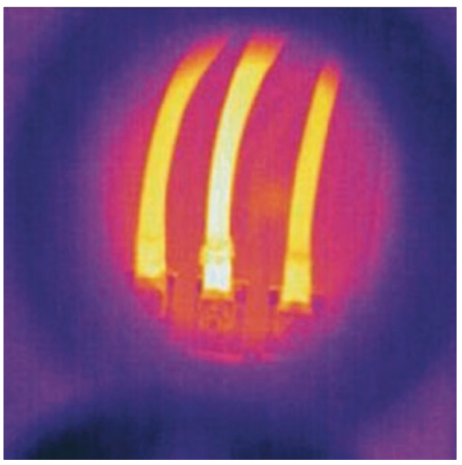
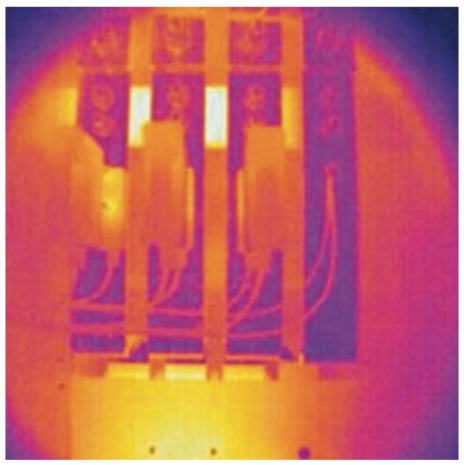
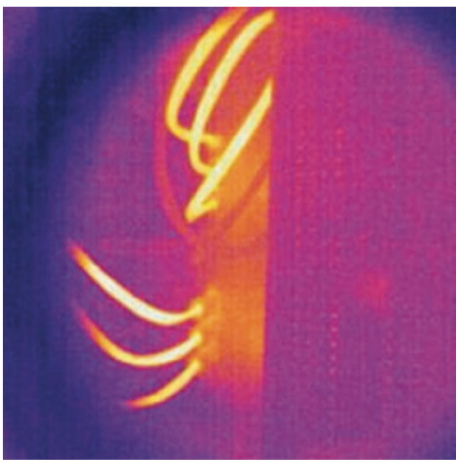
The 3 hidden hazards of IR thermography







SDMyers™ ACTS 4:12

How to avoid mistakes that jeopardize productivity, profits and lives.

It's your job to maintain the efficiency of your operation while protecting both ROI and the workers who depend on the decisions you make to keep them safe. A big (and sometimes overlooked) part of that job is keeping your electrical equipment operating safely and productively.

Congratulations to you for investing in (or considering) IR thermography to inspect motors, pumps, valve flow and leaks. Did you know it's equally invaluable for inspecting electrical components? It adds another dimension to a visual inspection to see what's going on behind closed panel doors. Comparing thermography inspection results over time lets you see problems develop and gives you the ability to intervene before hot spots threaten your operation.

You've done your homework. You've seen it work. You know IR thermography's time-tested advantages for condition monitoring. But no tech is perfect. **IR comes at a cost in ways you may not have considered.** Let's take a moment to look closer at its drawbacks and their effects on your operation's safety and bottom line.

We've also included some ways to help eliminate these hidden hazards and protect your operation and your workers.

Hazard #1:

Lost Productivity

Your business lives or dies on productivity. Knowing that every minute matters, regularly scheduled inspections and maintenance are critical to catching problems like electrical overloading and component failure before they stop your operation in its tracks.

IR thermography gives your team a clear picture of potential problem spots. But it requires a lot of downtime. Typical IR inspections of energized components require opening panels… and that's an extremely time-consuming and risky job that negatively impacts your efficiency.

Even proper IR inspections create downtime.

The first problem is scheduling. You get IR readings that most consistently represent your operating conditions when you're running at 100%, but that means inspecting when your operation is at its most productive. Too often, inspections are pushed into the night shift when things slow down, running the risk of missing hot spots that only show up (and cause problems) at higher capacities.

If you don't conduct readings at the same time of day, you get inconsistent, misleading results. As temperatures increase, radiant energy increases exponentially. The resulting calculations can be radically understated, leading your thermographers to misdiagnose a fault's severity.

Companies may even delay their inspection schedules to avoid downtime, letting costly and dangerous problems grow undetected.

Bulky PPE is necessary but restricts movement. Once a panel is opened, your team is exposed to dangerous electrical hazards. That's why it's an NFPA standard and OSHA requirement that thermographers and electricians wear PPE during open-panel IR inspections.

