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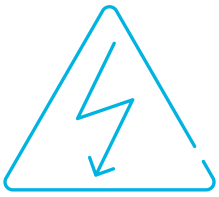


ELECTRICAL SAFETY

How to protect your organization from electrical hazards.

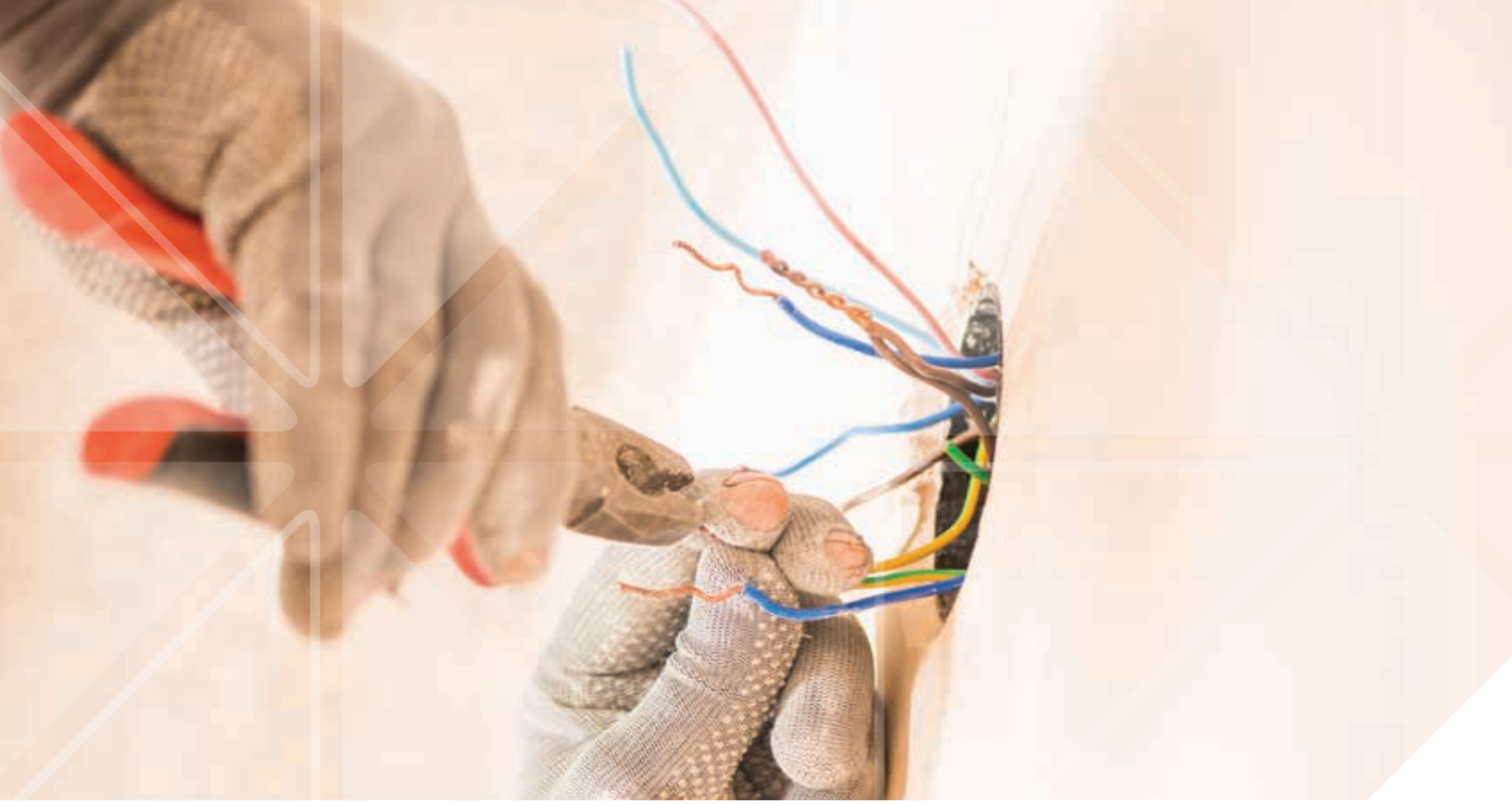
GUIDEONE®
INSURANCE

Nothing is more important to you than the people you help — and their safety always comes first.

By taking precautions to protect your organization from electrical problems, you're helping to prevent issues that could distract from your mission.

While it is important to address all aspects of safety at your organization, electrical maintenance is an area that requires special attention. Taking preventative measures and appropriate precautions now can help prevent injuries and unintentional deaths to those on your premises.

Our risk management experts at GuideOne Insurance have compiled 50 years of industry expertise and claims service for thousands of organizations to create this electrical safety resource. To assist you in addressing safety issues, this eBook contains important tips to protect against the risks your organization could face — and recommendations for reducing them.



