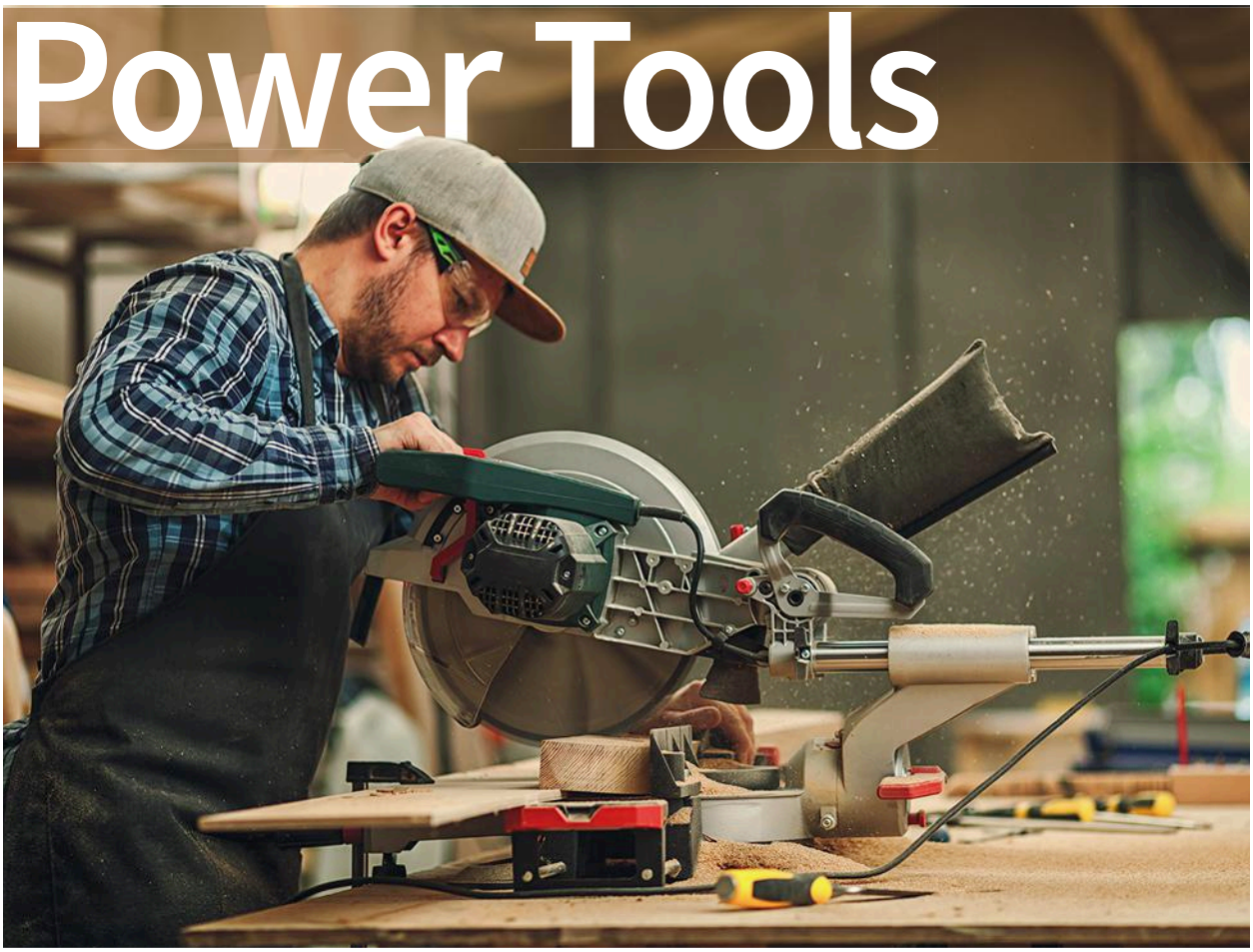
Electrical Safeguarding of Power Tools



Smaller power tools cause nearly as many injuries as more expensive industrial machines.

