

# PGM Diversified Industries, Inc. Forensic Engineering Update

Volume 2

Summer 2000

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Welcome to the Forensic Engineering Update. With these quarterly newsletters we hope to keep our client base informed with regards to the latest in product liability cases, precedents, product recalls, information resources and new areas of forensic analysis.

## **Product Recalls**

ACCO Brands Inc. based in Lincolnshire, IL has recalled several models of its Apollo light boxes. The models recalled are LB100, LB101, LB102 and LB110. The model number is located on a sticker attached to the unit's side that reads "Portable Light Box... CSA". The light boxes were sold in a box labeled in part: APOLLO PRESENTATION PRODUCTS, GLOWPRO PORTABLE LIGHT BOX, Made in China." Approximately 30,000 light boxes were recalled due to loose wiring and inadequate grounding that poses a danger of fire, electrocution or shock. Apollo can be reached at 1-800-532-6853 or through their web site:  
[www.apollo.presentation.com](http://www.apollo.presentation.com). *from AP reports*

## **Fire Causes - The High Resistance Connection**

Fires of unknown electrical origin that are attributed to "bad wiring" or a defect in an appliance or piece of equipment may actually have been caused by a high resistance electrical connection in the device or its associated wiring.

**What is a high resistance connection?** A high resistance connection (or HRC, for short) is just that, a connection between two or more contact surfaces that resists the flow of electricity. The contact surfaces could be the prongs on a plug and the metal contacts inside a convenience outlet, or a clamping screw and a conductor, or two conductors inside a wire nut to name a few.

**Why is an HRC potentially dangerous?** Anything that impedes the flow of electricity generates heat. From Ohm's Law where the voltage across a device is equal to the current flowing through the device multiplied by its electrical resistance,  $V=IR$ , and the fact that power is equal to the square of the current flowing through the device multiplied by the device's resistance (or the voltage multiplied by the current),  $P=I^2R=VI$  we can determine how much power is being dissipated in an HRC. For example, the #12AWG 7 strand copper wiring used in many homes has a resistance of 2.05 ohms ( )/1000 ft. If we have an outlet 50 feet from the breaker panel the resistance of the wiring connecting the outlet to panel will be .205 (100ft x 2.05 /1000 ft.) If we assume zero resistance at the contacts in the outlet when a load is plugged in and a 20 ampere load, we find that the power dissipated through the wiring is 82 watts, roughly the amount of power consumed by a reading lamp. Since this 82 watts is being dissipated over the length of the wire the actual temperature increase of wire itself is minimal. Now, if we introduce an HRC at the outlet of 2 our circuit resistance now becomes 2.205 . With a 20A load the power being dissipated will now be 882 watts, or roughly the power used by a small heater or coffeepot. While we still have 82 watts being dissipated over the length of the wiring, 800 watts is being dissipated at the point of the HRC. The HRC may be confined to a very small volume, less than .1 cubic inch if it exists between a clamping screw and a wire on the outlet. Because you have a great deal of power being dissipated in a very small volume,