COMMON HAZARDS

Some of the most common electrical hazards are often the easiest to identify and control and are affordable to correct. However, if left unchecked, they can lead to a major fire for your facility. There's good news: Many of the most common electrical hazards have easy solutions.

Missing Covers

Missing covers on junction boxes, switches and outlets expose energized circuits, creating arc flash, shock and electrocution hazards. In addition, missing covers provide a path of entry into the interior of the enclosure, allowing dust, dirt and debris to accumulate. Missing covers could allow metallic objects to fall into the circuits that could arc or lodge in a way that presents a hazard when the enclosure is opened. Covers should be provided for all of these items.

Broken/Unsupported Light Fixtures

Light fixtures should be permanently mounted to the base and show no signs of damage. Light fixtures that are hanging unsupported by wiring put undue stress on the electrical connections. These two conditions present the potential for an electrical short, which can produce sparks that can ignite combustibles.

Circuit Breakers

A circuit breaker is a protective device designed to protect the circuit and equipment when it becomes overloaded as a result of too many appliances or equipment on the circuit, as well as when a short develops in a wire. The following safety precautions should be taken to prevent an electrical fire or damage associated with circuit breakers:

+ All electrical breaker panels should be equipped with an appropriate cover and remain closed. Missing covers expose the circuits to dust and physical damage. If an arc or short circuit would occur, the cover will contain the sparks from igniting surrounding combustibles.
+ There should not be any missing breakers or other openings between breakers. These openings allow for the potential for electrocution, physical damage and dust and dirt to accumulate in the circuits. Spare clips should be installed in any openings in the breaker panel.
+ Breakers must never be taped or physically secured in the "ON" position. If the breaker is not allowed to trip, or cannot be manually tripped, the wiring could overheat, increasing the chances of a fire.
+ The electrical panel should be indexed, identifying each individual circuit breaker. The directory must identify the various receptacles, general area or equipment serviced by each circuit breaker. This will allow for quick de-energizing of a circuit under emergency situations.

Housekeeping

Electrical equipment can and does fail, often catastrophically, producing large amounts of heat. Any combustible material in the vicinity can be ignited. The following housekeeping rules should be followed in electrical equipment areas:

+ Access to electrical rooms should be limited to authorized maintenance or operations personnel who understand the importance of maintaining a clean, well-ventilated electrical area.
+ Electrical equipment areas should be kept dry and equipment needs to be protected from moisture. When evidence of moisture contamination is noted, equipment should be examined for damage and necessary repairs made. The source of the moisture needs to be identified and eliminated.
+ Electrical equipment areas should be clean and protected from dust and dirt. When evidence of dust and dirt is noted, equipment should be examined for damage, cleaned and any necessary repairs made.
+ Placing storage items too close to electrical panels or near electrical equipment will restrict air circulation and impede proper cooling. Excessive heat buildup will result in premature failure and shortened service life. Storage must be no closer than 36 inches to the electrical panels, electrical equipment, ventilation vents and openings. A concerted effort should be made to reduce the number of unused items and to store items in a neat and orderly fashion.

As you can see, some of the most common electrical hazards require only a small amount of time and effort to control. By following the safety precautions outlined above, your chances of having a fire resulting from an electrical issue are greatly reduced.

Temporary Wiring

The use of temporary wiring is often due to increased electrical demands and lack of available electrical outlets, especially in older buildings. For definition purposes, the phrase "temporary wiring" includes extension cords, power strips, multiple outlet adapters and inadequate wiring. Temporary wiring is an easier and less expensive solution than having additional electrical services installed, but "temporary" often becomes the permanent solution, and can lead to electrocution, short circuit, overloading and fire. If temporary wiring is necessary, the following safety precautions should be followed:

Extension Cords

+ Never cut off the ground pin to connect a three-prong appliance cord to a two-wire extension cord or receptacle. Use only three-wire extension cords for appliances with three-prong plugs.
+ If an extension cord's insulation has been damaged, remove the cord from service. Never try to repair a damaged extension cord with electrical tape.
+ Never plug multiple extension cords into each other.
+ If the cord feels hot or if there is a softening of the plastic, the cord is drawing too much power and the plug wires or connections are failing, which could present a fire or shock hazard. The extension cord should be discarded and replaced.
+ Extension cords should never be nailed down, stapled, run through walls, under rugs or across doorways.
+ Avoid placing cords where someone could accidentally trip over them.
+ Never use an extension cord while it is coiled, looped or tied in a knot.
+ Never place an extension cord where it is likely to be damaged by heavy furniture or foot traffic.
+ Use special, heavy-duty extension cords designed for high wattage appliances, such as air conditioners and freezers.
+ Purchase extension cords from reputable distributors and retailers and check the product to ensure that a nationally recognized testing laboratory, such as Underwriters Laboratories (UL) or Canadian Standards Association (CSA) has certified the product.
+ For outdoor use, use extension cords specifically rated to be used outside.