By Scott Swaaley

With the ever-increasing breadth of EHS responsibilities, it's important to not lose sight of the everyday hazards. This article looks at one such group of hazards: the hazards of stationary power tools and plug-in industrial machinery under 5HP. These relatively small machines—including everything from a $50 bench grinder in a maintenance closet to a 5HP band saw on a production floor—are responsible for nearly half of the 37,000 machinery-related injuries that occur each year.

Inexpensive Tool ≠ Inexpensive Hazard. Many companies struggle to justify spending more on safeguards than they did on the machine itself. However, an amputation caused by a $200 table saw has the same human and financial cost as one caused by a $2,000,000 press and federal injury data shows that these smaller machines are causing nearly as many injuries as their industrial counterparts.

OSHA provides some specific requirements for injury prevention on these machines but also has general requirements that necessitate a more nuanced look. In these requirements, OSHA requires businesses to "protect the operator and other employees in the machine area from hazards such as those created by point of operation, ingoing nip points, [and] rotating parts." It goes on to state that any mitigation device "shall be so designed and constructed as to prevent the operator from having any part of his body in the danger zone during the operating cycle."

This requires that EHS professionals consider two additional dimensions on risk assessments: hazards to other nearby employees, and time outside of the normal operation of the device. The latter includes setup that takes place before an operation, cleanup or post-processing that takes place after an operation, as well as jams, malfunctions, power loss, maintenance and myriad other conditions in which operators and employees are working with or around

a machine. This expanded hazard definition is supported by the fact that 55% of all machinery-related injuries occur outside of the normal operation of a machine.

We have found several general hazard categories that help to account for these additional and less-obvious injuries, and each can be mitigated by moving up OSHA's hierarchy of controls from PPE (the least effective safeguard) to engineering controls. These hazard categories are:

1. Failure to control hazardous energy. The industry has already responded in force to one manifestation of this hazard with lock-out/tag-out, but the industry has failed to recognize automatic and unintentional restarting as a critical part of hazardous energy control policies. If electrical power is lost while a tool is operating (as a result of a power outage, tripped circuit breaker, thermal overload, etc.), a tool will cease to operate even though its power switch remains in the "on" position. When power is restored to the tool, it will start up unexpectedly and can cause severe injury to an unsuspecting operator or bystander. That is why OSHA, ANSI, NFPA, NEC and CSA all explicitly require means to prevent unintentional restarting of machinery.

Many products exist to mitigate this hazard but buyers should beware of under-rated and confusingly misrepresented marketing when selecting a solution (more about this later).

2. Tool coasting. Most power tools have significant inertial mass that keeps them operating, sometimes in virtual silence, for as long as two minutes after power has been removed. It goes without saying that you wouldn't leave a tool operating unattended, yet that is what happens every time an operator walks away from a coasting tool. These coasting tools can cause injury to an operator as they reach to remove or measure a workpiece after an operation, when a passerby comes into accidental contact with the tool, or when another operator begins setup on a new operation. This hazard can be mitigated with a mechanical friction brake and employee training or with an electrical motor brake.

Though retrofits of these technologies have been historically difficult, recent innovations in this area have made electrical motor braking retrofits much more accessible.

3. Emergency situations. While this is a broad term, it generally refers to a situation that needs to be quickly mitigated to prevent human injury and damage to machinery or works-in-progress. In the event of an emergency situation, a common compounding effect is that standard manufacturer-provided tool switches are difficult to locate and turn off in an emergency situation, increasing the rate and severity of potential injuries. This hazard is most commonly mitigated with an emergency stop system.

It's worth noting that what most people consider an e-stop system is a "Category 0" or "uncontrolled" emergency stop. A Category 0 e-stop is equivalent to pulling the plug on a tool. Having an accessible way to power down a tool is important (and an OSHA/ANSI requirement), but if the tool in question has already made contact with a human operator or is destroying a workpiece, then the seconds or minutes required for a tool to coast to a stop may inflict significantly more damage. A "Category 1" e-stop, on the other hand, provides a "controlled stop" when activated and may significantly lessen the severity of an injury. A Category 1 e-stop can be achieved with the same mechanical or electrical braking described above.

