connection, were walking along the track to the higher reaches of the logging operation. The day was nearly done and this was the last tract to clear before the mid-winter sun disappeared behind the blue mountains.

"Maurice, Maurice!" Dragos cocked his head and looked at his friend who had a vacant, far-off look. "What are you thinking about?"

Maurice, shaken from a temporary reverie, replied, "Uh, yes. It is nothing. I was just wondering" He trailed off, trying to compose himself, and then asked "Dragos, what brought you East?" Maurice didn't expect the answer.

"I am, or was, looking for someone." Dragos replied.

"Who?" He said distractedly, trying to focus on his friend, who had something important to say.

"My mother." He looked at Maurice expectantly. "Her name was Thérèse. Thérèse Ouvrier."

The train groaned by, moving up the tracks. Maurice said something, but Dragos could not hear it for the noise of the Shay. Steam was spitting from the pistons as the train passed by, pulling uphill to the left of the pair of men. The driver was leaning out the window, watching the progress of the train on the newly-laid track, his left arm on the throttle, goosing the engine slowly up the incline.

"What did you say?" Dragos yelled over the noise. He had heard, but couldn't quite fathom the possibility.

Maurice looked at his cousin's face. A great many questions were answered and the next chapter scribbled itself out across the pages of the journal, not in his hand, but in his mind's eye he saw it.

Suddenly, the train lurched hard to the left and there was a great sound of cracking timber. The driver yelled above the noise of the steam and the sound of the train breaking through the un-shored portion of the track and hit

REALITY Engineering

the brakes, simultaneously pulling the reversing linkage hard, grunting. The wheels stopped and then spun quickly backwards, but the momentum of the huge machine was too great, its perch too precipitous. The train continued to pitch forward and to the left, the bulk of the weight of the behemoth over the left wheels of the train truck. The driver pushed the throttle fully forward and the pistons roared, churning furiously, the wheels spinning backwards now at full speed, but to no effect save to chew through the rails, the wheels turning motion to friction to heat and heat turning wood to smoke and flame.

Chunks of wood flew forward of the train as the wheels rotated backwards, a big limb clanged hard into the connecting linkage, bending the rod and pulling the rotation of the steel wheel out-of-round, the left wheels of the train deformed the track and the train lurched hard, once, then again, pitching the driver from the controls, which were set at full throttle, full reverse. He fell against the fireman, who was struggling to shut down the air inlets when the train tipped, knowing that they didn't have much time before part of the machinery would fail due to heat and the battling mechanical forces.

The engine now screamed above the roar, metal grinding at great speeds making a screeching, hideous howl, rinds of steel peeling off from the thin guards, ripped away and caught in the rotating wheels as the machine tore itself apart. Smoke poured out of the stack, adding to the confused scene: shouting men and failing machinery and wood and smoke and steam mixing with the yells of the men and rending of metal.

Maurice realized his oversight and failure to get the track repaired. He ran to the front of the train, bent down to look and confirmed his suspicion: the supports had splintered and the rail sagged under the weight of the locomotive. He cursed and looked back as Dragos sprinted to the engine as the wheels slowed, steam still belching through the valves. Steam and grease sprayed onto the ladder to the cab, the heat igniting hot oil and fire began creeping up the rungs. The bowels of the engine groaned and three low-pressure steam lines popped free from their fittings, hissing and spitting.

Inside the firebox, fully stoked and now agitated to a greater heat by the motion, the coals flared red and blue; wood and smoke and fire roared. The tender had not been refilled, at Finn's urging, because the trek to the nearest water would have taken 30 minutes to complete. What was worse, he urged the crew to get underway and started the day off with little more than half the water in the boiler. As the train rolled front and listed to the left, the water ran away from the highest part of the crownsheet, the half-inch thick steel that separated the boiler water from the fire.

The now-dry crown began to soften, stoked to above melting point by the intensity of the fire in the chamber, now a blast furnace. The driver scrambled to his feet and watched in horror as the water dipped below the sight glass. The easiest way out of the doomed locomotive was down, but the exit on the left of the cab was blocked by a large tree that the engine lay into. The wheels spun to a stop as the water, concentrated on the left, cooler side of the boiler, gave off less steam to the pistons. He scrambled up the inclined floor, slipping and grabbed the railing on the door.

He yelled at the fireman. "Get out! We've got to get out of here!" The fireman clawed his way forward, holding onto the driver. The driver saw Dragos, now up on the ledge of the engine, furiously working the door latch. "Help me!" cried the driver, who was hanging on the hand rail, holding the door shut against Dragos' mighty pull. Dragos recognized the two men as the one who had taunted him that morning and paused, just for a moment, to let the recognition be shared. "Help me, please."

The man now was desperate and Dragos yelled: "Let go of the door!"

The driver realized he was holding the door closed and moved his grip, grabbed the brake handle and wedged his foot against the handbrake and the floor.

As he gained his footing, the fireman came to eye level with the sight-glass. It was broken—exploded from the inside. Steam shot out the empty frame of the tube and he realized that the fire was undoing the steel holding back the roiling steam, now pressurized to hundreds of pounds per square inch. The crownsheet was stabilized by an array of stays, arrayed along in rows from the top of the boiler, linking the top and bottom together. If the crown were to buckle and fail, the stays would be pulled past their limit and the fasteners holding them in place would pop, leading to a catastrophic explosion.

Dragos pulled the door open and flipped it around, grabbed the driver and hoisted him free. The fireman scrambled up, fairly pulling his rescuer down into the cab as he climbed up and out. The heat bloomed in the space and the bolted end of the boiler was starting to leak steam. Dragos still had his harness clipped around his waist and as the firemen scrambled out, he pulled Dragos off-balance and half-way into the cab and a loop of his harness caught on a hissing valve. Dragos tried to pull himself out, but the valve was over his head and he could not reach it as he desperately tried to twist free. In his writhing to wrench himself away, his head struck the edge of the door and he was temporarily dazed.

Maurice jumped up on the ledge of the cab, slipping on the oily surface. He grabbed the edge of the opening of the cab and leaned inside. The valve that had hooked Dragos had started to turn and steam leaked furiously from the sealing nut. Maurice grabbed the rope, the skin on his hands burning and turning instantly to scarlet, but still he managed to pull Dragos free. With his uninjured hand, Maurice pulled his friend out and lowered him to the ground, who rolled against the truck of the train.

As Maurice leaned half-inside the cab and looked to see if there was anyone left in the smoky fogged murk, the crown, at the highest point tortured the longest by the intense heat, ballooned into the firebox, a bubble of steel. The retaining stays lengthened and as the crown stretched the rivets pulled through the holes in the sheet, now as soft as cheese. The thickness of the steel thinned to a mere eighth-of-an-inch. With a roar, the bubble burst and the boiler erupted. Superheated water dumped into the fire and steam at 200 thunderous pounds-per-square-inch blew into the firebox, blowing away the door. A shock of steam and smoke shook the cabin and split the roof of the locomotive. Shrapnel showered the woods and the men running for their lives.

Maurice was vividly aware of what would happen next. As the blast hit, he covered his face and braced. But the explosion was powerful and he was slammed against the back of the cab, his head jerked and smashed against a handrail. He felt nothing more. The heat and fire and smoke sizzled and hungrily devoured his clothing, skin and sinew.

He crumpled onto the floor of the cab, consumed. IN

Excerpted from The Bearers
by Michael Violette

(the author)

MIKE VIOLETTE, P.E. is founder of Washington Labs and American Certification Body.

He can be reached at mikev@wll.com

TECHNICALLY Speaking

"Energy Hazard"

A History and Analysis

Product Safety Newsletter - July 1988

BY RICHARD NUTE

Dear Readers,
Over the past couple of years many of you have requested that we include more product safety related information in our issues. Of particular interest has been Rich Nute's series of "Technically Speaking" articles. And so… Mr. Nute has graciously agreed to work with us to bring you that series! Look for his column each month. We hope you enjoy the addition of "Technically Speaking" to the pages of In Compliance*.*

Bob Lundin, through Al Brazauski, was able to find the origins of the so-called "energy" hazard in UL 478. Here is a review of the origins.

HISTORY

The material dates back to a manufacturer's (identity withheld) Corporate Standard for Product Safety, dated February 1962. Within this standard is a section titled "Effects of Electrical Current on the Human Body." Within this section, the following appears:

> "Burn Hazards. Circuits with sufficient energy to cause arcing when short-circuited can be a potential burn hazard or a source of ignition. High energy discharges can cause an intense arc with erosion and splattering of the metal at the point of contact.
>
> "The amount of energy required to create a hazard of this type is a function of the type of metal, its shape, its heat sink mass, and the way contact is made. Since so many factors are involved, it is not practical to establish a specific energy level that defines this level. However, any circuit capable of supplying 240 volt-amperes without operating overcurrent devices should be considered a potential burn hazard."

In the "Electrical Design" section of the standard, we find:

> "Customer access areas must not have exposed... potentials below 30 volts that can supply more than 240 volt-amperes."

Without addressing the documents dated 1962 until 1966, we finally find the following UL 478 meeting report dated October 14, 1966:

> "Burn Hazard -Where high current is available at potentials down to about 2 volts, enough energy is present to melt and splatter metal from neck chains, eye-glass frames, watchbands, bracelets, rings, and other personal metal objects unintentionally put across hot bus or between such a bus and ground by operators or servicemen, thereby giving rise to severe burn hazard. One of the industry representatives reported that his company reduces this hazard by limiting the apparent power

available to 240 volt-amperes and the available energy to 10 joules."

Elsewhere in the same document, we find:

"Energy Hazard - An energy hazard is considered to exist at any exposed live part of a piece of equipment if, between the exposed live part and an adjacent exposed live or dead metal part of different polarity, there exists a potential of 2 volts or more and either an available continuous power level of 240 volt-amperes (or more) or a reactive energy level of 10 joules (or more)."

QUESTIONS

There are several questions here:

1. Why was the title of the requirement changed from "burn" to "energy"?
2. What part does energy play in splattering of molten metal?
3. By what mechanism do limitations on volt-amperes and volts prevent the splattering of molten metal?
4. Energy is measured in joules; why is the parameter "apparent power", measured in volt-amperes, used?
5. Molten metal results from heat. Heat arises from the dissipation of watts. Why is the parameter volt-amperes used?
6. If the criterion is the product of volts and amperes, then why is there a minimum of 2 volts?

HYPOTHESES

I thought that I would verify the theses on which the "energy hazard" is based:

At potentials between 2 volts and 30 volts rms, volt-ampere levels greater than 240 can cause metals to splatter.

If this statement is true, I ought to be able to produce splattering of metal and consequent burns at something more than 240 volt-amperes at all potentials between 2 and 30 volts rms. In other words, I ought to be able to confirm the thesis that "high energy discharges can cause an intense arc with erosion and splattering of the metal at the point of contact."

In order to melt anything, we've gotta have heat. Electrically-caused heat comes from dissipation of power. A zero-impedance short-circuit cannot dissipate any power in the short. So, the only way of getting power dissipation is in the arc. In this case, power is defined as the product of volts and amps in the arc.

EXPERIMENTS

So, I got out my trusty 200 watt, 10 Ampere power supply, connected a 7200 μF, 75 volt capacitor across the output (to get instantaneous volt-amperes greater than 240), connected a storage scope with DC-to-50 mHz current probe in series, and voltage probe across a couple of tinned copper wires. I wanted to measure the voltage and current during the time of arcing between the two copper wires as they were shorted together. With these two parameters, I can calculate power in watts.

Somewhere in the literature, I have read that air does not break down at less than about 300 volts peak. This

TECHNICALLY Speaking

hypothesis is supported by Table AII of IEC Publication 664. I'm sure this is difficult to measure as the distances involved are in the neighborhood of 0.01 millimeter! That's 0.0002 inch!

So, I started with 2 volts. By golly, there was a very small arc. Pretty tiny, but it was there. And the current was a whopping 25 amps! (I tried the same experiment without the capacitor, and found the same arc, but the current was only about 12 to 15 amps.) So, we have two arcs at 2 volts, one at 12 to 15 amps, and the other at 25 amps. This does not square with either the breakdown voltage of air, nor with the current-carrying capacity of air. And, the arcing occurred in the first 1 millisecond of bringing the conductors together. Very short time.

I checked at 5, 10, 15, 20, 25, 30, 35, and 40 volts. The arc was brighter with every increase in voltage. The current went up to a whopping 40 to 60 amps! The time for things to settle down to steady state increased from less than 1 millisecond to about 20 milliseconds. The erosion of metal also increased with increased voltage.

I repeated the tests without the capacitor. About the same results, except the arc was noticeably less bright. The current was about 1/3 of that with the capacitor.

I put my finger and the back of my hand next to the arc. It was obvious that some material was being emitted from the shorting process. I could feel something blowing on my finger, but I could not feel anything on the back of my hand. There was no sensation of heat or burning, even with my finger in the flame of the arc.

I was holding the wire during the arc, about 1/4 inch from the end. Shortly after a 25 volt or greater arc, say 1 to 5 seconds, I could feel the wire get hot. And then it immediately cooled. But, if I left it shorted, it did not get hot.

The wires tended to stick together, indicating some degree of melting and "welding" of the wires. A close inspection of the wires readily proved melting of the metals.

I repeated the short using a gold chain necklace. About the same results insofar as the arc, except there were two arcs, one at each of the two places where the chain made contact with the wires. But, between the two points of contact, the chain became uncomfortably hot.

ANALYSIS

Okay. Those are the facts from the experimentation. Now, let's develop some hypotheses - explanations - that fit the facts.

Some of the facts strongly suggest a virtual short circuit, where the current was limited only by the impedance and charge of the source.

If the voltage is virtually zero, then power, if E x I, must be virtually zero. But, this is not the case because the conductors tend to stick together after shorting. If they stick together then the metal must be melting (which is confirmed by the marks left on each wire). If the metal is melting, then it must be heated by the electrical energy. If the voltage is virtually zero, then power must be dissipated by the I x I x R version of the power of the equation rather than the E x I version. But, the brighter arc as a function of voltage indicates that the arc is indeed E x I.