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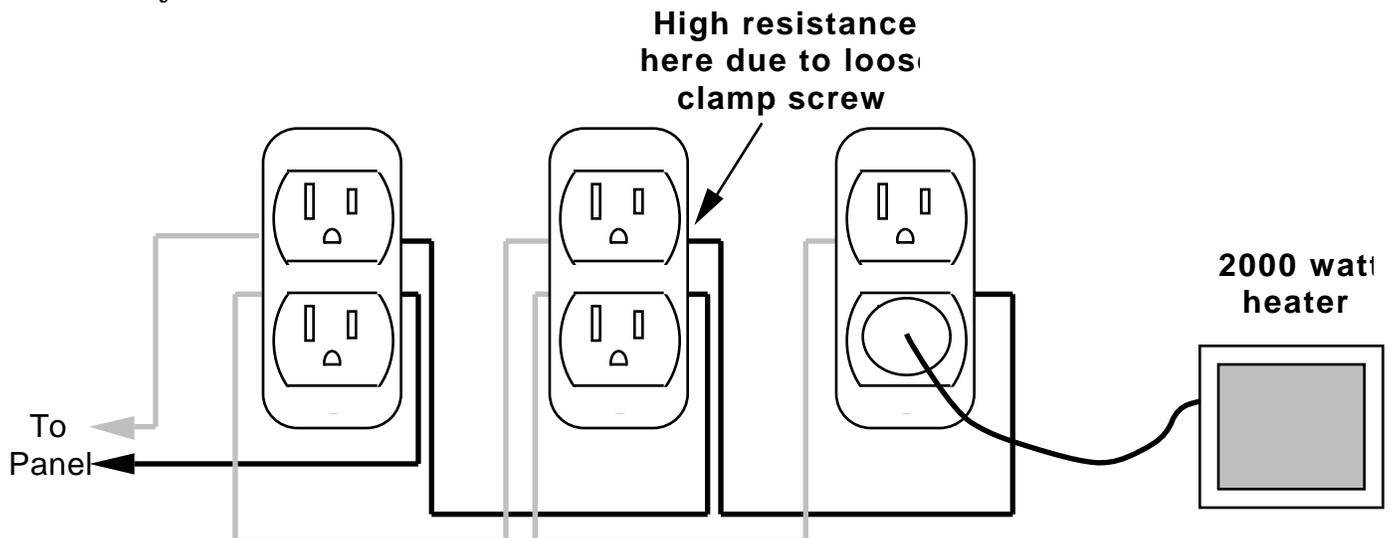
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this volume can get extremely hot. The temperature can get high enough to melt the insulation off of the wires, melt the plastic of the outlet or plug, and potentially ignite an adjacent wooden stud. Due to the power density, the HRC may incandesce or glow visibly. **What causes an HRC?** An HRC can be caused by numerous problems. A loose clamp screw, weak spring contact, oxide or other contamination on the contact surfaces can cause HRCs. Oxide contamination is an especially prevalent problem with aluminum wiring, which is why there were so many problems with aluminum wiring installations 20 or so years ago. Aluminum oxide is very good insulator. Think about it, aluminum oxide is the material used on many types of sandpapers and is the base crystal matrix for several types of precious stones. This material can be very hard, and forms almost immediately on an open surface of aluminum. Installation of aluminum wiring conductors typically requires the use of an anti-oxidant material and a tight mechanical connection to break apart the oxide layer on the conductor's surface. Weak spring contacts, especially those on low cost outlets designed for solid conductors can cause HRCs. Loose or improperly installed clamp screws can cause HRCs. One recent case involved an incorrectly installed retaining screw on a cable lug for a circuit breaker. The retaining screw prevented the conductor from being tightly fastened in the lug. This HRC caused heating of the bus bar to which it was attached and subsequent tripping of the breaker. The heating of the bus bar tripped the breaker because the breaker "thought" it was in an overload condition, even though it was not. The breaker had functioned as it was designed; unfortunately, the breaker trip resulted in a loss of livestock. Loose connections can result in arcing which can also be a potential ignition source.

**Can an HRC cause a fire in an outlet even though nothing is plugged into it?** Absolutely! If, for example you have several outlets daisy chained together as in the following illustration with a load connected to the last outlet, an HRC may exist on one of the outlets in the middle of the chain. While all the other outlets may be at room temperature, the middle outlet may become very hot due to the HRC.



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A plug inserted into the top outlet can exhibit thermal damage such as melted plastic even though the device attached to the plug may not even be energized. This damage is due to the conduction of heat from the HRC through the metal components of the outlet.

**The moral.** Don't be quick to blame a fire on a defective power cord or AC adapter block that exhibits thermal damage. The root cause may be something more insidious, like a high resistance connection!

## **New Areas of Support**

PGM Diversified Industries is pleased to announce a new program relating to lawyer/jury education. We realize that working on technologically sophisticated cases can be frustrating for both the attorney and the jury. We can provide educational support for your cases by developing materials and programs so that you and the jury can obtain a better understanding of the case subject matter.

PGM Diversified Industries is also pleased to announce its affiliation with Midwest Industrial Hygiene and its principal Mr. George Niedermeyer. Mr. Niedermeyer is certified by the American Board of Industrial Hygiene as an industrial hygienist and has a degree in chemistry from Case Western Reserve University in Cleveland, Ohio. Mr. Niedermeyer has experience in industrial hygiene monitoring, strategy and assessment as well as OSHA compliance, fire prevention, confined space entry programs, HAZCOM and HAZWHOPPER training, RCRA programs and hazard evaluation. Midwest Industrial Hygiene can be contacted at 216-932-4156.

## **Upcoming Events**

PGM Diversified Industries in conjunction with Apple Computer is pleased to sponsor a Final Cut Pro seminar on Monday, September 11, 2000 at the Cleveland Hilton South at I-77 and Rockside Road in Independence, Ohio. This 2-1/2 hour seminar will cover the entire digital video workflow; from video acquisition and professional desktop editing to final output to tape or web. Come and learn how this powerful tool can assist you in accident scene documentation, video depositions and evidence gathering. Why pay a video company for something that you can do in house? Choose either the morning (9:30 AM to 12:00PM) or the afternoon session (1:30 PM to 4:00 PM). These seminars are limited to 54 people per session so register early. Register online at [www.seminars.apple.com/series/finalcut](http://www.seminars.apple.com/series/finalcut) or call 800-895-4853 and ask to register for Final Cut Pro. For more information call us at 440-885-3500.

Remember, if you have a case involving electrical or electronic equipment, appliances or computer software call us for a case evaluation. Typically, we can provide a satisfactory resolution for your case. Better than 90% of our cases are settled to our client's satisfaction before trial.

Additional copies of the Forensic Engineering Update can be downloaded in pdf format from our web site: [www.pgmdi.com](http://www.pgmdi.com) and follow the Forensic Engineering link.