Power Strips

Power strips are essentially an extension cord with multiple receptacles. These are most commonly used where multiple outlets are needed, such as for office and audio/visual equipment. The safety precautions outlined for extension cords also apply to power strips. Additional precautions for power strips include:

+ Only use power strips that have a built-in circuit breaker that will trip if overloaded or shorted.
+ Do not plug appliances that demand a high amount of power into power strips. Examples include refrigerators, microwave ovens or wall air conditioning units. These types of appliances should each have a separate electrical outlet.
+ If the power strip feels hot, it should be discarded and replaced. This is a good indication that the electrical load is too high and should be evaluated.

+ Do not locate a power strip in any area where the unit would be covered with a rug, furniture or any other item that would inhibit air circulation.
+ Under no circumstances should one power strip be plugged into another power strip, also known as "daisy chaining." If the electrical demand gets to that point, it is definitely time to call an electrician.

Multiple Adapters

Multiple adapters also allow several appliances to be plugged in at once and are often not protected with a built-in breaker. This can cause overloading and overheating of the circuit. Multiple adapters are not recommended for use.

Do-it-yourself temporary wiring is never recommended. Consider these reasons:

+ Wiring extension cords directly into electrical panels is in violation of national and local electrical codes.
+ Making your own extension cords or power strips has no testing conducted by nationally recognized testing laboratories and may not be properly sized for the voltage and current.
+ Improperly installed electrical equipment or spliced wiring should also be identified as temporary.
+ Any condition that will involve creating your own temporary wiring solutions should be immediately removed from use.

Temporary wiring should be just that: temporary. The use of extension cords, power strips, multiple adapters (and homemade variations) indicate that additional electrical services are needed. They are not designed to be installed in a permanent manner, and if this becomes the case, a licensed electrical contractor should be hired to install additional electrical services.

FUSES

A fuse is a device designed to stop the flow of current to protect the circuit and equipment when they are overloaded as a result of too many appliances and/or equipment on the circuit. It also provides protection when a short circuit develops in a wire or a ground fault.

Fuses are common in older buildings. Even if the main electrical service has been updated to circuit breakers, the use of fuse-protected sub-panels is fairly common.

Fuses can be safe; however, it is recommended that fuses be replaced and updated to circuit breakers. If this is not feasible, the following safety precautions should be followed.

Electrical Inspection

The presence of fuses indicates that the electrical service was installed before 1970. This wiring was installed to meet electrical needs. With today's added power demands, such as appliances and electronics, this older wiring may not be adequate. A certified electrician or licensed electrical contractor should be hired to inspect the electrical system. This inspection will identify the electrical demands needed and any corrections that are necessary. This should be completed, at a minimum, once every three years.

Tamper-Proof Fuses

More often than not, a blown fuse is the result of an overloaded circuit. This means there is too much electrical demand on the circuit. If the fuse is continually blowing, there is a much more serious problem, and a certified electrician or licensed electrical contractor should be hired to correct the problem.

Electrical Safety: Fuses

Fustat® fuses, (also called type S) are not interchangeable — you cannot install a 20-amp fuse into a 15-amp base. However, an all too common practice to stop a fuse from continually blowing is to install a higher-rated fuse in the circuit. For example, replacing a 15-amp fuse with a 20-amp fuse. This is a recipe for disaster, as this allows for more current into the circuit than it was designed for, which can lead to overheating of the wire and probable fire.

To prevent mismatching or over-fusing of the circuit, Fustat® fuses — also called type "S" tamper-proof fuses — should be installed for all screw-in fuse panels. These come in different amperage sizes, and each tamper-proof fuse will only screw into the correct tamper-proof base. This will prevent installing a higher rated amp fuse into a lower rated amp circuit.

Fake Fuses

Inserting cartridge-style fuses into copper/metal tubes (to create fake fuses) is an extremely dangerous situation, since this does not provide overcurrent protection. If the circuit is not protected, you increase the potential for a fire to occur, arcing and electrical shock. If a fuse has to be replaced, always install properly matched fuses. If the fuse is continually blowing, as earlier discussed, this is an indication of a serious problem and should be corrected by a certified electrician or licensed electrical contractor.

Renewable Fuses

A renewable fuse is a cartridge-style fuse. If the fuse is blown, the cap is unscrewed and the link can be replaced, allowing the fuse to be reused. Once the link has been replaced, the mechanical connection between the link and the fuse cap can become loose, dirty, corroded or otherwise faulty, resulting in a connection that can generate heat in the hundreds of degrees and cause the insulation on the conductor to deteriorate. Once the conductor makes contact with the metal of the panel or the conduit, a short circuit occurs, which can result in arcing and fire. Renewable fuses should not be used and should be replaced with one-time use standard fuses.