Hazard #1:

Lost Productivity

Continued

Imagine changing your spark plugs dressed like an astronaut. PPE is hot and makes it hard to see and reach components in switchgear, breakers, sub panels and transformers. If metal cladding obstructs access to bus joints or connections are positioned behind dead-front panels, it can be even more time-consuming.

Unfortunately, it's human nature to take the path of least resistance. Too often, inspection teams leave their PPE in the locker, say "It's okay, I'm wearing long sleeves," and hope for the best.

Time is not your friend. Typical IR inspections eat up a lot of man-hours and lost productivity. Consider this typical open-panel IR inspection scenario.[1]

- It takes an average of 30 minutes to suit up and dress down with Category 3 or 4 PPE. For a three-man team, this adds another 1.5 man-hours every time the team starts a shift or takes a break. That's a lot of expensive wardrobe changes.
- Time-motion studies reveal that it takes two electricians about 60 minutes to safely remove then replace a bolted panel…all for a six-minute inspection.
- During that time, the thermographer is idled 60 out of those 66 minutes, and the electricians are idled a combined 12 minutes waiting for the thermographer to complete the inspection.

All these steps add up to more than 3 lost man-hours per panel. Considering all the panels on your floor that require inspection, the downtime really adds up.

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Hazard #2:
Unrealized ROI

More than 3 man-hours per cabinet inspection may not seem like much, but it can dramatically affect your ROI. Using typical hourly rates for the electricians and thermographer, we broke down the cost to inspect just one energized panel.

OPERATION	MAN-HOURS	TOTAL MAN-HOURS	RATE/HOUR	TOTAL
Cover removal	0.5	1.0	$125	$125
IR inspection	0.1	0.1	$150	$15
Cover replacement	0.5	1.0	$125	$125
Thermographer wait time	1.0	1.0	$150	$150
Electrician wait time	0.1	0.2	$125	$25
	Manpower costs per inspection of one energized panel			**$435**

Multiply that number by all the components in your facility that require inspection, and you begin to see the true cost burden it places on your ROI.

> Only 1/3 of workers return to the job within 2 months of an electrical injury.[2]

Electrical injuries affect ROI, too. Opening panels during inspection exposes your electricians and thermographers to arc flash injuries. These are serious injuries with long-term consequences. A study of workers injured this way revealed that two-thirds had not returned to work nearly two months after being injured. More than half of those who did go back waited an average of 108 days before attempting to return to work. That's a lot of lost manpower and expensive workman's comp cases...all of which impact your return on investment.[2]

Preventing a problem is always cheaper than fixing it. Preventive maintenance costs less in man-hours than repairs. And it avoids expensive unplanned shut-downs and possible workman's comp issues when and if a problem results in injury. The best prevention is one that doesn't torpedo your productivity, ROI or safety...things that typical IR inspections just can't promise.

Hazard #3:

Unsafe Practices

Did you know that the NFPA lists electrocution as the fourth leading cause of workplace fatalities? One slip, trip or fall during an inspection can have disastrous consequences. In fact, the National Safety Council estimates one fatality for every 30 electrical shocks.[1]

Electrical injuries occur less frequently than typical EHS issues, but they carry far greater consequences. That's because **electrical tasks** (including open-panel IR thermography) are far more hazardous.[1]

Electric shock occurs when current flows through a worker's body. Maybe a piece of equipment wasn't properly insulated or a worker didn't wear proper PPE. The resulting electric shock can be mild or deadly depending on the amount of current flowing through a worker's body, the current's frequency and how long the worker remains in the circuit. If the current is high enough, it can cause a worker to freeze, actually preventing them from letting go to break the circuit.

CURRENT	REACTION
1 milliampere	Faint tingling.
5 milliamperes	Slight shock.
6-25 milliamperes (women)	Painful shock, loss of muscular control.
9-30 milliamperes (men)	Muscles freeze so person can't let go, increasing their exposure.
50-150 milliamperes	Extreme pain, respiratory arrest. Death possible.
1,000-4,300 milliamperes	Heart stops pumping. Muscular contraction and nerve damage. Death likely.
10,000 milliamperes	Cardiac arrest, severe burns. Death probable.

Controlling Electric Hazards, OSHA 3075, 2002 (revised)

According to OSHA, the effects of electric shock depend on the strength of the current. Consider the voltages in your own operation and the potential for serious injury or death.