The oscilloscope display is difficult to interpret. We see both short-circuit and variable E and I displays in a 1 to 10 millisecond window with duration increasing with voltage. Thereafter, we have a stable short-circuit.

About the only hypothesis that fits all the facts is that BOTH kinds of power dissipation are occurring, E x I and I x I x R. And, it is not air that is the conducting medium, but metal.

Consider the following hypothesis:

At the instant of contact, we have a metal-to-metal contact of very small cross-sectional area. Because of the very small cross-sectional area, there is high contact resistance, and we have I x I x R power dissipation. This heating causes the metal in the region of the high current to melt. The electromotive force of the high current causes the small amount of molten material to move away from the point of contact. As the metal moves away, an arc occurs; characterized by E x I power dissipation. Because the electrodes are moving, both by external forces (my hand) and by electromotive forces, the process tends to repeat until a large contact area is achieved.

Such a hypothesis explains all the reported facts:

The increase in brightness of the arc with both current and voltage; the heating of the wire in the vicinity of the arc; the sensation of emitted material, the arcing at less than 300 volts, the melting and erosion of the metal on the electrodes.

Without further investigation and experimentation, this hypothesis explains the reported facts, but does not confirm a hazard, burns from splattered metal, severe enough to warrant a 240 watt (not volt-ampere) limit. It is difficult to convert the electrical energy to sufficient thermal energy to actually cause burns with the very small amount of molten metal produced and with the very small distance the metal travels.

The 2 volt limit seems appropriate, as the E x I power at 2 volts barely results in an arc.

Interestingly, there is a more severe hazard which shows up in this experimentation, but is not controlled by this requirement or any other requirement: I x I x R heating in the necklace chain (and in a ring or watchband). This heating occurs quite quickly, and can cause burns at currents as low as 6 to 8 amperes. This is because of the square function of I in the power equation.

ENERGY

Energy can be defined as a watt-second and is measured in joules. Energy, in mechanics, is defined as a newton-meter, and is also measured in joules.

With the first definition, how can "energy" be hazardous? That is, what is the harm or injury that arises from energy?

If we take 1 watt-second (which is a joule) and dissipate it over several seconds, then we have a small amount of heating. If we take that same watt-second and dissipate it in a millisecond, then we will have a small explosion (assuming we dissipate it at a single point in space).

Thus, whether or not electrical energy is hazardous depends on the time period during which the energy is expended. Note that this is true for mechanical energy.

The energy involved in my experiments can be calculated:

J = W x t

J = E x I x t

For the worst-case arc, I had the following:

E = 40 V

I = 60 A

t = 20 mS

J = 40 x 60 x 0.020 joules

J = 48 joules

If we store electrical energy in a capacitor, and if we assume that the energy will be dissipated in a short-circuit, and that the hazard is that of burns which will arise from the splattering of molten metal, then we can specify a maximum energy (in joules) AND VOLTAGE to produce an acceptable level of splattered molten metal. Remember that we must have a voltage exceeding 2 volts to produce any significant arc.

The energy stored in a capacitor is

J = 1/2 x C x V x V

For the capacitor I used,

C = 7500 uF

V = 40

J = 1/2 x 0.0075 x 40 x 40 joules

J = 5.76 joules

CONCLUSIONS

First, the term "energy hazard" is a misnomer. We are dealing with a burn hazard arising from molten material expelled from an arc. Contrast the inconsistent use of the term "energy hazard" with the use of the terms "shock hazard" and "fire hazard".

Second, volt-amperes is not a measure of either power or energy as stated and implied in the various standards. I deplore the fact that graduate and experienced engineers continue to promulgate this requirement with such obvious misstatements.

Third, while energy is involved in the splattering of molten metal, the principal parameter is that of power, namely joules per second. Consider that the energy stored in a capacitor can only be released as a function of time, the worst case being a short-circuit. The power dissipated in the arc causes the splattering of metal and any consequent burns. For a capacitor, it may be convenient to specify joules, but for continuously energized circuit, the proper parameter is power.

Fourth, the 240 watt limit appears very conservative.

Fifth, every safety requirement should be verifiable as to its effectiveness in controlling a situation to a non-hazardous level. I would challenge you to repeat this experiment and convince yourself as the viability of the so-called "energy hazard" requirement. IN

(the author)

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is a product safety consultant engaged in safety design, safety manufacturing, safety certification, safety standards, and forensic investigations. Mr. Nute holds a B.S. in Physical Science from California State Polytechnic University in San Luis Obispo, California. He studied in the MBA curriculum at University of Oregon. He is a former Certified Fire and Explosions Investigator.

Mr. Nute is a Life Senior Member of the IEEE, a charter member of the Product Safety Engineering Society (PSES), and a Director of the IEEE PSES Board of Directors. He was technical program chairman of the first 5 PSES annual Symposia and has been a technical presenter at every Symposium. Mr. Nute's goal as an IEEE PSES Director is to change the product safety environment from being standards-driven to being engineering-driven; to enable the engineering community to design and manufacture a safe product without having to use a product safety standard; to establish safety engineering as a required course within the electrical engineering curricula.

MR. Static

Static Electricity and People

BY NIELS JONASSEN, sponsored by the ESD Association

The question of interactions between the phenomenon of static electricity and people can be looked at in two ways: how people cause static chargings and how they are affected by it. The first of these may not always be well understood, but is generally not controversial. The second, however, is the subject of much unsubstantiated speculation.

INTRODUCTION

Associate Professor Neils Jonassen authored a bi-monthly static column that appeared in *Compliance Engineering Magazine*. The series explored charging, ionization, explosions, and other ESD related topics. The ESD Association, working with *IN Compliance Magazine* is re-publishing this series as the articles offer timeless insight into the field of electrostatics.

Professor Jonassen was a member of the ESD Association from 1983-2006. He received the ESD Association *Outstanding Contribution Award* in 1989 and authored technical papers, books and technical reports. He is remembered for his contributions to the understanding of Electrostatic control, and in his memory we reprise "Mr. Static".

~ The ESD Association

HOW PEOPLE CAUSE STATIC

The best-known charging process created by people is that of walking across an insulated floor covering. At first glance, this process seems simple. The contact and friction between the shoe soles and the floor cause a charge separation for each step. This charge makes the voltage of the human body capacitance increase until the unavoidable leakage current balances the charging current.

But the charge is separated at the interface between the shoe sole and the floor covering, and the sole is insulating. So how does the charge get transferred from the underside of the sole to the person?

Maybe it doesn't—maybe the person does not in fact achieve a net charge. All we see, in that case, is the effect of the induction caused by the charge on the sole. Mind you, this effect might well raise the person's voltage to substantial levels, with the net charge remaining zero. Or there may be leakage around the edges of the sole, or even a combination of these processes.

Oddly enough, nobody has ever really looked into this problem. And when you pose it to people presenting papers on the topic, they tend to become fidgety.

Another common way people can charge themselves is by removing an item of clothing. When a sweater is rubbing against a blouse, charges may be separated, but the voltage of the person will not increase, since equally large opposite charges are in principle located on the person. But when the sweater is removed, with, for example, a negative charge, the positive charge from the blouse provides a positive voltage.

Incidentally, the little zap you might feel at your ear when removing the sweater is not a sign of charging. Quite the contrary: it's a discharge (and it's not a spark, but a brush discharge). Sliding out of a car seat produces a similar charging process, and the slight shock you may feel is caused by you discharging to the car (and in this case with a *spark*), not by the car being charged. The latter process came to an end in the 1930s with the introduction of conductive rubber in tires.

HOW STATIC ELECTRICITY AFFECTS PEOPLE

Electrical Shocks

The best known effect of static on people, and the only proven effect in the opinion of many scientists, is that of the shock from a spark discharge. This usually occurs when a charged person touches a grounded object, or comes into contact with another person who is at a different potential. Although this phenomenon is well known, there are no well-defined ranges for what level of body voltage will result in discharges that can be felt.


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MR. Static

Few people, however, will notice discharges at voltages lower than about 1000 V. Most people will start to feel an unpleasant effect around 2000 V. Almost everyone will complain when exposed to discharges at voltages above 3000 V.

How high can body voltage be from walking on an insulating floor with insulating shoes? Certainly voltages in the range of 10–20 kV have been encountered under certain conditions, but in my opinion, the sometimes-quoted maximum value of about 35 kV is apocryphal. Long before that kind of voltage is reached, corona discharges would probably occur from the nose, ears, and other protrusions.

It is interesting to note that the question of whether the discharge of a conductor to a human body might have beneficial effects was once a serious question. In the 18th century, electrotherapy was widely used. In one application, capacitors, known as Leyden jars, were charged to voltages in the tens of kilovolts and discharged to paralyzed limbs. The resulting jerk was interpreted as a sign of a positive effect.

In most cases, however, the effects of static electricity on human beings have been considered harmful, or at least unwanted. In the age of the sick-building syndrome, it was almost unavoidable that some of the many unspecific effects of an imperfect indoor climate should be attributed to the exotic phenomenon of static electricity. Static charging has sometimes been the suspected cause of headaches, dry mucosa, itchy skin, and other similar ailments. Rarely in such cases has any possible mechanism or explanation been suggested that was based on well-documented studies.

Plating Out

There is, however, one physical effect of static electricity that has some likelihood of causing physiological or hygienic problems: the effect an electric field around a person has on airborne particulates.

If a person is positively charged, he or she will attract negatively charged particles from the air. Or, as a physicist might prefer to phrase it, the field around the body will enhance the plateout of negatively charged particles onto the clothes and exposed skin. But neutral particles will also be attracted, because they will be polarized, and because the fields, in general, will always be inhomogeneous. The field around a person may, as explained above, originate from charges being separated by walking on an insulated floor covering. But it may also be caused by proximity to a television or computer monitor.

Interestingly, if no one is close to a television or computer screen, the field will move toward the screen. Consequently, this is where particles will plate out, with resultant smudging. When a person is close to the screen, however, the field will also converge on that person's face, especially around protrusions such as the nose and ears.

Several scientific projects have demonstrated that electric fields around a person dramatically increase the plateout rate of airborne particulates. It has been suggested that if such particulates are of an allergenic nature, the plateout might result in an increased occurrence of skin irritation or disease. Such a relation, however, has not been demonstrated.

ARE IONS GOOD FOR YOU?

A somewhat similar process is the effect on atmospheric ions of an electric field around a person (for a definition and description of the physical properties of atmospheric ions, see my column in the May/June 1999 issue of *Compliance Engineering*, page 24).

It has often been claimed that an excess or deficit of one of the polarities of ions in the air inhaled has a direct effect on human beings. Decades ago, one such claim was that an excess of negative ions would increase the vibration frequency of the cilia in the respiratory tract, thereby improving the cleaning efficiency of the cilia in the upper respiratory region. This theory was apparently supported by experimental results in the 1940s and 1950s and was widely quoted. About 1970, however, it was put to rest—or at least it should have been—because new investigations with more up-to-date instrumentation demonstrated conclusively that there

It is interesting to note that the question of whether the discharge of a conductor to a human body might have beneficial effects was once a serious question. In the 18th century, electrotherapy was widely used. In one application, capacitors, known as Leyden jars, were charged to voltages in the tens of kilovolts and discharged to paralyzed limbs. The resulting jerk was interpreted as a sign of a positive effect.

was no such effect. Nevertheless, you may still find the ion-cilia relation cited in medical and quasi-medical publications.

An even more popular claim is that an excess of negative ions makes the air feel fresh and clean, while an excess of positive ions makes the air feel stuffy. Since this kind of vague effect is extremely difficult to prove or disprove, let it suffice to observe that the stuffy air under a thunder cloud has an excess of negative ions, while the fresh air on a mountain top is rich in positive ions. Thus there seems to be more to air quality than ion balance.

But let us nevertheless assume that the relative concentration of positive and negative ions in the air we breathe has an influence on our health. It is then clear that a person who is surrounded by an electric field (because he or she is charged) will inhale fewer ions than an uncharged person. If this person is positively charged, he or she will repel positive ions. Although the body will attract negative ions, the ions will be deflected to the skin and thus be removed from the inhaled air. And even if the person is not charged, most of the ions in the air inhaled will probably plate out in the airways before they even reach the bronchi.

The whole question about the fate of ions in the air we breathe still needs a lot of experimental work. It has been argued that since a negative ion is likely to contain an oxygen molecule, inhaling negative ions must be a good thing. Beyond what I've noted about the plate-out on the skin and in the upper part of the airways, it should be pointed out that even in the highest possible ion concentrations there are trillions of uncharged oxygen molecules for each negative ion.

Over the last five to six years there have been many reports (at least in Europe) on the reputed benefits of exposing the skin of a person suffering from rheumatic or other ailments to a highly ionized airflow with ions of only one polarity.

In order for the person thus treated not to be charged, he or she must be connected to ground. The stream of ions will then cause a current from the point of impact to the ground connection. According to some of the reports, the effect of the treatment is highly dependent on where on the body the ground connection is placed. Of course, you can also create a current through the body simply by applying two or more electrodes, but doing so limits the path of the current to some degree.

If the ionized air does have an effect, it may be because the current originates from a larger area and thus has a greater chance of finding the path with the largest effect. This also depends on the placing of the counter electrode or ground connection.

Please notice that I said if the ionized air has an effect.

The results that I keep hearing about are not from regular scientific investigations with double-blind tests and all that jazz. But they do keep coming, and I don't want to completely rule out the possibility that they are real.

I started working with ions in about 1958 to investigate some sensational claims from a national ion-guru in Denmark on the effects and behavior of ions in indoor air. I almost got crucified for requesting scientific documentation for the claims (such as that the air in a room with a vinyl floor had a bad ion balance). My above commentary on the possible effect of ionized air on the skin does not mean that I have mellowed over the years and relented in my requirements for documentation. Rather the contrary. I still love to play the role of St. Thomas the Doubter. IN

(the author)

NIELS JONASSEN, MSC, DSC, worked for 40 years at the Technical University of Denmark, where he conducted classes in electromagnetism, static and atmospheric electricity, airborne radioactivity, and indoor climate. After retiring, he divided his time among the laboratory, his home, and Thailand, writing on static electricity topics and pursuing cooking classes. Mr. Jonassen passed away in 2006.