Fuse Clip Clamps

Fuse clip clamps — also known as torpedo or depth charge clamps — were originally used on submarines and some warships in World War II. Their purpose was to prevent fuses from coming out of the clips during depth charges or other explosions. Today, they are used in some older buildings in an attempt to press the clip to the fuse blade. This is an indication that the clamp does not have enough compression to make solid contact with the fuse cartridge blade, which can lead to resistance to current flow. This makes the clamp and blade elevate in temperature and can lead to fire. Clip clamps should not be used and a certified electrician or licensed electrical contractor should be hired to replace the clips.

The presence of fuses in the electrical system indicates older wiring, and every attempt should be made to replace fuses with circuit breakers. If this is not financially feasible, follow the above guidelines to reduce your chances of an electrical loss from faulty fuses.

THE HIDDEN DANGER LURKING IN YOUR ELECTRICAL BOX

A quick check of your circuit breaker panel can shed new light on your electrical hazard exposure.

If your facility was built between 1950 and 1985, it is possible that you have a Federal Pacific Electric Stab-Lok® breaker panel. Although this company is no longer in business, many of these Stab-Lok panels still exist in basements and electrical rooms.

The Stab-Lok panels are associated with several problems related to the breakers not tripping and issues with internal connections on the busbars.

The Consumer Product Safety Commission looked into many problems in 1982 with these breakers not tripping properly according to UL testing requirements.

Tests performed by the Consumer Product Safety Commission, and independent consulting engineers, concluded that certain Stab-Lok breakers do not trip according to requirements and in some cases can jam in the "ON" position. This condition was most pronounced in the Stab-Lok two-pole version of the breakers.

Unfortunately, this information surfaced after many Stab-Lok installations were completed and in service for years. The purpose of the breaker is to prevent the wiring from overheating and causing a fire in the building when there is a short circuit or when someone plugs too many cords into one receptacle.

In 2002, a New Jersey class-action lawsuit decided that the manufacturer of the Stab-Lok breakers committed fraud over many years when they issued UL labels to their products.

They did this knowing that the breakers did not meet testing requirements at the time. The National Electrical Code requires that all installed electrical products be listed and labeled by an independent testing agency such as UL.

Due to the fraudulent testing, the original Stab-Lok panelboards and breakers were never verified to be suitable for the intended use.

A licensed electrical contractor should confirm whether Federal Pacific Electric Stab-Lok breakers and panelboards are currently in use.

Based on these issues, when a Federal Pacific Electric Stab-Lok installation is discovered, the safest course of action is to replace it with a completely new panelboard and breaker installation.

Knob and Tube Wiring

Knob and tube wiring is named for the knobs, or insulators, used to keep wires isolated and the ceramic tubes used to line holes (for example, through wooden floor joists). This type of wiring was installed up until the year 1950 and, although not common, can still be found in use today.

Knob and tube wiring is different from modern day wiring in that it consists of only two wires — a hot and neutral, with no ground wire. Both wires run separately to fixtures as opposed to all three wires contained within one plastic sheath, as in today's applications.

Although knob and tube wiring is a workable system, the potential fire hazards far outweigh its use for modern day installations. Here are some of the main hazards with this type of wiring:

+ Its presence indicates old, outdated wiring. It will typically be below a 100-amp service, which is undersized for modern day electrical demands.
+ Knob and tube wiring does not use circuit breakers, which increases the risk of fire.
+ It only has a hot and neutral wire, with no electrical ground, and is therefore considered unsafe in kitchens, bathrooms, laundry rooms and for use outdoors. You cannot install a Ground Fault Circuit Interrupter outlet with knob and tube wiring.
+ The hot and neutral wires can accidentally make contact, which is a potential fire hazard.
+ The cloth and rubber insulation may be dry and brittle, exposing the bare wires.
+ In-line splices in walls are installed without junction boxes, exposing a potential fire hazard from an uncontained spark caused by arcing following mechanical failure of the splice.
+ Knob and tube wiring is designed to let heat dissipate to the surrounding air. With energy efficiency upgrades that involve covering the exposed wires with insulation, this negates this cooling effect, increasing the chances of overheating and fire.

If any part of your building's electrical system functions with knob and tube wiring, it presents a potential fire hazard. This wiring is old, outdated, not insulated and is not able to adequately handle the electrical demands of modern day appliances. This wiring should be replaced by a licensed electrical contractor.

GROUND FAULT CIRCUIT INTERRUPTER

A ground fault circuit interrupter (GFCI) is an inexpensive electrical device designed to protect people from severe or fatal electric shocks by detecting ground faults. They also can prevent some electrical fires and reduce the severity of others by interrupting the flow of electric current.