Hazard #3:

Unsafe Practices

Continued

An arc flash is reported every 18 minutes.[1]

Know the risks of arc flash. Arc flash acts like lightning. Unlike other short circuits, arc flash travels through the air with the explosive force of dynamite. It usually starts as a phase-to-ground short circuit, commonly triggered by human error (and often exacerbated by bulky PPE). That means that human trigger is standing just feet away from the blast. Triggers include:

- dropping tools or panels
- making contact with energized parts
- changing the state of the equipment

After the initial "bolted fault," the arc vaporizes the copper conductor, producing a hyper-conductive cloud of copper plasma and ionized gases. This "unbolted fault" intensifies, producing a blinding explosion that's hotter than the surface of the sun and actually feeds on itself. In a millisecond, the copper conductor expands 67,000 times its initial size and creates a pressure wave that rips apart switchgear and sends molten shrapnel toward anything in its path. It's like being hit by a hand grenade.

Unfortunately while PPE can guard against burns, it won't protect a worker from the explosive effects of an arc flash.

Every day, an electrician never goes home.[1] Drop a wrench on most jobs and you get a ribbing from your buddies. But arc flash is far less forgiving. All it takes is one slip, trip or fall to trigger an arc flash that sends a worker to the burn unit.

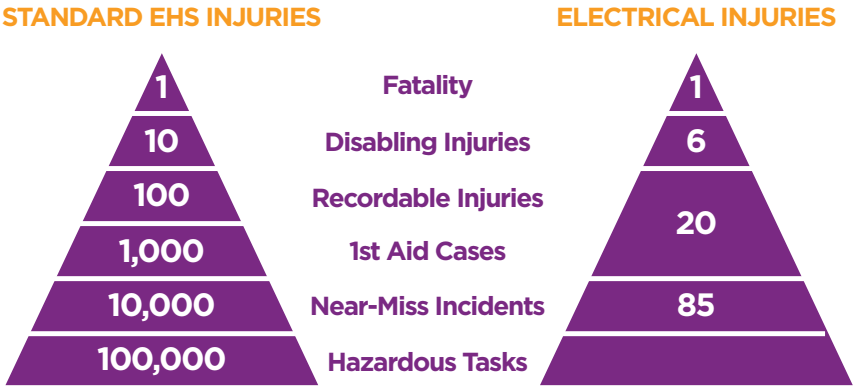
Hazard #3:

Unsafe Practices

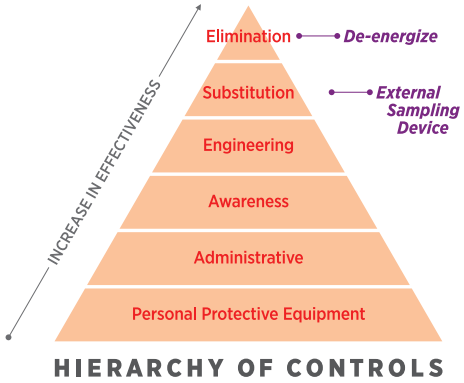
Continued

Arc flash incidents are reported every 18 minutes in the U.S. (although non-reporting probably drives that number even higher). These incidents cause about 20 people to suffer arc-induced burns. Out of that 20, five to 10 patients sustain incurable third-degree burns over more than half their body.[1]

Arc flashes are far deadlier than other workplace injuries. For typical tasks, workers suffer 10 disabling injuries and one fatality for every 10,000 near-miss incidents. Compare that to arc flash incidents: six disabling injuries and one fatality from just 85 near-misses.[1]



Addressing the risks associated with electrical hazards can be accomplished on a variety of levels. A greater amount of safety is afforded at higher levels of control.



Comply with the latest NFPA 70E standards for electrical safety in the workplace.

Recent changes to The National Fire Protection Association (NFPA) "Standard for Electrical Safety in the Workplace" document highlight the varying levels of protection available for those working on electrical equipment. The highest level of protection towards the top of the Hierarchy of Controls pyramid (above).

At the apex of the pyramid is "Elimination." IR thermography, however, only works while equipment is energized, so eliminating the hazard is not an option. It is also impossible to substitute or relocate the hazard. IR windows fit squarely into the "Engineering Controls" section of the pyramid, which is the best possible alternative to the bottom rung—PPE.

Using an IR window is your safest option when inspecting electrical equipment.

How to eliminate these hidden IR thermography hazards.