ON Your Mark

Effective Product Safety Labels

Your Guide to Symbols

BY GEOFFREY PECKHAM

Designing effective product safety labels that can help to prevent injuries and save lives is a complex task. This month, we'll focus on one of the key elements to consider: symbols.

One of the most fundamental building blocks in designing an effective safety label may surprise you. It's not your text, format, or signal words (although these are all key elements). With the understanding that it's imperative for product manufacturers to communicate safety information about residual risks efficiently and effectively, and to do so in a global marketplace, it's the *symbols* you place on your safety labels that have become increasingly significant.

HOW SYMBOLS ACHIEVE BASIC COMMUNICATION GOALS

When it comes to protecting your product's users (and those that might install, service or dispose of your product), there are two basic things that your product safety labels must typically communicate:

1. A description of what the hazard is (which often includes describing its seriousness and the consequence of interacting with it) and
2. How to avoid the hazard.

Using well-designed symbols on your labels allows you to visually communicate one or both parts of this information across language barriers.

THE IMPORTANCE OF VISUAL PERCEPTION

Yet, the primary reason to use symbols is more interesting than overcoming language barriers. Scientific research has shown that the human brain processes images far more efficiently than it processes text. The fact is, we perceive the world primarily through our sense of sight. It's been well established that over 70% of everything we learn is learned visually. The limbic portion of our brain includes the visual system; this is our sense of sight. Even more importantly for our discussion here with regards to product warnings, it's the limbic portion of our brain that controls our emotions and our behavior. The cerebral cortex, on the other hand, is the part of the brain that processes spoken and written language and it plays a far lesser role in our day-to-day processing of information.

The implications of this research is profound when the goal is to design effective warnings – warnings that are meant to change people's behavior so that they make wise choices when confronted with potential hazards. When you think about it, the idea that our visual sense is hardwired in a much closer way to our behavior-making brain function makes complete sense. Ten thousand years ago, when a caveman (or should we say cave *person*?) saw a saber-toothed tiger coming around the bend, a quick, immediate action was required: hide, run or climb a tree! It's the **visual** perception of the danger that causes us to pay attention and react. When it comes to a product's safety labels, it's the job of the symbols to do this same task, bringing a heightened degree of noticeability and comprehension to the label's message.

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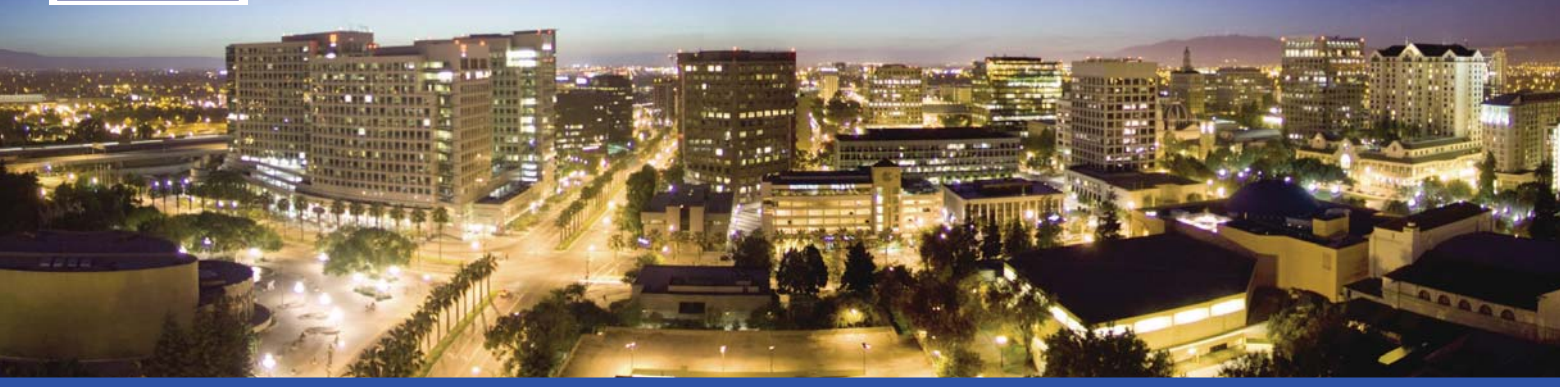

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It's important to note that, to be most effective and compliant with best practices, the symbols you use should come from the most up-to-date standards or be drawn using the latest standards-based illustration techniques.

LABELS IN FOCUS: EXAMPLES OF BEST PRACTICES

It's important to note that, to be most effective and compliant with best practices, the symbols you use should come from the most up-to-date standards or be drawn using the latest standards-based illustration techniques. Use of these symbols and design principles should provide a sense of uniformity that, according to design theory, will aid in people's ability to comprehend a symbol's meaning. In other words, when it comes to graphical symbols, don't reinvent the wheel if you don't have to. (See the November 2012 *On Your Mark* column for more information on this.)

Look at Figure 1. It shows a best practice Read Manual safety label in English – with a clear and eye-catching symbol. Even if your audience does not know English, they would have an understanding of the label's message because of the symbol. To better illustrate this, see Figure 2: a safety label in Russian, with and without a symbol. Would the label on the left stand out to you in the midst of all of the other messages you encounter in a day? Do you have any understanding of its content? Now look at the Russian label to its right, and consider the difference in noticeability. Would your attention be better drawn to this label because it has a symbol and would you now, at the least, understand a portion of the label's message?

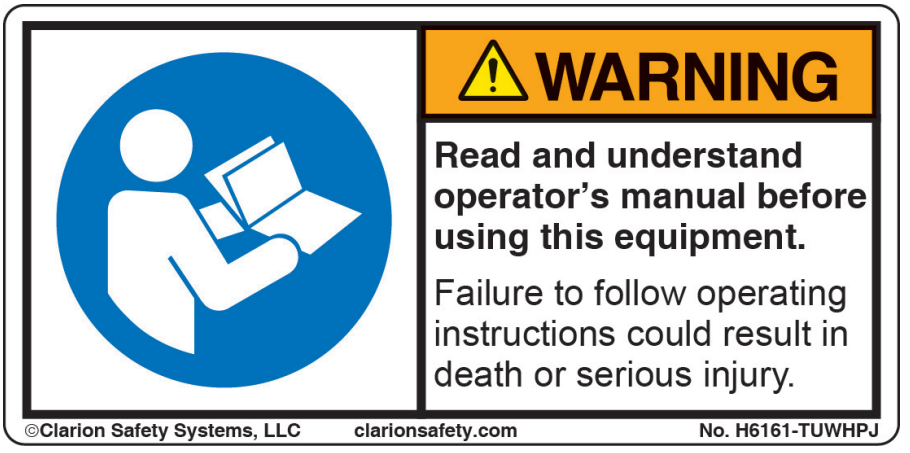

Figure 1: ISO/ANSI-formatted safety label in English with a symbol. (Design ©2014 Clarion Safety Systems. All rights reserved.)

LABELS, SYMBOLS, AND YOUR DUTY TO WARN

Now that we've reviewed the role that symbols play in safety communication, let's look at this from the perspective of providing a legal defense for your

Figure 2: ISO/ANSI-formatted safety label in Russian – without a symbol (at left) and with a symbol (at right). (Designs ©2014 Clarion Safety Systems. All rights reserved.)

Figure 3: ANSI Z535 chemical hazard safety label with ISO-formatted symbols. (Design ©2014 Clarion Safety Systems. All rights reserved.)

company should an accident occur and your product's safety label is challenged. While product liability laws vary from state to state, one principle holds true: your duty to warn revolves around your ability to provide adequate warnings and instructions for the safe use of your products. If you provide warnings on your product, the court will typically grant you the assumption that warnings would have been read and heeded by a reasonable person. The more that you can make your warning reasonably understandable by the widest possible audience (including non-English speakers), the better off your position will be in court if you are required to defend your warnings. In this way, adding graphical symbols to your safety labels not only protects the user of your products, it also protects your company. Figure 3 is an example of a best practice ISO/ANSI-formatted safety label that uses ISO symbols to both describe the hazard and define the avoidance procedure. If your product needed a safety label to communicate this message, the ISO/ANSI-formatted label will accomplish your goals of improved product safety and reduced product liability exposure far better than its predecessor (shown in Figure 4).

Both national and global best practices dictate that, as the product manufacturer, you should provide warnings on products that have residual risks. The use of graphical symbols to help accomplish this task is highly encouraged in many regulations and standards. Rarely, though, are the actual label design specifications defined. This means you have options to choose from when it comes to how best to integrate symbols and text to convey your safety message.

The next *On Your Mark* column will explore the layout choices you have to combine text and symbols to best accomplish the goal of effective safety communication. IN

Figure 4: Old safety label design.

For more information on best practices related to ISO symbols, watch a short, educational video produced by Clarion Safety Systems.

(the author)

GEOFFREY PECKHAM

Geoffrey Peckham, CEO of Clarion Safety Systems, is chair of both the ANSI Z535 Committee for Safety Signs and Colors and the U.S. Technical Advisory Group to ISO Technical Committee 145 - Graphical Symbols, and member of the U.S. Technical Advisory Group to ISO Project Committee 283 - Occupational Health and Safety Management Systems. Over the past two decades, he has played a pivotal role in the harmonization of U.S. and international standards dealing with safety signs, colors, formats and symbols.


10:10 AM

How and Why to Green-Light Sustainability in Your Electronics Engineering

BY WILLIAM F. HOFFMAN III, Ph.D.

Surveys show that price and performance are still the most important consumer criteria when selecting a mobile device.[1] However, increasing commoditization coupled with growing environmental concerns are placing sustainability front and center among considerations for manufacturers that hope to differentiate their products and demonstrate good corporate stewardship.

Pursuing sustainability initiatives in the electronics industry can be a complicated and resource-intensive process. With so many materials and components, offshore sourcing and price-sensitive consumers involved, sustainability can still be a secondary factor when it comes to the design and manufacture of technology devices. In this article, we will consider the context for sustainability initiatives in the electronics industry. We will examine the challenges facing manufacturers as they consider environmental initiatives, as well as the benefits of being proactive. We will outline criteria for a comprehensive approach to sustainability and consider how and why third party certification works and what aspects it analyzes.

THE RISING TIDE OF MOBILE DEVICES

Mobile devices are quickly shifting from a cutting-edge technology tool to an absolute necessity of modern life. There will be an estimated 7.3 billion cell phone accounts in use by the end of 2014.[2] That means the number of mobile devices in use will outpace the world's population.

While the industry is pursuing plenty of game-changing innovation such as improved battery life, infrared ports for controlling home equipment and enhanced voice recognition, mobile device manufacturers still face increased commoditization, thinning margins and downward price pressures. Business Insider Intelligence forecasts that the average selling price for a handset in four years will be just $150.[3] That's compared with an average selling price of $372 in 2013, according to the International Data Corporation.[4] This signals that manufacturers will be striving to differentiate their goods and wring additional cost savings out of materials and manufacturing processes.

At the same time, consumers are mindful of the pervasiveness of mobile devices and their close contact with these devices for extended periods of time. Some are questioning the potential health, safety and environmental impacts these devices could have long-term.

From the manufacturers' perspective, there is increased demand to incorporate and report on sustainability initiatives within their companies from both consumers and non-government organizations.

But the road to sustainability is a long, unpaved one, littered with obstacles such as unverified claims by competitors, supply chain management challenges, regulatory concerns, as well as competing cost and performance objectives. At what point does the benefit of pursuing sustainability outweigh the challenges?

A LOOK AT THE PROBLEM: E-WASTE, E-WASTE EVERYWHERE

The statistics on mobile usage above paint a clear picture of the sheer volume of devices being manufactured and ultimately discarded. The United States alone dumps an estimated 300 million to 400 million electronic items per year, and less than 20% of that e-waste is recycled.[5] One forecast, based on data gathered by United Nations organizations, governments, and non-government and science organizations in a partnership known as the "Solving the E-Waste Problem (StEP) Initiative," predicts e-waste generation will swell by a third in the next five years, led by waste output from the United States and China.[6]

Not much interpretation is needed to understand that this kind of exponential growth in the waste stream simply can't continue. Consumers, the community and the industries making up electronics manufacturing must work together to stem the creation of e-waste through responsible device manufacture, use and disposal.

While e-waste is the most visible environmental problem presented by the growing prevalence of mobile devices, there are other pressing concerns as well.

e-Waste, e-Waste Everywhere

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Potentially hazardous materials and chemicals used in mobile phones, as well as in other technology devices, can present human health risks for both the consumer and workers. These elements can also leach into soil, air and water if not disposed of correctly, presenting widespread health problems to humans and ecosystems.

Regulations limiting use of potentially toxic materials are requiring manufacturers to take stock of the materials used in their products and quantitatively track their use.

The European Commission (EC) has put forward some of the most aggressive regulations to address the environmental impact of electrical and electronic equipment. The RoHS Directive (2002/95/EC) and the recast (2011/65/EU) regulates specific hazardous substances (below), limiting parts per million (ppm) concentrations by weight of each homogeneous material that can be mechanically separated.

- Cadmium (Cd) — 0.01% (100 ppm)
- Lead (Pb) — 0.1% (1000 ppm)
- Mercury (Hg) — 0.1% (1000 ppm)
- Hexavalent chromium (Cr(VI)) — 0.1% (1000 ppm)
- Polybrominated diphenyls (PBB) — 0.1% (1000 ppm)
- Polybrominated diphenyl ethers (PBDE) — 0.1% (1000 ppm)

The impact of the EU's RoHS Directive on the worldwide electronics industry has been significant. At the tactical level, the regulation has required development of new solders and new soldering process for manufacturing printed wiring board (PWB) assemblies, the selection of alternate materials for solder terminations of components, the qualification of alternate types of flame retardants and the need to identify replacements for other banned substances.

In order to comply with RoHS, manufacturers have taken a closer look at the materials used in production of their products, have put in place processes to evaluate and measure materials used by their suppliers and have increased visibility into their supply chains.