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In a building's wiring system, the GFCI constantly monitors electricity flowing in a circuit, to sense any loss of current. If the current flowing through the circuit differs by a small amount from that returning, the GFCI quickly switches off power to that circuit. The GFCI interrupts power quickly to prevent a lethal dose of electricity.

Types of Ground Fault Circuit Interrupters

+ **Wall Receptacle** – This is the most widely used GFCI. These fit into a standard duplex electrical outlet and protect against ground faults whenever an electrical product is plugged into the outlet.
+ **Circuit Breaker** – In buildings equipped with circuit breakers, this type of GFCI may be installed in a panel box to give protection to dedicated electrical circuits.
+ **Portable** – There are two different types of portable GFCIs; one type is plugged directly into an existing outlet and the other type is an extension cord that has a GFCI built in. GFCI extension cords only should be used on a temporary basis.

Where to Install GFCIs

GFCI protection should be provided wherever water and electricity are in close proximity to each other. The standard rule of thumb is three feet or less from any water source. The National Electric Code (NEC) has required installation of GFCIs for outdoor receptacles since 1973. These requirements have been expanded over the years to also include the following receptacle locations:

+ Outdoors
+ Bathrooms
+ Garage walls
+ Kitchens
+ Crawl spaces and unfinished basements
+ Laundry and utility rooms
+ Pool and spas

Organizations without GFCI receptacles installed in these specific locations should have this completed. For broader protection, consider GFCI circuit breakers to replace ordinary circuit breakers. If you have a building that is protected by fuses, you are limited to receptacle-type GFCIs, and these should be installed in areas having the highest exposure to a water source, such as kitchens, bathrooms and outdoor circuits.

To further protect employees, staff and volunteers from electric shock, GFCI protection should be provided when electric powered equipment is used. This would include items such as hedge trimmers, leaf blowers, lawn edgers and hand-held power tools.

Testing GFCIs

Like all products, GFCIs can be damaged. GFCIs damaged by lightning or electrical surges may fail to provide adequate protection. All GFCIs should be tested monthly and after any severe lightning storm.

To protect people from severe or fatal electric shocks and to prevent possible electrical fires, GFCI protection should be provided wherever water and electricity are in close proximity to each other. Any electrical installation should be completed by a licensed electrical contractor and be in accordance with the NEC and local codes.

AIR CONDITIONING SAFETY DISCONNECT

Many organizations have a licensed electrician on the building maintenance staff to complete electrical maintenance and repair work. If this is not the case, it is vital to hire licensed electrical contractors who are familiar with national and local electrical codes. The risk of electrical failures and fires increase significantly when work is performed by unqualified personnel. Take this recent loss, for example:

+ An electrical arc fault occurred within the control panel of an air conditioning unit. The arc fault continued down the line, causing extreme overload to the remainder of the incoming electrical service and distribution panel. A fire ensued, causing all electrical equipment in the switch room to be destroyed. Heavy smoke damage to the building resulted in a $350,000 loss. The fire investigator found that the A/C unit was wired directly to the electrical service without the proper safety disconnect installed.

National and local electrical codes are developed to protect people and property. Code compliance will result in an electrical installation that is done correctly. Code requirements for air conditioning units require the installation of a safety disconnect between the condensing unit and the main electrical service feed. The safety disconnect must be within sight and readily accessible. This will allow shutting down power for maintenance operations and emergencies such as mechanical failure or electrical fires.

This safety disconnect will have overcurrent protection in the form of a circuit breaker or fuse. In the loss described above, the installation of an electrical safety disconnect would not have prevented the arc fault within the A/C unit, but the overcurrent device would have prevented the down line damage to the main electrical distribution panel and subsequent fire and smoke damage.

If your organization does not have a safety disconnect installed for each air conditioning unit, a qualified electrician or licensed electrical contractor should be hired to complete this. This will ensure that the electrical work completed will meet current national and local electrical codes.

PROTECTING YOUR FACILITY FROM ELECTRICAL SURGE DAMAGE

Did you know that more than 45 percent of all accidental data loss is attributed to power failure or surges? In fact, transient voltage is one of the leading causes of electrical equipment failure, accounting for approximately $28 billion of damage in the United States every year.

Transient Voltage – What You Can't See Can Hurt You

Transient voltage — also known as an electrical surge — is a short surge of electricity or rise in voltage that exceeds safe levels of operation for electrical equipment. Transient voltage can pass through any piece of electrical equipment in just a millisecond.

There are several sources of transient voltage, but the main causes are:

+ A direct or nearby lightning strike.
+ The operation of high-power electrical devices, such as elevators, air conditioners and refrigerators.
+ Faulty wiring or problems with the utility company's equipment and downed power lines.
+ Blackouts or brownouts.

What Damage Does Transient Voltage Cause?