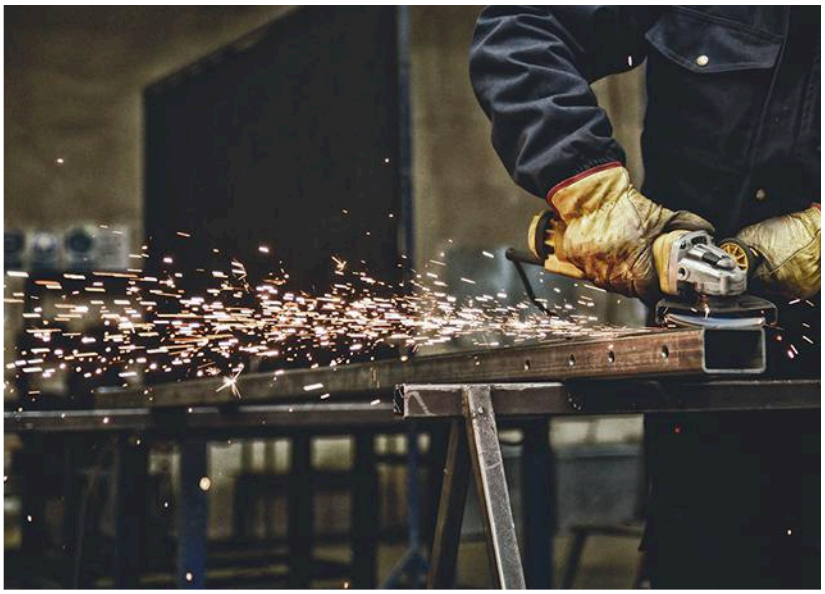
PEOPLE, PRODUCTION & PROFITABILITY

It's time to mention the elephant in the room. Safety professionals are one piece of a larger system and must always balance proposed mitigations with technical requirements, the needs of human operators, impact on production, and company profitability. On the technical side, mitigations need to be compatible and reliable within the chosen context. On the human side, mitigations can't get in the way, be easily bypassed by operators, or increase the complexity of an operation. On the production side, mitigations can't slow down an operation, require down-time to install, or impact overall product workflows. And lastly, on the financial side, an excessive cost for mitigation can impact a company's ability to be competitive in their market segment and threaten the livelihood of all involved.

All of these requirements and constraints can feel overwhelming, so here are a few quick tips for evaluating mitigations for these hazards:

- **New Tool ≠ Compliant Tool.** Most brand-new tools are non-compliant out of the box. It is not a manufacturer's legal responsibility to protect operators—it's yours—so don't make any assumptions.
- **Risk Assessments.** Always perform a risk assessment to evaluate specific machinery in a specific context before proceeding with any mitigation. Then, once a mitigation is installed, assess its performance against the assessment's goals. This doesn't mean you need to start from scratch; you can start by researching what hazards others have identified for a tool type or context and evaluating if they apply to your situation.
- **Check for Industrial NRTL Listing.** OSHA requires every AC-powered device

Figure 1. Examples of NRTL listing marks, a required feature on every device plugged into AC power in a workplace.



to be listed by a Nationally Recognized Test Lab (NRTL). In addition to looking for an NRTL mark (see **Figure 1**), ensure that the listing is for an appropriate category.

- **Horsepower is King.** Evaluate products by their horsepower (HP) ratings, not their current ratings. Motors are very hard on switching devices and failure to install a motor-rated switch or device is likely to result in device failure and/or fire.

INDUSTRY TRENDS

Despite long-standing industry support for custom control panels and physical guards on large industrial machines, application of these controls on power-tool-scale machinery is commonly seen as prohibitively complex and expensive. Recent years have seen a departure from this thinking with the introduction of new NRTL listed plug-and-play safety products that can mitigate many of the hazards presented above at a fraction of the cost of a custom control panel. These new safety devices are designed to protect machine operators from accidental restart, coasting tools, emergency situations and uncontrolled hazardous energy.

In short, the industry's new focus on usability, ease of installation and pre-listed products is making it easier for safety professionals to prevent injuries caused by industrial machines. **EHS**

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