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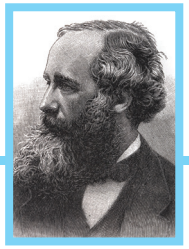

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Other countries, including China and South Korea, have introduced similar regulations. With Proposition 65, the state of California requires strict labeling of products that contain any of a given list of potentially hazardous substances above a certain threshold concentration for each substance covered. Legislation of this kind will continue to put increasing pressure on manufacturers to fully understand and measure the comprehensive health, safety and environmental impact of their products.

COMPREHENSIVE SUSTAINABILITY

Clearly electronics present environmental challenges that need to be addressed. Yet pinpointing the best approach for pursuing sustainability in a comprehensive manner can be challenging.

It is valuable, first, to consider key aspects of a comprehensive sustainability program. Sustainability is more than just a series of stand-alone environmental programs, independently initiated in the name of good corporate stewardship. While certainly these efforts represent a step in the right direction, they fail to truly evaluate and measure a product's full impact on human health and the environment. A good sustainability program takes a truly comprehensive approach in evaluating and measuring multiple attributes, at every stage of the product's life as well as considering direct and indirect environmental impact from the product itself as well as the process used to create it. Identification of key product hot spots, energy, materials content, end of life or social justice in the supply chain, is a key step in improving the performance of a product. Specifically considering the product materials use, energy use, supply chain issues such as working conditions and materials source, final disposition and recycling and corporate governance, the sustainability of the organization as a whole are all part of sustainability of a product.

e-Waste, e-Waste Everywhere

Of particular importance where electronics are concerned is disposal at the end of their life. Electronics destined for the landfill can leach toxic materials into surrounding air, soil and water. If not recycled or disposed of properly, cell phones can create significant environmental issues.

Product and Materials

Electronic devices are made of materials that include precious, finite resources such as gold, copper and silver. Encouraging recycled content helps to relieve some of the pressure on natural resources and also promotes the recovery of these materials at end-of-life. Some chemical elements present in devices may have potentially negative impacts on human health when not recovered correctly or during manufacture. Some electronics may emit harmful chemicals or ultrafine particles during use, which can present a detrimental human health impact. Finally, throughout their useful life, these products all consume energy.

Process

The process involved in manufacturing electronics includes extracting raw materials from the earth, transporting these materials, fabrication and assembly, and distributing these products to retail stores where they finally reach the consumer. Consider all of the environmental implications along this journey: the impact on the local economy and land where raw materials are mined, resources such as water used during the manufacturing process and waste products created or released into the air or landfills as a result of manufacturing and fossil fuels used for transport, all along the supply chain. In addition there can be considerable social considerations from the supply chain such as conflict minerals and working conditions.

Packaging

The environmental impacts of packaging can be similar to those of the item being packaged and range from sourcing of packaging materials, to fabrication and transportation of those materials and finally, to end-of-life disposal of the packaging. Considerations include use of minimal materials, recyclability or ease of decomposition, carbon footprint, use of renewable resource materials and others.

Disposal

Of particular importance where electronics are concerned is disposal

e-Waste, e-Waste Everywhere

So called informal recycling where the product is burned to recover the precious metals can release considerable hazardous substances to the local environment. It is possible to both design for a more recyclable electronics product and to encourage proper recycling by established recycling companies.

at the end of their life. Electronics destined for the landfill can leach toxic materials into surrounding air, soil and water. If we just consider the mobile phone category, there is significant contribution to the e-Waste stream. In 2010, the EPA estimates more than 152 million mobile devices were disposed of – exceeding 350,000 mobile phones being discarded every day[7].

If not recycled or disposed of properly, cell phones can create significant environmental issues. So called informal recycling, where the product is burned to recover the precious metals, can release considerable hazardous substances to the local environment. It is possible to both design for a more recyclable electronics product and to encourage proper recycling by established recycling companies. Key are design features such as easy removal of user data for privacy reasons, easy disassembly and simple large plastic parts free of contamination. All of these can make a product more profitable to recycle and will even encourage recycling. Even during responsible recycling there is the potential for the creation of dioxins and furans which are eliminated through emissions controls. By careful choice of materials and encouraging recycling some of the hazards at the end of life can be avoided.

Considered in their full context, each and every electronic or high-tech device has a significant impact on the environment over the course of its full lifecycle. These are just a few of the considerations. Sustainability programs that measure and evaluate comprehensive impact are the most effective, impactful and defensible. So let's consider, step-by-step, what a comprehensive program looks like.

THIRD PARTY CERTIFICATIONS OFFER A RUNNING START

In order to address sustainability in the electronics space, one option is to tackle the issue along the entire lifecycle of the product. For those who choose this option, one of many certification options available to the manufacturers of mobile phones is ECOLOGO Certification to UL 110, Sustainability for Mobile Phones Certification. This, and other certifications such as EPEAT, EcoMark (Japan) and Ecma / IT Eco-Declaration, are designed to offer third party validation of sustainable practices and a recognizable label to consumers that desire to select dependably environmentally responsible products. Standards such as UL 110 address issues along the entire lifecycle of the product, including materials, manufacturing and operations, health and environment, packaging, energy use and end-of-life management and durability. Alongside these end-to-end standards, there are also single-attribute certifications and claim validations options open to manufacturers in the electronic space.

For manufacturers seeking to embark on the journey of increased sustainability, certification programs provide a ready-made framework, access to expertise and third-party claims validation that offer companies a running start when it comes to pursuing comprehensive sustainability.

HOW CERTIFICATION WORKS

Third-party testing and certification bodies assist manufacturers by providing scientific expertise in assessing and auditing the wide range of environmental criteria required to meet a variety of certifications and standards.

For the ECOLOGO standard for mobile devices, for example, categories are based on a combination of life cycle stages and key performance areas, making for a comprehensive evaluation of sustainability. To streamline efforts and ensure broad compliance, chemicals of risk and levels are harmonized across key standards like RoHS, Proposition 65 and other international standards. This means that earned certification automatically signals compliance with common standards required to conduct business internationally.

In order to earn certification, manufacturers must meet baseline requirements provided in each category and earn supplemental points based on meeting several optional criteria. Standard and gold certifications are issued based on the final number of points earned.

Energy Use

A fundamental tenet of environmentalism, no sustainability initiative is complete without an evaluation of energy use and conservation. Lifecycle standards such as UL's ECOLOGO also evaluate devices for energy conservation and charging efficiency. Single-aspect standards, such as Energy Star, are uniquely focused on energy use.

Health and Environment

Environmentally sensitive materials are audited to minimize risk to human health. It restricts the use of the potentially harmful substances specified in RoHS. This category also calls for the evaluation of PVCs and dermal contact testing to evaluate the impact of materials that may come into contact with normal device usage.

Product Stewardship

To encourage recycling of devices, this category awards points to products that are easily deconstructable into components that can be separated for recycling, reuse or disposal. Product Stewardship also reviews features that extend the usable life of a product. This includes availability of replacement parts, easy battery replacement and data erasure capabilities so that phones can easily be securely staged for reuse. Single attribute environmental claim validations in this area could include recycled content claims, bio-based materials claims and zero-waste claims.

Packaging

Packaging is evaluated for hazardous materials. Recycled and recyclable packaging is encouraged. Inks and adhesives, which can emit potentially harmful volatile organic compounds into the air, are also considered.

e-Waste, e-Waste Everywhere

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Manufacturing and Operation

There is much that can be done in the area of manufacturing and overall company operations. With multi-attribute environmental certifications, supply chain management and operations are audited for social compliance with fair labor practices and other social components. The corporation as a whole is evaluated for a corporate social responsibility plan and executing to the plan, for environmental management systems and for adherence to corporate social responsibility policies,

Innovation

Some certification programs include this category, which allows the product to receive credit for innovative environmental efforts and programs that are not covered in the other evaluation categories. The intent is to award activities that exhibit exceptional performance above and beyond those listed in the standard's requirements. These may include things like use of renewable energy in the manufacturing process, significant waste reduction in manufacturing or water conservation efforts.

NAVIGATING THE CHALLENGES

Even when neatly organized into easily understandable segments, managing effective execution of sustainability efforts to achieve certification is no easy process. Sustainability programs that are comprehensive in nature present significant challenges to product design and engineering teams. Here are some strategic steps that manufacturers can put in place to help support the adoption of sustainability initiatives.

Design for Sustainability

Creating sustainable products all starts with better design. Sustainability is not an element that can be sprinkled in last-minute, but a discipline that must be incorporated into the every step of the design process and into the corporate culture.

Perhaps the most obvious example is thinking about end-of-life when a product is designed on paper. Designing a product for better end-of-life performance means building it for easy deconstruction, separation and recycling. Perhaps never before introduced as a required product feature, the earlier it can be brought to the drawing table as a design requirement for new product, the easier it is to accomplish.

While the final product doesn't typically expose the user to hazardous substances careful choice of components and materials can also have a substantial impact on worker exposure to hazardous substances. Using a water-based paint or coating instead of a solvent based system can avoid considerable emissions. Or using an alternative to spray coating can improve materials use efficiency. Even better would be to avoid coatings completely if possible. Another example is considering energy use during manufacture and use during the design process. When designing product attributes, including the requirements for energy efficiency at the outset allows for downstream design, production and testing to evaluate energy use throughout the process.

Designing for sustainability means making sustainability a priority from the earliest stages of the process. It is simply a commitment to making sustainability a priority and factoring it in as a requirement from the outset, rather than an afterthought as a product is going to market.

Internal Costing of Raw Materials

Many factors, such as natural disasters, droughts, shortages, civil unrest in nations worldwide, put access to raw materials at risk. Additionally, many commodities – such as water – are obtained at a cost much lower than their value to the company.

Manufacturers gain immense benefit from these raw materials, without which their products could not be produced and distributed. Some companies are undertaking efforts to develop financial models that price raw materials closer to their actual value to the company rather than their commodity price. This exercise helps companies evaluate the true value of raw materials and to understand the volatilities to the business should these materials become unavailable for any reason. In some cases, it leads companies to proactively reduce their dependence on key materials, to diversify their sources or to identify substitutes. This exercise is one that generates corporate-wide awareness of the value of raw materials and often results in a reduction in waste and use of precious natural resources wherever possible.

Measure everything!

Implement better tracking mechanisms. In the age of big data, everything is quantitative. The difficulties associated with tracking metrics by hand (in a spreadsheet) are quickly going by the wayside, as never before have such powerful tracking tools or so much data been available.

Measuring makes it easier to understand and report on the true environmental impact of everything from product contents to waste produced to resources used in the manufacturing process.

Implementing tracking systems often has ancillary benefits, like increased visibility into operations, supply chain and virtually every other aspect of the business, resulting in a win-win for the company.

In many cases, efforts to gather the data to submit for certification audit have resulted in discoveries of overpayments, operational inefficiencies and even additional revenue streams as recycled materials were gathered and sold. Measuring is the first step to understanding, and understanding is the first step required to start taking action.

THE BOTTOM LINE BENEFITS

Pursuing a course of environmental responsibility is the right thing for electronics manufacturers to do. For employees, customers, the company and the earth – doing business in ways that offers promise and hope of continued life and prosperity for generations to come is a powerful incentive all its own. However, there is also a compelling business case for sustainability. Cost savings are all but guaranteed, based on improved efficiencies, identification of alternative resources and driving out unnecessary overuse of materials. Ultimately, much of sustainability is about reducing waste, which also reduces cost – a benefit that falls straight to the bottom line.

Intangibles such as improved brand image, product differentiation and increased goodwill toward the company are measurable in customer loyalty and positive PR, also driving sales to support the bottom line.

Reduced liability as a result of reducing the toxicity of products and finding healthier materials substitutes can yield immense savings in legal fees and damages.

Similar to the rising tide of mobile device usage serving as an engine of the electronics sector, a rising tide of sustainability is coming. Savvy companies will prepare and use the changing winds to adjust their sails and project their businesses into a healthy, profitable and sustainable future. IN

RESOURCES

- The Electronics Industry Citizenship Coalition (EICC) hosts sustainability tools and resources for electronics manufacturers. Tools and resources at www.eicc.info/tools_and_resources04.shtml.
- The Consumer Electronics Association (CEA) resources for sustainability, including its *CEA 2013 Sustainability Report*, are available online at www.ce.org/green.
- NC State University's Supply Chain Resource Cooperative (SCRC) High-Tech and Electronics Industry Sustainability Report can be found at http://scm.ncsu.edu/scm-whitepapers/wp/high-tech-electronics-industry-sustainability-industry-report.
- For more information and to view the specific standards for UL's ECOLOGO certification for electronics please visit www.ul.com/el.

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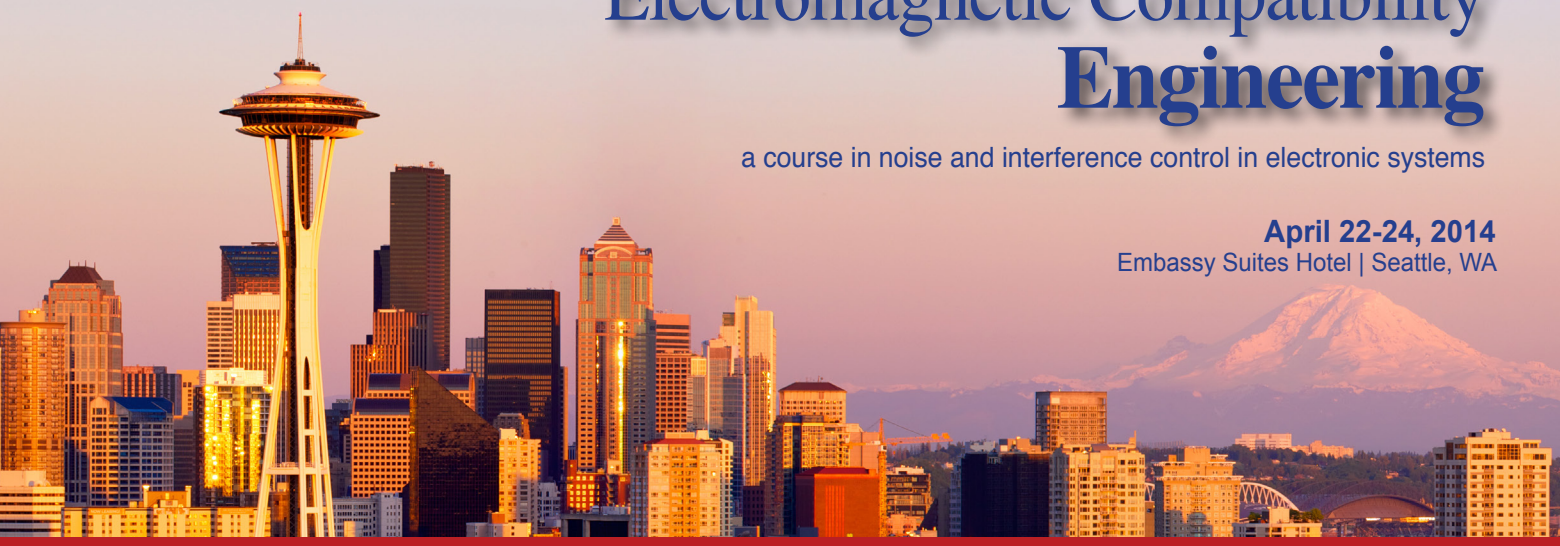

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The Power of IEC 62474 for Product Compliance and Eco-design

BY WALTER JAGER, ROBERT FRIEDMAN AND LINDA YOUNG

INTRODUCTION

Environmental compliance is a moving target – each region can impose unique environmental requirements on products sold in their market and new regulations continue to emerge. Different global substance regulations create significant challenges for all actors in the electrical and electronics industry. Substances added twice a year to the EU REACH[1] SVHC Candidate List and the potential additional RoHS[2] substances are prime examples of new or changing regulatory requirements.