Transient voltage renders electronic equipment useless by damaging sensitive circuits and related components. It is estimated that 95 percent of electronic equipment failure is caused by transient voltage damage that has taken place over time. Typically, this type of loss is not covered by insurance. Only about 5 percent of transient voltage damage is noticed immediately; this happens when lightning strikes and the electronic equipment fails simultaneously. Transient voltage passes through all equipment in a millisecond.

How Can You Protect Your Equipment from Transient Voltage Damage?

In conjunction with your electrical grounding system, the best means of protecting your electrical equipment from transient voltage is to install surge protection devices (SPDs) throughout your facility. Surge protection devices contain electrical components that sense an electrical surge or spike and then divert this excess voltage safely to ground via semiconductors and resistors. This is why adequate grounding within your electrical systems is so critical. Even the best surge protector will not function properly if the electrical grounding system is substandard.

For the best protection, SPDs should be applied using the following zoned approach:

+ **Zone 1** – Install an SPD on the electrical service entrance equipment to protect against surges generated from outside the facility.
+ **Zone 2** – Install SPDs at each distribution panel supplying critical or sensitive electronic equipment. This will provide protection against internally generated surges.
+ **Zone 3** – Install SPDs locally at each piece of equipment requiring protection, such as computers, modems, fax machines, copiers or printers. Zone 2 and 3 devices protect against both internally and externally generated surges. Commercial locations should have at least two zones of protection: electrical service entrance and point-of-use.

By using the zoned approach, critical electrical components will be safely protected from transient voltage. To assess the feasibility of installing surge protection in your facility to protect critical components, contact a qualified electrical contractor.

PREVENTING COSTLY ELECTRICAL SYSTEM PROBLEMS

Why Preventive Maintenance is More Important than Ever

Electrical-related fires are occurring more often and causing more severe losses. Like the country's aging and overburdened electrical infrastructure, buildings and electrical systems are aging and may not be designed to handle the load most businesses need as they add more equipment.

Inadequately maintained electrical systems also are a leading cause of business interruption, poor energy efficiency, equipment wear out and breakdown — all costly problems.

An effective electrical preventive maintenance program can reduce your risk of an unscheduled outage by as much as 66 percent, according to statistics from The Institute of Electrical and Electronics Engineers.

WHAT YOU CAN DO TO KEEP YOUR ELECTRICAL SYSTEM SAFE

Focus your electrical preventive maintenance program on the most common and frequent problems leading to electrical fires and equipment failure. That includes inspection and preventive measures to ensure electrical apparatus is kept clean, cool, dry and tight.

Keep It Clean

+ Electrical apparatus and equipment rooms should be free of excessive dust and dirt accumulation.
+ Don't use electrical equipment rooms for storage.
+ Limit access to authorized operations and maintenance personnel.
+ Maintain proper lighting to ensure correct and efficient operation and maintenance.

Keep It Cool

+ Prevent excessive heat buildup in electrical apparatus enclosures and equipment rooms.
+ Exceeding design temperatures can be a fire hazard and also shorten the life of equipment.
+ Maintain cooling fans or blowers installed on equipment to provide adequate cooling.
+ Keep ventilation openings in equipment enclosures clean and free from obstruction.
+ Change or clean any installed filters according to the manufacturer's recommendations.

Keep It Dry

+ Keep equipment rooms dry and protect equipment from moisture. Persistent exposure and direct contact with moisture can cause equipment to fail or shorten its life.
+ Check equipment for moisture contamination. If found, examine equipment for damage and get necessary repairs made. Identify and eliminate the source of moisture.

Keep It Tight

+ Loose connections are the most common source of electrical equipment failure.
+ Check all connections and ensure they are kept tight.
+ Follow any applicable manufacturer's instructions for tightening. Get an infrared imaging survey to test for loose connections.

WHERE TO BEGIN WITH A MAINTENANCE PROGRAM

The first step in conducting electrical equipment maintenance is following applicable jurisdictional code requirements and specific manufacturers' recommendations.

Regular and routine maintenance is extremely important. Preventive maintenance should be performed at least every three years or more often when conditions warrant.

Please remember, it takes qualified and competent maintenance personnel to properly, safely and effectively maintain electrical equipment.

Electrical system maintenance increases safety and decreases losses. Reduce your risk of fire, equipment breakdown, business interruption, equipment inefficiency and premature wear out with a preventive maintenance program.

INFRARED THERMOGRAPHY

What Is Infrared Thermography?

Infrared thermography is a noncontact and nondestructive way for detecting "hot spots," which are temperature differentials that may indicate problems in an electrical system.

An infrared survey can detect a problem before it manifests itself into a costly failure. It is very common to find a loose wire that can be repaired for less than $100. But, if it were to fail, the cost could skyrocket to thousands of dollars for equipment, repair or replacement. Or worse, an electrical failure can lead to a fire, leading to injury, loss of life and irreparable damage to the building.