Thanks to today's technology, there are other ways to get safe, accurate readings. These include diagnostic software, ultrasound and IR windows.

Diagnostic software

Real-time sensors can alert you if electrical parameter measurements veer outside acceptable ranges. These systems allow you to diagnose potential problems so you can prevent short circuits and part failures before they shut you down.

The resulting data lets you manage your maintenance schedule and plan interventions for each device during less disruptive non-peak hours.

The software can be augmented with circuit protection ranging from fuses and GFCIs to arc-fault devices that recognize the characteristics unique to arcing and deenergize the circuit when an arc-fault is detected.[3]

Ultrasound

This is an easy-to-use technology for testing nearly all energized electrical equipment including transformers, relays, motor control centers and switchgear. Ultrasound testing is far safer because it doesn't require opening panels to conduct your inspection. It's particularly effective for detecting tracking, corona and arcing.

Ultrasound can augment but not replace IR thermography. Inspectors can detect hidden anomalies through ultrasound before opening the panel and exposing themselves to the dangers of tripping or arcing. Also, it's unlikely that IR thermography alone will detect corona. However, your team still has to open the panel to properly diagnose the problem with IR thermography.

You can employ continuous online monitoring by mounting an ultrasound monitor inside the panel or the wall that faces your electrical components. This generally weeds out ambient noises and alerts you immediately if a flashover or arc flash condition occurs. Unlike scheduled testing, it stands guard 24/7.

How to eliminate these hidden IR thermography hazards.

Continued

IR windows reduce infrared inspection man-hours by 90%.

Infrared Inspection Windows

Ideally, all your electrical testing would be done through closed panels, greatly reducing the risk of injury and losses in productivity and ROI.

That's what IR windows allow. A viewing pane with a lens is installed in the panel, forming a tight seal between the thermographer and the energized components inside the cabinet. Unlike a normal window that reflects radiation, an IR inspection window allows you to observe thermal radiation. The thermographer simply holds a camera to the window to check for hot spots within a wide, safe field of view.

IR windows dramatically boost productivity. Because there's no need to open the panel, you don't need to send out electricians with your thermographer to unbolt panel doors, stand around while the thermographer gets his readings, then rebolt the panels. And because the NFPA considers it an enclosed or guarded housing, there's no need for that hot, bulky PPE.

The result: a 90% reduction in man-hours. IR windows eliminate the need for technicians to fulfil stringent and time-consuming PPE requirements. And they eliminate the thermographer's downtime as he waits an hour for electricians to open and close each panel.

How to eliminate these hidden IR thermography hazards.

Continued

It pays for itself in one or two inspection cycles. To give you an idea of the ROI, consider these results from a U.S. paper mill that switched from typical IR thermography to IR window inspections. (Because their thermographer was qualified to assist their electrician, they only needed a two-man survey team.)

- The mill conducted a study prior to IR window installation to determine the actual cost of their IR testing. It revealed that the team spent approximately 331 man-hours to complete inspections on about 65 separate applications (mostly transformers and switchgear).
- After installing 197 IR windows, the thermographer was able to survey all 65 applications by himself (in addition to another five he was previously unable to inspect due to incident energy levels) in just 16 man-hours.
- The mill's total investment in IR windows was $42,050, plus another $18,910 for outsourced installation. This one-time investment of $60,960 paid for itself after just two inspection cycles.
- Their productivity gains after five inspection cycles totaled $135K. (This return on investment can be greatly affected by variables including the choice of IR windows, different hourly rates and more.)

IR windows reduce the risk of arc flash to less than 0.1%.[1] Arc flash happens when cabinet doors are opened. No open doors, no arc flash. Closed panel inspections through IR windows save hundreds of injuries and deaths every year. Bonus: they're also NFPA 70E compliant.

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The biggest hazard? Business as usual.

You're on the right track with IR thermography. It's an industry-leading weapon in your preventive maintenance arsenal. Now that you understand its pitfalls as well as its promise, you can make more informed decisions about your IR program and the potential to truly maximize your operation's productivity, safety and ROI.

Learn more about the hidden dangers of IR thermography.

Contact an IR Safety Specialist for more information at 330-632-8614 or saferIR@sdmyers.com.

[1] 10 Things You Need To Know About Infrared Windows, IRISS, Inc.

[2] Occupational Injuries From Electrical Shock and Arc Flash Events, Fire Protection Research Foundation, March 2015

[3] NEC 210.12 (2002 National Electrical Code)