The first step in regulatory compliance evaluation for substance restrictions is to determine the substances of concern contained within the parts that comprise a finished electronic product. This article describes an internationally recognized standard that is available to engineers to help identify the substances of concern that need to be taken into consideration when designing, procuring, and manufacturing electrical and electronic equipment (EEE) products for a global marketplace. It also presents a summary of the updates made to the industry Declarable Substance List (DSL) in 2013 and early 2014 to meet the changes in global requirements.

Organizations need to implement internal processes that are flexible to accommodate new regulations and to leverage information from a global supply chain. The new International Standard IEC 62474 Ed. 1.0 titled *Material Declaration for Products of and for the Electrotechnical Industry* (hereafter referred to as IEC 62474)[3] described in this article is invaluable in assisting organizations to meet these global requirements.

THE MARKET NEED FOR MATERIAL DECLARATIONS

Restricted substance compliance is a challenge that is continuing to grow - Manufacturers need to be aware of the substances of concern in their products.

A key benefit of the IEC 62474 material declaration standard is that it includes an internationally recognized DSL specific to the electronic industry. The IEC 62474 DSL is based heavily on the Joint Industry Guide (JIG-101), which was the EEE industry's de-facto substance list from 2005 through 2012. The JIG 101 substance list maintenance activity has now been officially sunset and transitioned to the IEC 62474 validation team (for more on this visit http://www.incompliancemag.com/press/1404_F2.)

The IEC 62474 DSL contains information on what substances to declare and the conditions under which they need to be reported. To help users, it also includes information about common uses of the chemicals in electronic products.

The IEC 62474 DSL contains information on what substances to declare and the conditions under which they need to be reported. To help users, it also includes information about common uses of the chemicals in electronic products. The information in the IEC 62474 DSL helps companies to design and manufacture their products to meet global market requirements.

Manufacturers need to know the materials contained in their products. This is important input for environmentally conscious design (ECD) to understand opportunities to improve environmental performance.

Organizations with ECD processes need to understand environmental aspects associated with their products across the various product life cycle stages. A robust ECD process will collect data to understand which environmental aspects are significant during each life cycle stage and evaluate what may be done to improve these aspects. Examples of common environmental aspects include material use, energy use, water use, waste generation, and wastewater and air emissions.

IEC 62474 can assist organizations determine their global regulatory compliance status, as well as to declare data on the type of materials that are contained in their products. With this information product design teams may better understand the opportunities available to improve environmental life cycle performance. For example, the data may indicate that several different types of plastics are present in certain parts and indicate there are opportunities to reduce these materials to improve overall product recyclability.

The IEC 62474 standard supports ECD through the establishment of fifteen defined material classes. These classes are defined non-overlapping categories of materials that can be used to fully describe the contents of an electronic product. The material classes cover both inorganic and organic material categories.

EU RoHS 2 has new CE marking technical documentation requirements – material declaration can play a significant role

RoHS 2 – the recast of the EU RoHS Directive (2011/65/EU) – is a CE Marking Directive that introduced new obligations for manufacturers, importers, and distributors. In particular, manufacturers now have obligations for conformity assessment of products, marking, manufacturing, technical documentation and notification and tracking of any possible non-conformances.

RoHS 2 specifies that manufacturers must carry out conformity assessments based on internal production control procedures in conformance with EU Decision 768/2008/EC and EU Regulation (EC) No 765/2008. It also specifies that manufacturers must compile technical documentation that demonstrates conformity of their products before the products are put on the EU market. To assist manufacturers with understanding the expectations for technical documentation, the European Commission issued a Communication specifying the CENELEC standard EN 50581[4] as the RoHS 2 harmonized standard for technical documentation.

EN 50581 *Technical Documentation for the Assessment of Electrical and Electronic Products with Respect to the Restriction of Hazardous Substances* specifies minimum requirements for technical documentation. In determining the information that is needed, EN 50581 suggests that manufacturers use a risk assessment approach to consider the probability of restricted substances being present in the product and also the trustworthiness of the supplier.

To demonstrate the absence of restricted substance content in materials, parts, and sub-assemblies, EN 50581 identifies three types of information that may be appropriate for the technical documentation:

1. Supplier declarations and/or contractual agreements;
2. material declarations; and
3. analytical test results.

For materials declaration, the standard references EN 62474, the European version of IEC 62474. An IEC 62474 material declaration will communicate information about all instances of RoHS substances in the product above the restriction threshold, allowing the downstream manufacturer to determine conformity and assess the applicability of any RoHS exemptions that have been identified by the supplier. This makes IEC 62474 material declarations suitable as RoHS 2 technical documentation.

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Meet the Instructor

Dr. Bruce Archambeault is an IEEE Fellow, an IBM Distinguished Engineer Emeritus and an Adjunct Professor at Missouri University of Science and Technology. He received his B.S.E.E degree from the University of New Hampshire in 1977 and his M.S.E.E degree from Northeastern University in 1981. He received his Ph. D. from the University of New Hampshire in 1997. His doctoral research was in the area of computational electromagnetics applied to real-world EMC problems. He has taught numerous seminars on EMC and Signal Integrity across the USA and the world, including the past 12 years at Oxford University.

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Maintaining REACH compliance is a challenge given the large number of Substances of Very High Concern (SVHCs) on the Candidate list and the frequent additions. A systematic and flexible approach is needed.

Manufacturers may also test their products for RoHS restricted substances, but this can become expensive very quickly and is not always practical, making material declarations a cost effective way to meet the technical documentation requirements.

REACH SVHCs require a systematic and flexible approach

Organizations that manufacture or import products into the European Union must comply with the EU REACH regulation (EC) No 1907/2006 – this includes manufacturers of EEE products. REACH is a comprehensive chemicals regulation with many requirements. For EEE manufacturers, the most common requirement is the obligation to communicate information about the presence of any Substances of Very High Concern (SVHC). SVHCs include substances that are carcinogenic, mutagenic, toxic to reproduction, persistent, bioaccumulative and/or endocrine disrupting. Only the SVHCs on the SVHC Candidate List that is published by the European Chemical Agency (ECHA) incur this obligation, but as of April 2014, the SVHC Candidate List had grown to 151 entries with additional substances added twice a year. When new SVHCs are added, the communication requirements are immediate.

Maintaining REACH compliance is a challenge given the large number of SVHCs on the Candidate List and the frequent additions. A systematic and flexible approach is needed [5, 6]. Good communication of substance content information down the entire supply chain is invaluable. Also, awareness of which SVHCs can occur in EEE versus those that are not realistically present helps narrow the focus to specific substances of concern. For example, many of the current 151 SVHCs are manufacturing intermediate chemicals that are not expected to remain in a finished electronic product. One way that the IEC 62474 DSL provides value-added information for the electronics industry is by identifying most likely uses of REACH SVHCs.

CHALLENGES WITH MATERIAL DECLARATION

There are many challenges to get the substance and material data needed by electronics manufacturers. These include:

- Suppliers do not know the countries that a downstream manufacturer will sell to, and even if they did, they usually do not have the resources to research and know all substance restriction regulations.
- Without a standardized list of minimum substances to report, each customer requests the substances it wants its suppliers to report. This means many different variations and details as to what a supplier has to report, making it difficult and costly to prepare.
- Without a standardized way to exchange material declaration data, suppliers receive customer-specific forms and formats to report in. Many suppliers provide hardcopy data that has to be entered again manually for the next declaration down the manufacturing chain. This leads to extra effort, costs and reporting errors.
- There have been no internationally accepted rules to report substances or materials, and this leads to variation and data errors.
- Suppliers provide information on a case-by-case basis according to individual contracts. In some cases, the data is provided at no cost, in some cases it is provided at additional cost and in some cases, not provided at all. This leads to market barriers that tend to give advantage to larger organizations and to those that purchase in large quantities.

HOW IEC 62474 HELPS ORGANIZATIONS OBTAIN MATERIAL DECLARATION DATA

The IEC 62474 Standard on material declaration includes an internationally recognized DSL, a material declaration procedure and a data exchange format.

The standardized rules and data exchange format provided by IEC 62474 enables manufacturers and suppliers to exchange material and substance information using a common language. A supplier that prepares their material declarations in conformance with IEC 62474 enables their customers to correctly interpret the information to assess conformance of the product against substance restrictions.

The requirements for creating a material declaration that conforms to IEC 62474 are listed in the various parts of the standard. The declaration

rules specified in Clause 4 of the IEC 62474 standard ensures that specific minimum information about substance content in the product is provided and specific requirements are followed for declaring optional information. The DSL in the IEC 62474 database specifies the minimum set of substances that must be declared if they are present in the product above the reporting threshold; and the data exchange format (specified by the XML schema and developer's table) allows supplier and customer to exchange the data using a common format. Several of the features and benefits of IEC 62474 material declaration are discussed below.

IEC 62474 is an International Standard recognized by the World Trade Organization (WTO) and is therefore intended to have a harmonizing effect across the global industry. It has been adopted by the EU and several other countries as a national standard, including China. Japan is adopting the International Standard for their JGPSSI and JAMP material declaration systems. And IPC 1752 is now referencing the IEC 62474 DSL. The IEC 62474 and IPC 1752 (class D) XML formats are already quite similar and efforts are underway to bring these further into alignment.

The IEC 62474 DSL has already gained significant adoption within the EEE industry – many organizations are now using the DSL for engineering and procurement specifications— and Environmental Product Declaration (EPD) standards are referencing the list in their environmental performance criteria. Nevertheless, it takes time and effort to implement new functionality in IT systems; therefore the adoption of IEC 62474 by manufacturers may take some time. However, once the standard is widely adopted, the efficiency of data exchange throughout the supply will enable companies to meet expanding regulatory requirements in a timely and cost-efficient manner.

A unique aspect of IEC 62474 compared to most other IEC and ISO standards is that it not only includes the International Standard document, but is designed to work with a companion publicly available online database for information that needs to be updated regularly. The IEC 62474 database is publicly available at http://std.iec.ch/iec62474. The business rules governing the reporting and how declarable substances are added/removed from the list are more stable and, consequently, are contained in the standard itself.

Declarable Substance List (DSL)

The DSL is a list of substances and substance groups (e.g. lead and lead compounds) that a manufacturer is required to declare if present in the product at a concentration level above the reporting threshold. Figure 1 provides a screen capture of the main web page of the IEC 62474 database. The DSL may be accessed from the IEC 62474 database via the menu bar on the left side of the web page – click on **Declarable Substance Groups and Declarable Substances** and then select the substance from the drop down list. There is also an option to export the entire DSL in Excel or XML format.

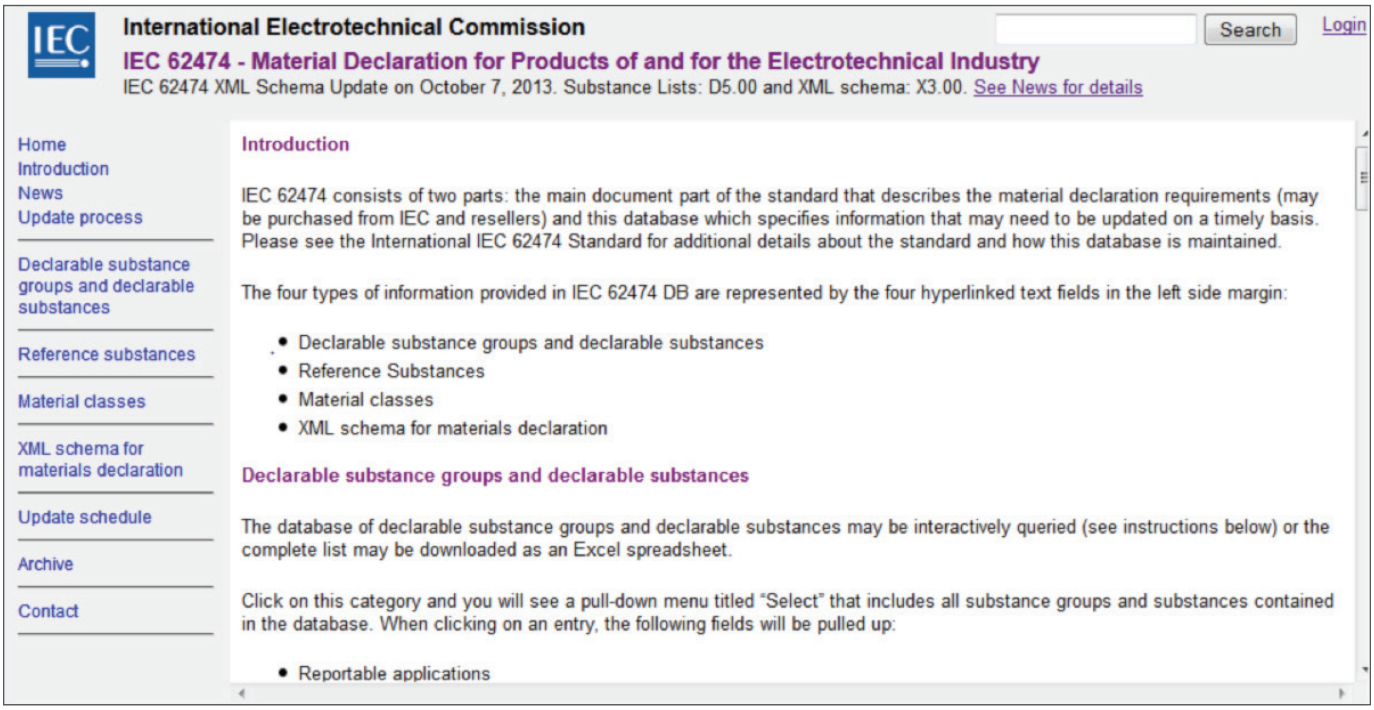

Figure 1: Introduction Page of IEC 62474 database

Each substance or substance group entry in the list is accompanied with a reportable application and a reporting threshold level. For example, selecting **Lead/Lead Compounds** presents five entries with different reportable application/reporting threshold combinations – the first entry corresponds to the RoHS restriction. Clicking on the **Details** button reveals information about reference substances, typical EEE applications, regulations, and other information (see Figure 2).