All electrical and mechanical equipment emits heat in the form of electromagnetic radiation. Infrared cameras, which are sensitive to thermal radiation, can detect and measure the temperature differences between surfaces. Abnormal or unexpected thermal patterns can be indicative of a problem with the equipment — problems that could lead to a breakdown or failure, or cause a fire.

For example, thermal patterns in equipment can indicate conditions such as:

+ Loose connections
+ Overloaded circuits or phases
+ Deteriorated or damaged insulation

Infrared thermography uses a camera-like device which views a large area at a time, senses infrared emissions and converts the emissions into a visual display. Trouble spots can be pinpointed quickly, saving labor and cost, and targeting building maintenance resources where they are needed.

How Does the Camera "See" Heat?

All objects, even cold ones, radiate heat in the form of infrared energy. As an object heats up, it radiates more energy, and the wavelength gets shorter. Infrared radiation, visible light and ultraviolet light are all forms of energy in the electromagnetic spectrum. The only difference is their wavelength.

The human eye can only see a small range of colors in the electromagnetic spectrum. These light waves range in length from 0.4 to 0.7 microns. If an object gets hot enough, the energy will reach the visible range and the object will be "glowing" red, like the burner on an electric stove. Fortunately, infrared imaging systems can detect infrared energy long before it reaches the visible stage.

The camera-like device then converts these invisible light waves into a graphic image that is displayed on a monitor. Modern infrared cameras also provide actual temperature readings, and store the data, so that the information can be later used to produce a report.

Electrical Applications

Electrical components, such as fuse blocks, control circuits, circuit breakers, transformer bushings and main disconnects, can all develop faulty connections. Infrared thermography can detect faulty connections in early stages so that repairs may prevent possible future breakdowns that would be very costly.

ELECTRICAL SELF-ASSESSMENT SURVEY

Electrical systems and equipment need to be evaluated and inspected to ensure proper working condition. By completing an electrical self-assessment survey on each building, you will be able to identify any electrical concerns and take corrective action, thus reducing your chances of an electrical fire.

The items listed below will describe the categories the GuideOne Electrical Assessment Survey (see below) was developed from and the concerns associated with each one of them. These categories should be referred to when answering the questions in the assessment survey.

Electrical System Age

All electrical equipment has a limited service life. Behind outlets and switches is a system of wires, panels, circuit breakers, busbars and transformers. Repeated surges, power outages, load changes, moisture and dirt all impact the service life. As a result, any electrical systems that are greater than 30 years old have a much greater occurrence of failure. Identifying and evaluating these facilities can determine what steps should be taken to reduce the potential for electrical system failure and/or fire.

Electrical Preventive Maintenance (EPM) Program

As electrical equipment ages, an increase in failures occur. More than two-thirds of electrical system failures can be prevented by a routine preventive maintenance program. Studies show that the failure rate of electrical equipment is three times higher for components that are not part of a scheduled preventive maintenance program as compared with those that are. This program translates to: is the electrical system clean, cool and dry and are the connections tight? In general, preventive maintenance on electrical equipment should be conducted by a qualified electrician or licensed electrical contractor at least once every three years.

Recurring Electrical Problems

Recurring electrical problems, such as blown fuses, tripped breakers, flickering lights or overheated appliance cords can be symptoms of overloaded circuits, improper grounding, non-code wiring, loose connections and a host of other serious adverse conditions. These events also can indicate potential problems with connected equipment, such as motors and transformers, as a result of insulation breakdown, causing abnormal current draw. This increases the load on the system. A qualified electrician should be tasked with identifying the cause and implementing the required corrective action.

Missing Covers

Missing covers on junction boxes, panels, switches and receptacles expose energized circuits, creating arc flash, shock and electrocution hazards. In addition, missing covers provide a path of entry into the interior of the enclosure, allowing dust, dirt and debris to accumulate. Missing knockouts or covers could allow metallic objects to fall into the circuits that could arc or lodge in a way that presents a hazard when the enclosure is opened.

Maintenance

Only a qualified electrician or licensed electrical contractor should be maintaining the electrical system within your facility. It is important to determine if equipment is actually being inspected and maintained and the skill level and qualifications of those performing the work. The risk of failures and fires increase significantly when work is performed by unqualified personnel.

Temporary Wiring

Temporary wiring is not compliant with the National Electrical Code (NEC) and increases the risk of electrical equipment failure and fire. Wiring extension cords or electrical conductors that are not properly routed through conduit directly into electrical panels are in violation of local and national electrical codes. In addition, temporary wiring may not be properly sized for the voltage and current. Improperly installed electrical equipment or spliced wiring also should be identified as temporary and immediately removed from service by a qualified electrician or licensed electrical contractor.