The reportable application and reporting threshold level fields provide criteria for a supplier to determine whether they must report the presence of a substance or substance group in their product.

The declarable substances are categorized in three criteria levels: criteria 1 currently regulated; criteria 2 for assessment; and criteria 3 for information only. For a supplier to declare that their material declaration conforms to IEC 62474, they must declare all criteria 1 or 2 substances that are present in their product above the threshold level for the specified reportable application. The declaration of criteria 3 substances is optional.

Key functionality, flexibility and power of IEC 62474

A strength of the IEC 62474 International Standard is the flexibility in material declaration reporting. A supplier may declare just the mandatory declarable substances/ declarable substance groups or they may provide a full declaration of all materials and substances in the product using the same XML-based data exchange format.

Data Exchange

The information in an IEC 62474 material declaration is captured in

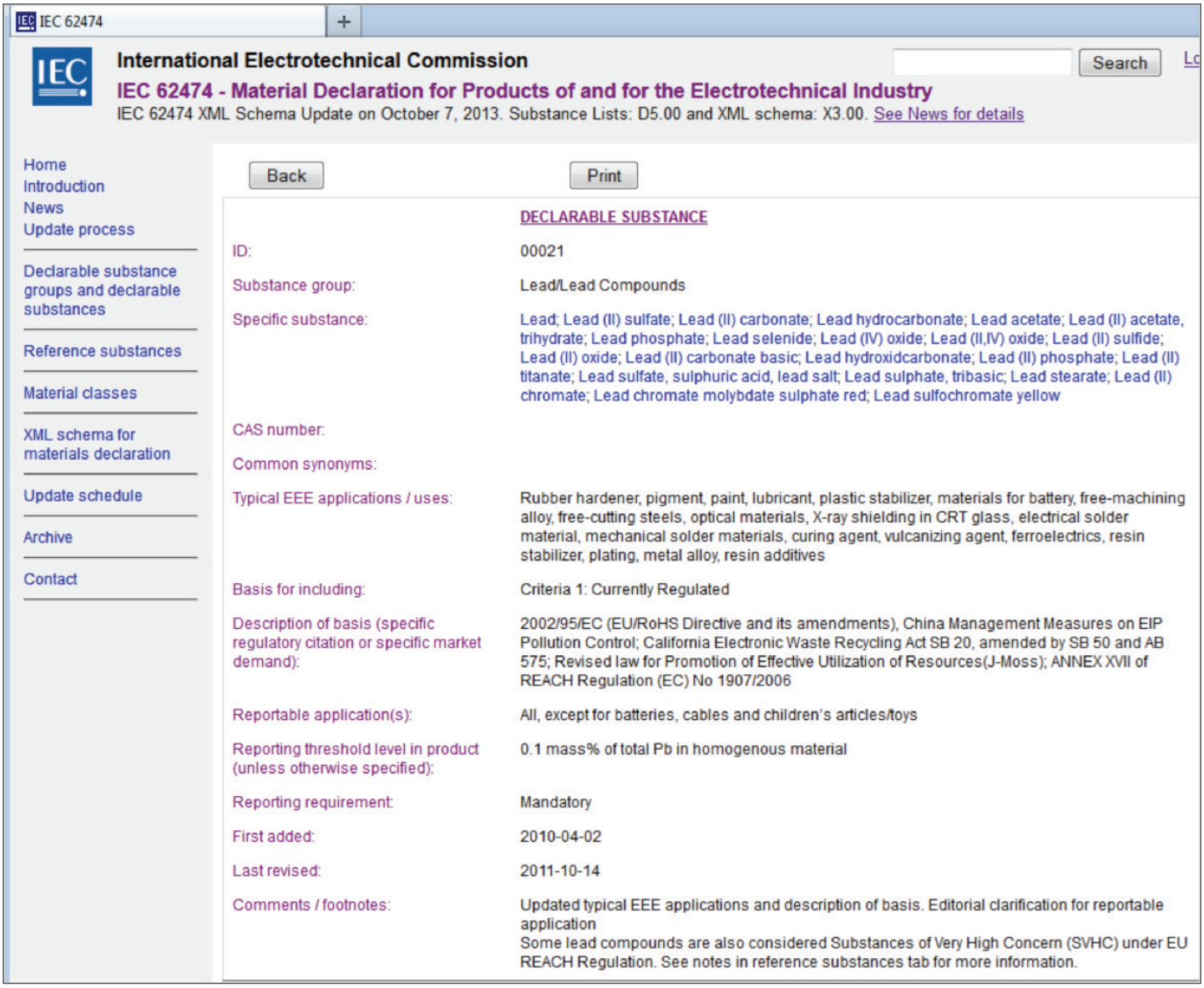

Figure 2: IEC 62474 DB entry for RoHS Lead Restriction

a tree data structure using an XML format. Figure 3 illustrates a simplified conceptual representation of the elements in the tree data structure. The product is at the top of the tree with product parts, materials, substance groups and substances underneath. In most circumstances, declaring product parts and materials is optional; however, there are occasional circumstances when a product part must be declared – these circumstances are described below. There may also be information on material classes in the declaration, although this information is not shown in Figure 3.

The XML schema specifies the basic format of the XML file but must be used in conjunction with the developer's table, which specifies additional rules that must be met in an XML material declaration file – for example, the multiplicity of data fields and the maximum number of characters allowed in text fields (i.e., maximum string length). The multiplicity of data fields refers to whether only one instance of a specific data field is allowed or if multiple instances may be provided. Multiplicity of greater than one is important for information such as RoHS exemptions for which multiple entries may need to be reported. The developer's table is also available from the IEC 62474 database.

IEC 62474 states that material declarations should be exchanged between supplier and customer using the data format provided in the XML schema; but it also allows a paper format to be used. The paper format capability was provided because not all organizations around the world have the computer tools available for electronic data exchange. A paper-based material declaration must still provide all of the information specified in the standard.

For an electronic material declaration to conform to IEC 62474, it must meet all of the applicable requirements in the XML schema, the developer's table and the IEC 62474 document.

Declaration Procedure

The declaration procedure (rules), as defined in Clause 4 of the IEC 62464 document, is partitioned into *base requirements* for a minimum declaration and *additional requirements* that must be met when a supplier provides additional (optional) information. The requirements identify key information that must be provided in the material declaration and how the information must be organized. Following these requirements is necessary to ensure that the recipient is able to interpret the information and assess conformity of the product.

IEC 62474 material declarations allow conformity to be calculated

An important objective for the development of IEC 62474 was to ensure that the recipient of a material declaration has sufficient information to properly assess the conformity of a material or product – this overcomes a limitation of several earlier material declaration specifications. For example,

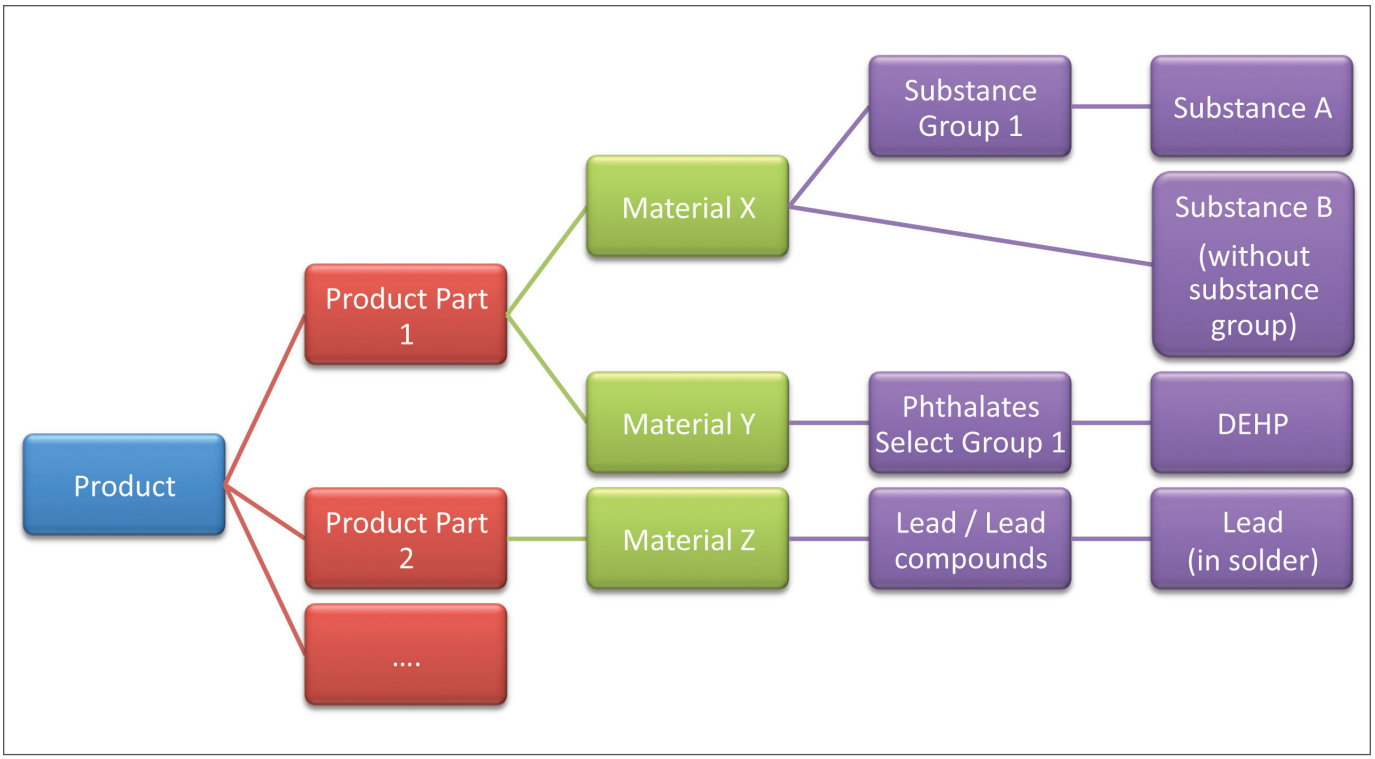

Figure 3: Example Material Declaration with Optional Declaration of Product Parts and Materials

The IEC 62474 International Standard is available from the IEC webstore or your favorite reseller of standards documents.

a material declaration that reports only a single highest concentration of lead in the product can be deceiving when assessing RoHS compliance, which is based on homogeneous materials. The highest concentration may be covered by a RoHS exemption, potentially masking a lower concentration of lead in another material. The IEC 62474 DSL listing of *lead and lead compounds* for EU RoHS requires that all instances of lead in homogeneous materials above 0.1 mass percent must be declared. This requires the supplier to provide more information about declarable substances in their product, but it significantly improves what the recipient can do with the information.

There are also a few circumstances when a product part must be declared. For example, when the substance reporting threshold is mass percent of a battery, a battery included in a product is a product part and it must be explicitly declared so that the recipient of the material declaration can properly assess conformity.

In the case of REACH SVHCs, the threshold of the substance is based on the mass percent of the article[1]; thus, in general, only one declaration of the substance is required if the SVHC substance declaration is assigned directly to the product. However, if product parts, materials or substance groups are declared, then the SVHC must be allocated and assigned to each applicable product part, material and/or substance group that contains the SVHC. Note that even if the SVHC is allocated across several materials or parts, the reporting is still based on 0.1% of mass (w/w) of the entire article and not the mass percent of individual occurrences.

KEEPING THE DECLARABLE SUBSTANCE LIST UP-TO-DATE

The key challenge with publishing a list of substances is keeping the list up to date with environmental regulations. The IEC 62474 DSL is maintained by a Validation Team (VT 62474) that currently consists of 39 representatives from 14 countries (including the authors of this article) covering North and South America, Europe, Asia and Australia. VT 62474 includes experts from chemical manufacturers, component manufacturers, finished product manufacturers, and consultants.

The VT 62474 typically conducts maintenance cycles to update the database content two or three times per year. The update process is triggered when a National Committee or a VT 62474 member submits a formal change request. The VT 62474 will also pro actively screen new substances added to existing regulations (such as substances being considered for the EU REACH SVHC Candidate List).

The IEC 62474 standard specifies the rules that the VT 62474 follows to evaluate a change request and the decision criteria it uses to determine whether or not a substance should be included on the DSL. Two key evaluation criteria used by VT62474 are:

- Is the substance contained in electronic products; and
- Does the substance remain in the product above the regulatory threshold?

After the VT evaluates the change request and supporting evidence, a final validation phase requires each participating country to vote on the change.

Updates to the IEC 62474 database content were made in June 2013 and September 2013. Another maintenance cycle was launched in October 2013 with final validation voting just completed at the time that this article was being written. The update to the IEC 62474 database is expected in March 2014. The June and September 2013 updates included 35 additions and 10 modifications to the DSL. Most of the updates were the result of additional substances added to the REACH SVHC Candidate List, but there were also a few modifications and a couple of substance deletions. The maintenance cycle that was started in October 2013 focused on the REACH SVHCs that were added to the SVHC Candidate List on December 16, 2013. A comprehensive summary of the changes is available at: http://rohs.ca/IEC62474.html.

HOW TO GET MORE INFORMATION

The IEC 62474 International Standard is available from the IEC webstore or your favorite reseller of standards documents. The IEC 62474 database containing the DSL, XML schema and developer's table is publicly available at http://std.iec.ch/iec62474. A user guidance document is also in the works. The user guidance, which will be designated IEC 62474-1 has an expected publication date of late 2014.

The online database includes a news page that provides information on the status of the database and a summary of updates and a contact page. Additional information and a discussion forum are

Maintaining the compliance of products to environmental regulations has become a significant challenge and effort for product manufacturers.

also available on a blog hosted by ECD Compliance at http://iec62474.rohs.ca.

SUMMARY

Maintaining the compliance of products to environmental regulations has become a significant challenge and effort for product manufacturers. Internal processes are needed to identify requirements, obtain information from a global supply chain, assess conformity/risks, and to maintain documentation (particularly for the RoHS 2 technical documentation requirement). This needs to be accomplished efficiently and cost effectively and be flexible enough to accommodate new regulations. Leveraging industry best practices, including the use of risk assessment can be particularly valuable.

For substance restrictions and disclosure, identifying the substances of concern that need to be considered during the design, procurement, and manufacturing phases of a product is an important and practical first step to help focus the conformity efforts. The Declarable Substance List (DSL) included in IEC 62474 provides a convenient starting point for engineering and procurement specifications and helps organizations focus on key substances for market acceptance. The standardized rules and data exchange format provided by IEC 62474 enable manufacturers and suppliers to exchange material and substance information using a common language and rules. A supplier that prepares their material declarations in conformance with IEC 62474 enables their customers to interpret the information to assess conformance of the product against substance restrictions. IN

REFERENCES

1. EU Regulation (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), 18 December 2008.
2. EU Directive 2011/65/EU, on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast), 8 June 2011.
3. IEC 62474 Material declaration for products of and for the electrotechnical industry may be purchased from the IEC webstore at http://webstore.iec.ch or a reseller of IEC International Standards.
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Fundamentals of Electrostatic Discharge

Part Two: Principles of ESD Control – ESD Control Program Development

BY THE ESD ASSOCIATION

In Part One of this series, Introduction to ESD, we discussed the basics of electrostatic charge and discharge, the mechanisms of creating charge, materials, types of ESD damage, ESD events, and ESD sensitivity. We concluded our discussion with the following summary:

1. Virtually all materials, including conductors, can be triboelectrically charged.
2. The amount of charge is affected by material type, speed of contact and separation, humidity, and several other factors.
3. Charged objects have electrostatic fields.
4. Electrostatic discharge can damage devices so a parameter fails immediately, or ESD damage may be a latent defect that may escape immediate detection, but may cause the device to fail prematurely.
5. Electrostatic discharge can occur throughout the manufacturing, test, shipping, handling, or operational processes, and during field service operations.
6. ESD damage can occur as the result of a discharge **to** the device, **from** the device, or from charge transfers resulting from electrostatic fields. Devices vary significantly in their sensitivity or susceptibility to ESD.

Protecting products from the effects of ESD damage begins by understanding these key concepts of electrostatic charges and discharges. An effective ESD control program requires an effective training program where all personnel involved understand the key concepts. Armed with this information, you can then begin to develop an effective ESD control program. In Part Two we will focus on some basic principles of ESD control and ESD control program development.

BASIC PRINCIPLES OF STATIC CONTROL

Controlling electrostatic discharge (ESD) in the electronics manufacturing environment is a formidable challenge. However, the task of designing and implementing ESD control programs becomes less complex if we focus on just six basic principles of static control. In doing so, we also need to keep in mind the ESD corollary to Murphy's law, "no matter what we do, static charge will try to find a way to discharge."

Because we simply can't eliminate all generation of electrostatic charge, our fifth principle is to safely dissipate or neutralize those electrostatic charges that do occur.

Design In Protection

The first principle is to *design products and assemblies to be as resistant as reasonable* from the effects of ESD. This involves such steps as using less static sensitive devices or providing appropriate input protection on devices, boards, assemblies, and equipment. For engineers and designers, the paradox is that advancing product technology requires smaller and more complex geometries that often are more susceptible to ESD. The Industry Council on ESD Target Levels and the ESD Association's "Electrostatic Discharge (ESD) Technology Roadmap", revised April 2010, suggest that designers will have less ability to provide the protection levels that were available in the past. Consequently, the ESD target levels are reduced to 1000 volts for Human Body Model robustness and 250 volts for robustness against the Charged Device Model, with tendency to reduce these values further. Those target values are considered to be realistic and safe levels for manufacturing and handling of today's products using basic ESD control methods as described in international industry standards as e.g. ANSI/ESD S20.20 or IEC 61340-5-1. When devices with lower ESD target levels must be used and handled, application-specific controls beyond the principles described here may be required.

Define the Level of Control Needed in Your Environment

What is the most sensitive or ESD susceptible ESDS you are using and what is the classification of withstand voltage of the products that you are manufacturing and shipping? In order to get an idea of what is required, it is best to know the Human-Body Model (HBM) and Charged-Device Model (CDM) sensitivity levels for all devices that will be handled in the manufacturing environment. ANSI/ESD S20.20 and IEC 61350-5-1, both published in 2007, define control program requirements for items that are sensitive to 100 volts HBM; future version of those standards will most likely address also items that are sensitive to 200 volts CDM. With documentation, both standards allows requirements to be tailored as appropriate for specific situations.

Identify and Define the Electrostatic Protected Areas (EPA)

Per Glossary ESD ADV1.0 an ESD protected area is "A defined location with the necessary materials, tools and equipment capable of controlling static electricity to a level that minimizes damage to ESD susceptible items". These are the areas in which you will be handling ESD sensitive items and the areas in which you will need to implement the basic ESD control procedures including bonding or electrically connecting all conductive and dissipative materials, including personnel, to a known common ground.

Reduce Electrostatic Charge Generation

If projections of ESD sensitivity are correct, ESD protection measures in product design will be increasingly less effective in minimizing ESD losses. The fourth principle of control is to *reduce electrostatic charge generation and accumulation* in the first place. It's fairly basic: no charge – no discharge. We begin by eliminating as many static charge generating processes or materials, specifically high-charging insulators such as common plastics, as possible from the EPA work environment. We keep conductive/dissipative materials at the same electrostatic potential using equipotential bonding or attaching to equipment ground. Electrostatic discharge does not occur between materials kept at the same potential. In the EPA, ESD control items should be used in place of more common factory products such as worksurface mats, flooring, smocks, etc. which are to be attached to ground to reduce charge generation and accumulation. Personnel are grounded via wrist straps or a flooring/footwear system. While the basic principle of "controlling static electricity to a level that minimizes damage" should be followed, complete removal of charge generation is not achievable.

Dissipate and Neutralize

Because we simply can't eliminate all generation of electrostatic charge in the EPA, our fifth principle is to *safely dissipate or neutralize those electrostatic charges* that do occur. Proper grounding and the use of conductive or dissipative materials play major roles. For example, personnel starting work may have a charge on their body; they can have that charge removed by attachment to a wrist strap or when they step on ESD flooring while wearing ESD control footwear. The charge goes to ground rather than being discharged into a sensitive part. To prevent damaging a charged device, the magnitude of the discharge current can be controlled with static dissipative materials.

For some objects, such as common plastics and other insulators, being non-conductors grounding cannot remove an electrostatic charge because there is no pathway which is conductive enough to reduce the charge in a reasonable time. If the object cannot be eliminated from the EPA, ionization can be used to neutralize charges on these insulators. The ionization process generates negative and positive ions. The like charged ions are repelled from a charged object while the opposite charged ions are attracted to the surface of a charged object, therefore neutralizing the object (see Figure 1). If the ionizer is balanced, the net charge is zero.

Protect Products

Our final ESD control principle is to *prevent discharges that do occur from reaching susceptible parts and assemblies*. There are a variety of ESD control packaging and material handling products to use both inside and outside the EPA. One way is to protect ESD sensitive products and assemblies with proper grounding or shunting that will "dissipate" any discharge away from the product. A second method is to package, to store, or to transport ESD sensitive products in packaging that is low charging and are conductive/dissipative so can remove charges when grounded. In addition to these properties, packaging used to move ESD sensitive items outside the EPA should have the ESD control property of "discharge shielding". These materials should effectively shield the product from charges and discharges, as well as reduce the generation of charge caused by any movement of product within the container.

ELEMENTS OF AN EFFECTIVE ESD CONTROL PROGRAM

While these six principles may seem rather basic, they can guide us in the selection of appropriate

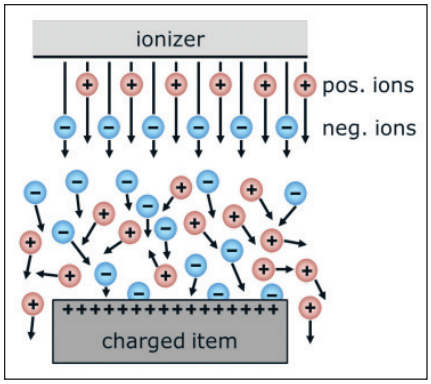

Figure 1: Principle of neutralization of a charged object by an ionizer that generates negative and positive ions. The like charged ions are repelled from a charged object while the opposite charged ions are attracted to the surface of a charged object, neutralizing the object.

materials and procedures to use in effectively controlling ESD. In most circumstances, effective programs will involve all of these principles. No single procedure or product will do the whole job; rather effective static control requires a full ESD control program.

How to we develop and maintain a program that puts these basic principles into practice? How do we start? What is the process? What do we do first? Ask a dozen experts and you may get a dozen different answers. But, if you dig a little deeper, you will find that most of the answers center on similar key elements. You will also find that starting and maintaining an ESD

Figure 2: Six critical elements of a successful ESD control program

control program is similar to many other business activities and projects. Although each company is unique in terms of its ESD control needs, there are at least 6 critical elements to successfully developing, implementing, and maintaining an effective ESD control program (see Figure 2).

Establish an ESD Coordinator and ESD Teams

A team approach particularly applies to ESD because the problems and the solutions cross various functions, departments, divisions and suppliers in most companies. ESD team composition includes line employees as well as department heads or other management personnel. The ESD team may also cut across functions such as incoming inspection, quality, training, automation, packaging, and test. ESD teams or committees help assure a variety of viewpoints, the availability of the needed expertise, and commitment to success. An active ESD team helps unify the ongoing effort.

Heading this ESD team effort is an ESD program coordinator ("ESD coordinator"). Ideally, this responsibility should be a full-time job. However, we seldom operate in an ideal environment and you may have to settle for the function to be a major responsibility of an individual. The ESD coordinator is responsible for developing, budgeting, and administering the program. The ESD coordinator also serves as the company's internal ESD consultant to all ESD control programs areas.

Assess Your Organization, Facility, Processes and Losses

Your next step is to gain a thorough understanding of your environment and its impact on ESD. Armed with your product quality loss and ESD sensitivity data, you can evaluate your facility, looking for areas and procedures that may possibly cause

Train and retrain your personnel in ESD control and your company's ESD control program and procedures. A sustained commitment and mind set among all employees that ESD prevention is a valuable, on-going effort by everyone is one of the primary goals of training.

ESD problems. Be on the lookout for things such as static generating materials, personnel handling procedures for ESD sensitive items, and contacts of ESD sensitive devices to conductors

Document your processes or work instructions. Observe the movement of people and materials through the areas. Note those areas that would appear to have the greatest potential for ESD problems. Remember, that ESD can occur in the warehouse just as it can in the assembly areas. Then conduct a thorough facility survey or audit. Measure personnel, equipment, and materials to identify proper resistance ranges and the presence of electrostatic fields in your environment.

Before seeking solutions to your problems, you will need to determine the extent of your product quality losses to ESD. These losses may be reflected in receiving reports, Quality Assurance and Quality Control records, customer returns, in-plant yields, failure analysis reports, and other data that you may already have or that you need to gather. This information not only identifies the magnitude of the problem, but also helps to pinpoint and prioritize areas that need attention. Where available, the potential for future problems as a result of technology roadmaps and internal product evolution should be considered.

Document your actual and potential ESD losses in terms of defective components, rework, customer returns, and failures during final test and inspection. Use data from outside sources or the results of your pilot program for additional support. Develop estimates of the savings to be realized from implementing an ESD control program.

You will also want to identify those items (components, assemblies, and finished products) that are the most sensitive to ESD noting the classification or withstand voltage. Note that two functionally identical items from two different suppliers may *not* have similar ESD ratings.

Establish and Document Your ESD Control Program Plan

After completing your assessment, you can begin to develop and document your ESD control program plan. The plan should cover the scope of the program and include the tasks, activities and procedures necessary to protect the ESD sensitive items at or above the ESD sensitivity level chosen for the plan. Prepare and distribute written procedures and specifications so that all departments have a clear understanding of what is to be done. Fully documented procedures will help you meet the administrative and technical elements of ANSI/ESD S20.20 or IEC 61340-5-1 and help you with ISO 9000 certification as well.

Build Justification to Get the Top Management Support

To be successful, an ESD program requires the support of your top management, at the highest level possible. What level of commitment is required? To obtain commitment, you will need to build justification for the plan. You will need to emphasize quality and reliability, the costs of ESD damage, the impact of ESD on customer service and product performance. It may be useful to conduct a pilot program if the experience of other companies is not sufficient and you have an expectation that you can show meaningful results in the pilot.

Prepare a short corporate policy statement on ESD control. Have top management co-sign it with the ESD coordinator. Periodically, reaffirm the policy statement and management's commitment to it. Published articles such as "The 'Real' Cost of ESD Damage" by Terry Welsher should be provided to top management.