Electrical Room

Electrical equipment can and does fail, often catastrophically, with arcing that produces large amounts of heat. Any combustible material in the vicinity of the arc flash can be ignited. Access to electrical rooms should be limited to authorized maintenance or operations personnel that understand the importance of maintaining a clean, well-ventilated electrical area. Placing storage items too close to electrical panels or near electrical equipment will restrict air circulation and impede proper cooling. Excessive heat buildup will result in premature failure and shortened service life. All ventilation vents and openings in equipment rooms should be kept clean and free from obstructions. A concerted effort should be made to reduce the number of unused items and to store items in a neat and orderly fashion. Storage must be no closer than 36 inches to the electrical panels, electrical equipment, ventilation vents and openings.

Presence of Moisture

Long-term exposure of metallic electrical components to moisture causes corrosion, and the build-up of corrosion by-products can lead to premature failure. Water entering electrical enclosures can cause failures due to ground faults and arcing. Electrical equipment areas should be kept dry and equipment should be protected from moisture. When evidence of moisture contamination is noted, equipment should be examined for damage and necessary repairs made. The source of the moisture needs to be identified and eliminated. All electrical work should be completed by a qualified electrician or licensed electrical contractor.

The Electrical Self-Assessment Survey below should be completed for each building. This assessment will produce a score of Low, Moderate or High based on the following:

+ **Low Exposure – 22–26 points**
  Electrical exposures were found to be acceptable. Exposure to an electrical loss is low.
+ **Moderate Exposure – 16–21 points**
  Electrical exposures were found to be acceptable, however; further electrical risk assessments are recommended.
+ **High Exposure – 0–15 points**
  Scores falling into this category have a high probability of suffering an electrical loss, and a comprehensive visual inspection of the entire electrical distribution system should be completed by a qualified licensed electrical contractor.

ELECTRICAL ASSESSMENT QUESTION	*SCORE
Is any part of your electrical system greater than 30 years old? (YES – 0 points, NO – 5 points)	
Do you have an Electrical Preventive Maintenance (EPM) Program in place that is conducted at least once every three years by a qualified electrician or licensed electrical contractor? (YES – 5 points, NO – 0 points)	
Has your facility noted any recurring problems, such as blown fuses, tripped breakers, flickering lights or overheated appliance cords? (YES – 0 points, NO – 4 points)	
Are there any missing covers on junction boxes, panels, switches or receptacles? (YES – 0 points, NO – 4 points)	
Who is responsible for maintaining the electrical equipment and system? *(select one)* ☐ Electrical Contractor (3 points) ☐ Maintenance Staff (2 points) ☐ Other (0 points)	
Do you have any temporary wiring within the facility? (YES – 0 points, NO – 2 points)	
Are combustible materials stored in the electrical room? (YES – 0 points, NO – 2 points)	
Have you noticed evidence of moisture or excessive dirt or dust on the electrical equipment or panels? (YES – 0 points, NO – 3 points)	
TOTAL SCORE	

**If a score of 0 is entered for any question, corrective actions should be taken.*

Name of person completing survey: _____

Date of survey: _____

GLOSSARY

Arc – High-density current between two conductors that produces high-intensity light and heat.

Arc Fault – When loose or corroded connections make contact, causing sparking or arcing between the connections. The resulting heat will break down the wire insulation and can trigger an electrical fire.

Arc Flash – Also called a "flashover," an arc flash is the light and heat produced as part of an arc fault.

Breaker – A switch that automatically stops electrical flow in a circuit if it detects an overload or short.

Busbar – A metal or metallic conductor used to connect several circuits.

Circuit – A path for transmitting electrical current.

Daisy Chaining – Connecting several devices together, such as extension cords or appliances.

Fuse – A safety device that protects electrical circuits from the effects of excessive currents.

Ground Fault – Occurs when there is a break in the low-resistance grounding path from a tool or electrical system. The current may then take an alternate path through the user, resulting in injury or death.

Ground Fault Circuit Interrupter – A fast-acting circuit breaker that shuts off electricity in the event of a ground-fault, acting as fast as 1/40 of a second.

Junction Boxes – A metal or plastic box where all the wires in a room, or wiring area, are joined together and fed by the main breaker.

Overcurrent – An excess of current in an electrical circuit, which can be caused by overloading the circuit or a short circuit, ground fault or arc fault. Circuit breakers and fuses can help prevent overcurrent from causing damage.

Stab-Lok Panels – A circuit breaker panel used in home construction between 1950 and 1990. They were later found to be faulty and should be replaced if your organization has one.

Tamper-Proof Fuse – Fuses designed to prevent people from installing the wrong-sized fuse in the fuse base.

Transformer Bushing – An insulated device that allows electrical conductor to pass safely through a grounded conducting barrier.

Transient Voltage – Also known as voltage spikes, transient voltage is a surge of electrical energy caused by the sudden release of energy previously stored or resulting from heavy inductive loads or lightning.

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