Develop and Implement a Training Plan

Train and retrain your personnel in ESD control and your company's ESD control program and procedures. Training should include testing or other method to verify comprehension. Proper training for line personnel is especially important. They are often the ones who have to live with the procedures on a day-to-day basis. A sustained commitment and mind set among all employees that ESD prevention is a valuable, on-going effort by everyone is one of the primary goals of training. Please be aware that it might be necessary to tailor the ESD training to the education of the trainees.

ANSI/ESD S20.20 requires a written training plan, however, your company has the flexibility to determine how best to design the plan.

Develop and Implement a Compliance Verification Plan

Developing and implementing the program itself is obvious. What might not be so obvious is the need to continually review, audit, analyze, obtain feedback and improve. Auditing is essential to ensure that the ESD control program is successful. You will be asked to continually identify the return on investment of the program and to justify the savings realized. Technological changes will dictate improvements and modifications. Feedback to employees and top management is essential. Management commitment will need reinforcement.

Include both reporting and feedback to management, the ESD team, and other employees as part of your plan. Management will want to know that their investment in time and money is yielding a return in terms of quality, reliability and profits. ESD team members need a pat on the back for a job well done. Other employees will want to know that the procedures you have asked them to follow are indeed worthwhile. It is helpful to integrate the process improvement process into the overall quality system and use the existing quality tools such as root cause analysis and corrective action reports. As you find areas that need work, be sure to make the necessary adjustments to keep the program on track.

Conduct periodic evaluations of your program and audits of your facility. You will find out if your program is successful and is giving you the expected return. You will spot weaknesses in the program and shore them up. You will discover whether the procedures are being followed.

ANSI/ESD S20.20 and IEC 61340-5-1 require a written compliance verification plan, however, your company has the flexibility to determine how best to design the plan. Test procedures are described in ESD TR53-01-06 Compliance Verification of ESD Protective Equipment and Materials which is available as complimentary download from www.ESDA.org. The objective is to identify if significant changes in ESD equipment and materials performance have occurred over time. Each user will need to develop their own set of test frequencies based on the critical nature of those ESD sensitive items handled and the risk of failure for the ESD protective equipment and materials.

CONCLUSION

Six principles of ESD control and six key elements to ESD control program development and implementation are your guideposts for effective ESD control programs.

The six basic principles of static control are:

1. Design in protection
2. Define the level of control needed in your environment
3. Identify and define the electrostatic protected areas (EPA)
4. Reduce electrostatic charge generation
5. Dissipate and neutralize
6. Protect products

Six key elements to to ESD control program development and implementation are:

1. Establish an ESD Coordinator and ESD teams
2. Assess your organization, facility, processes and losses
3. Establish and document your ESD control program plan
4. Build justification to get the top management support
5. Develop and implement a training plan
6. Develop and implement a compliance verification plan

In Part Three, we'll take a close look at specific procedures and materials that become part of your ESD control program. IN

FOR ADDITIONAL INFORMATION

- *ANSI/ESD S20.20-2007 – Standard for the Development of Electrostatic Discharge Control Program*, ESD Association, Rome, NY.
- Dangelmayer, Theodore, *ESD Program Management: A Realistic Approach to Continuous, Measurable Improvement in Static Control*, 1999, Kluwer Academic Publishers, Boston, MA
- *ESD TR20.20, ESD Control Handbook*, ESD Association, Rome, NY.
- *ESD TR53-01-06, Compliance Verification of ESD Protective Equipment and Materials,* ESD Association, Rome, NY.
- Industry Council on ESD Target Levels, White Paper I: "A Case for Lowering Component Level HBM/MM ESD Specifications and Requirements", Revision 2.0, October 2010.
- Industry Council on ESD Target Levels, White Paper II: "A Case for Lowering Component
- Level CDM ESD Specifications and Requirements", Revision 2.0, April 2010.
- ESDA Technology Roadmap, March 2013
- IEC 61340-5-1, ed. 1.0, *"Electrostatics – Part 5.1: Protection of electronic devices from electrostatic phenomena – General requirements"*, IEC, Geneva, Switzerland, 2007-08.
- Terry Welsher, "The 'Real' Cost of ESD Damage," *In Compliance Magazine*, May 2010.

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BUSINESS News

Arizona Polymer Flooring Launches StatRez™ Static Control Coatings to Protect Areas Requiring Static Dissipative and Conductive Flooring

Arizona Polymer Flooring (APF) has announced the launch of StatRez™ Static Control Flooring Systems, which are designed to protect areas requiring static dissipative or conductive flooring. The static control properties of StatRez prevent electrostatic damage to products and equipment, limit the ability of personnel to build up a charge and quickly remove a charge from a person or equipment. Three systems are available offering a range of static dissipative and conductive protection: StatRez PC 350/350C System, StatRez PC 225/225C System and StatRez PC 925/925C System. To learn more, visit the APF website at www.apfepoxy.com or check out the StatRez video youtu.be/61UbfA37khU.

Fair-Rite Products Corp. Announces the Addition of Flexible Ferrites

Fair-Rite Products Corp. has announced the addition of Flexible Ferrites to their extensive product line-up. These RoHS compliant flexible sheets are offered in four thicknesses and six material grades. Applications include shielding antennas and RF circuits from reflection and eddy currents induced by metal surfaces. Product samples are available upon request.
For information about Fair-Rite's flexible ferrite, please visit www.fair-rite.com/flex.

Gowanda's RF Inductors Approved for Military Market

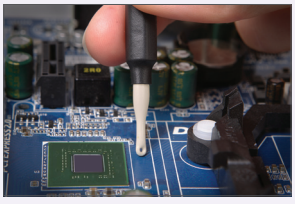
Gowanda Electronics announced that the company recently achieved military approval for four thru-hole RF inductor series: MLRF10M, MLRF15M, MLRF18M and MLRF17S. These Gowanda series meet the military's Qualified Product List (QPL) requirement for military spec MIL-PRF-15305. These new wirewound, molded, thru-hole, RF inductors are designed for radio frequency applications in military, aerospace and defense communities. This includes use in communication, guidance and security applications, as well as in radar, test & evaluation and special mission applications.
For more information regarding pricing, delivery or upscreening requirements, contact Gowanda Electronics at USA +1-716-532-2234 or sales@gowanda.com.

inTEST Thermal Introduces High-Temperature System for Electronics and Materials Test & Design

A temperature control system for high-speed and high-temperature testing of components, sensors, and PCBs has been introduced by inTEST Thermal. The Thermostream® ATS-750 delivers clean dry air from -90 to 300°C to support growing demands for testing electronics that need to operate at higher temperatures. Thermal cycling with wide swings in temperature can increase test time, decreasing throughput. See technical details at www.intest-thermal.com/high-temperature-forcing-electronics-test-750.

Harmonics of up to 10 GHz ˆ SX Near-Field Probe Set from Langer EMV-Technik GmbH

Langer EMV-Technik GmbH has released their SX near-field probes. They feature a frequency range from 1 GHz to 10 GHz and enable EMC analyses of interferences emitted by electronic boards, components and IC pins with high internal frequencies. The SX probe head's high resolution (SX R3-1 achieves 1 mm and SX E03 covers up to 4 x 4 mm) allows the developer to pinpoint RF sources on densely packed boards or on IC pins. For more information, visit www.langer-emv.de.

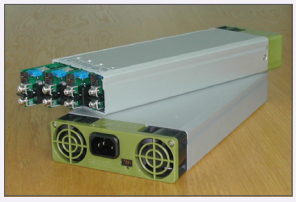


New Narda Hand Held Direction Finder with I/Q Analysis

Narda Safety Test Solutions has equipped the second generation of its Interference and Direction Analyzer with I/Q analyzer functions. The instrument records the I/Q data in real time at a maximum channel bandwidth of 32 MHz, and saves up to 250,000 I/Q data pairs without compression, i.e. without loss of data. Based on the I/Q data, the device generates high resolution spectrograms, persistence spectrums and time domain displays that were previously only available from high cost laboratory instruments. Radio spectrum interference and impairments can thus be detected and analyzed on the spot.
For more information, visit www.narda-sts.com.

Highly Configurable 1U Switch Mode Power Solutions from Powerstax

Powerstax has announced the introduction of their Multistax® Premium family of configurable switch mode power supplies. Targeted at demanding application scenarios with exacting cost/performance requirements, such as industrial, communication and medical, these units expand the scope of what is achievable by engineers in their power system designs. The new units are offered in 2 different chassis versions; a 4 slot 600W rated version and 6 slot 1200W rated version. Their slots can be populated with multiple power modules in order that the specific voltage and current combination requirements can be met. Their outputs are fully floating, so they can be brought together in either series or parallel (as well as series-to-parallel) arrangements.



For more information, visit www.powerstaxplc.com.

New Rohde & Schwarz RTE Oscilloscopes Combine Ease of Use with Powerful Analysis Tools

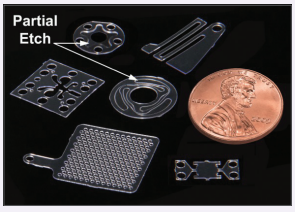
Rohde & Schwarz has announced the introduction of their R&S RTE oscilloscope is now available with bandwidths from 200 MHz to 1 GHz. An acquisition rate of more than one million waveforms per second helps users find signal faults quickly. The scope's highly accurate digital trigger system with virtually no trigger jitter delivers highly precise results. The new R&S RTE can now be ordered from Rohde & Schwarz with two or four channels and a bandwidth of 200 MHz, 350 MHz, 500 MHz or 1 GHz. For more information, visit www.scope-of-the-art.com/ad/press/rte.

SCHURTER T9 Circuit Breaker Now Available for PCB Mounting

SCHURTER's T9 fuseholder style thermal circuit breaker series is now expanded to include Model T9-818 for PCB mounting. The new model complements the existing T9 series assortment for panel mounting, providing a complete range of mounting styles equivalent to closed fuseholders. The T9 series features dimensions comparable to those of traditional fuseholders and is similarly designed for direct placement on circuit boards. More information on the T9-818 can be found online at www.schurterinc.com/New-Products/Circuit-Breakers.

New Polyester Photo Etching Capability by Tech-Etch

Tech-Etch has now developed a process to photochemically etch polyester sheet up to .010" thick. All of the advantages of photo etching, clean burr-free edges, the ability to create intricate features with minimal tooling cost, and fast delivery, can now be applied to this high-strength, hydrophobic, solvent-resistant, optically clear material. Polyester sheet can also be depth etched with grooves or channels unavailable with other manufacturing methods. For additional information, visit www.tech-etch.com/photoetch/polyester.html.



Vishay Launches New Automotive-Grade Precision Thin Film Chip Resistor Laboratory Sample Kits

Vishay Intertechnology, Inc. has announced that the company is now offering laboratory sample kits of its automotive-grade precision thin film chip resistors. The MCW 0406 AT (LCW AT 96/4) and MCT 0603 AT (LCT AT 96/4) kits aid engineers in prototyping, and speed time to market in a wide range of electronic systems. The devices included in the sample kits are RoHS-compliant and offer lead (Pb)-free solder terminations. The MCT 0603 AT (LCT AT 96/4) is approved according to EN 140401-801. For more information, visit www.vishay.com.

New GORE® Portable Electronic Vent Combines Highest Airflow With Waterproof Protection

W. L. Gore & Associates has expanded the waterproofing solutions in its line of GORE® Portable Electronic Vents. The new PE3 Series delivers the highest airflow of black venting solutions for OEMs in this rapidly changing market. This level of airflow allows for a smaller vent to improve the integrity and reliability of portable electronics by equalizing pressure while providing immersion protection. For more information about Gore's portable electronic venting products, visit www.gore.com/portableelectronics.

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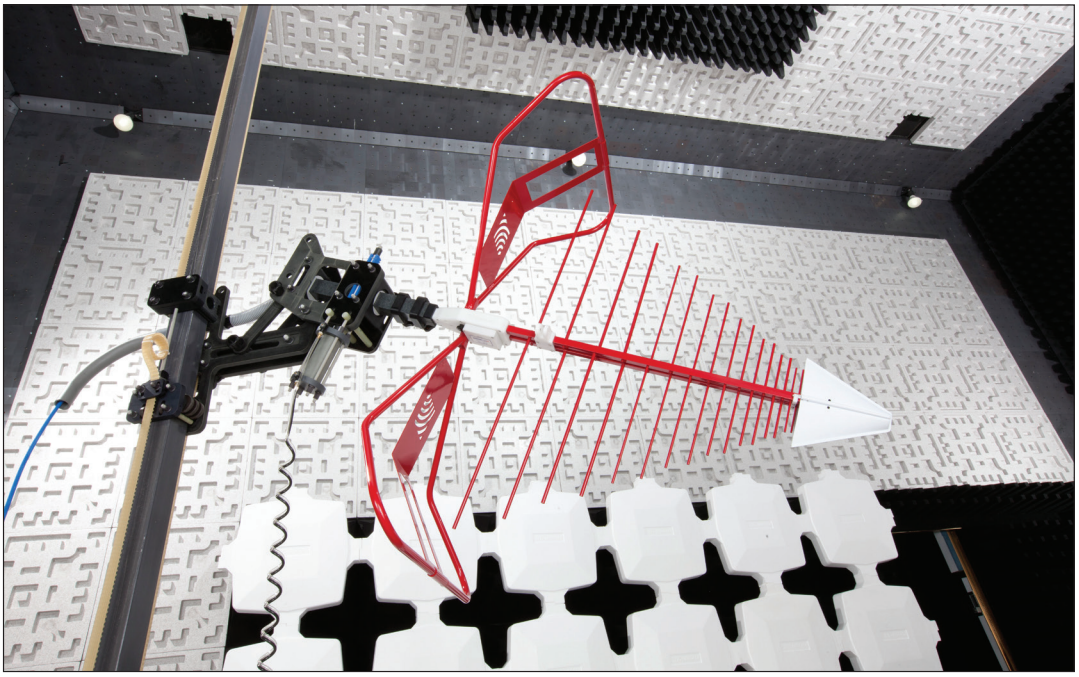

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