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For Best Distilled Home Ideas to Transform Your Smart Home Today Smart thermostatsEnergy Efficient Space HeatersAC units Whole House Surge ProtectionEMF Protection Z wave hubs Connection . Innovation . Intelligence . Automation Are you considering installing a transfer switch for your generator? If so, you're likely wondering… A piece of hardware designed to protect electrical or electronic equipment from voltage or current… Static electricity and electric current are fundamentally related but different. A good example of static… Surge protectors are essential in our daily lives for protecting valuable electronic devices from power… Are you tired of dealing with the maintenance and inefficiency of traditional lawn mowers? Or… Having the right size of a water heater can help you save a significant amount… Meet Kathy, your go-to expert for all things home technology! With over five years of experience crafting engaging content and insightful product reviews, Kathy combines her entrepreneurial spirit and marketing savvy to bring fresh perspectives to smart home enthusiasts. Her passion for cutting-edge gadgets and smart home innovations makes her blog a treasure trove of valuable tips and trends. Connect with Kathy on Twitter @Kathy_Q_Jones to join a community of smart homes aficionados and stay ahead in the world of home technology! Surge protectors are supposed to sit between an electrical outlet and your electronic devices and appliances, protecting them from power surges. What happens when they malfunction? More to the point, how can you tell that a surge protector has stopped working? Some people will encourage you to look at the lights. But what does a flickering light on a surge protector mean? What happens when that light dims or turns off altogether? A green light indicates surge protector is ready to defend against surges. A red light is normally a power light that indicates that the surge protector has been plugged into an active outlet. A switch light turns the protector on as well as a separate power light. However, You won't find obvious answers to these questions. This is because lights on a surge protector perform different functions depending on the model. As such, a flickering light on one surge protector might mean something entirely different from a flickering light on another surge protector. Of course, that shouldn't stop you from trying to interpret the flickering, blinking, and dimming lights on your surge protector. As you will soon see, if you apply some tact, there are ways to make sense of the behavior of your surge protector's light. If the green light on your surge protector is flickering, dimming or it has gone off completely, your response will depend on the purpose the green light plays. You have to realize that some surge protectors have several lights and they could mean any number of things, for instance: 1). You have lights that show that the surge protector's surge protection mechanisms are working. If these lights are on, you can trust your surge protector to defend your equipment from dangerous surges, not to mention fluctuations. 2). Some lights are associated with grounding. When they illuminate, they prove that the outlet into which the surge protector has been plugged is grounded appropriately. Some lights will turn on when you plug the protector into an outlet that hasn't been earthed. 3). Some surge protectors have lights that only activate when they encounter a problem. That includes over-voltage issues (where a voltage spike occurs) and under-voltage complications (where the voltage falls below the required level). A surge protector that detects over and under-voltage has sensors that can identify normal voltage levels. These same sensors will take note of abnormal fluctuations, using the lights to indicate an over or under-voltage to the consumer. 4). If you have a Belkin surge protector, the Belkin website mentions an inrush/over-current mechanism that kicks in when a connected device draws excessive amounts of electrical current. The manufacturer has included indicator lights that will warn you when this happens. You have to understand the function that each light plays. This is the only way to accurately diagnose your surge protector when things go wrong. In many surge protectors, the green light is associated with the surge protection mechanisms. Tripplite agrees with this assessment. As far as they are concerned, when a green light comes on, it means that the surge protector is ready to defend against surges. Therefore, once that green light goes off, you can conclude that things have gone wrong and the surge protection mechanisms have stopped working. It is worth noting that a catastrophe that causes the surge protection to stop working will most likely cause the green surge light to go off. It won't blink or flicker, and if it does, this won't last long. Related post Is A Surge Protector Necessary For A Refrigerator? These lights activate when you plug the surge protector into an outlet and you switch the power on. A power light tells you that the surge protector is on, that it has electricity running through it. The flickering power light on a surge protector isn't as problematic as you might think. Most power lights feature neon lamps which are highly efficient. While manufacturers love them, neon bulbs eventually wear out. Over the weeks, months, and years, their components will degrade, causing them to flicker. Eventually, they will turn off altogether. This shouldn't concern you. Your surge protector is still fine. You can replace the neon bulb. However, even if you don't, AZ Central doesn't expect the neon bulb's absence to affect the operations of the surge protector. This is also true for an ordinary power strip. Related Post Surge Protectors Vs Surge Suppressor(What's The Difference?) Some surge protectors have a switch that turns the protector on as well as a separate power light. Others combine the switch and the power light. In other words, when you flip the switch into the 'ON' position, the light inside the switch will come on. This light serves the same purpose as a separate power switch. It tells you that the surge protector has been turned on. If the switch uses neon bulbs, they will eventually degrade, causing the switch light to flicker and blink before going off altogether. This isn't an issue. A dead switch light cannot stop the surge protector from doing its work. Most power strip lights are red or orange. This is also true for switch lights. If the blinking/flickering light on your surge protector is red or orange, it is most likely a power light that indicates that a surge protector has been turned on or off. If that red or orange light has neon bulbs, they will degrade over time. This causes them to blink and flicker. Eventually, the light will stop working. But this won't affect the surge protection mechanisms of your power strip. Related Post Surge Protector Vs Power Strip(What's The Difference?) A lot of people panic when the red light on their surge protector refuses to go on. This is especially true in situations where the light was on but then it went off and refused to turn back on. A red light is normally a power light that comes on to indicate that the surge protector has been plugged into an active outlet. If the manufacturers of the surge protector used neon bulbs, those bulbs will degrade over time and the light will eventually go off. This isn't a bad thing. It doesn't mean that the surge protector has stopped working. The protector doesn't need the red light to perform its function. It should be noted that a dead red light is only innocent if it is the power or switch light. Check the surge protector's manual. On some surge protectors, a red light may represent the protector's surge protection abilities. This is normally assigned to a green light. However, a manufacturer may favor a red light. As such, if the red light is off, it means that the surge protection mechanisms have stopped working. In some surge protectors, a red light will come on to indicate that the surge protection mechanisms have stopped working, in which case, a red light that isn't on is a good thing. It means that the surge protector is still functional. It all comes down to the manual. If you don't have one, visit the manufacturer's website. They will tell you what the red light indicates and what it means when the light goes on or off. Related Post Is A Surge Protector Necessary For A Refrigerator? To understand the functions of the lights on your surge protector, you must first understand the role these devices play. Surge protectors are power strips with surge protection mechanisms. According to Home Depot, most of them use Metal Oxide Varistors which reduce resistance in the event of a power surge. This allows the MOVs to direct destructive quantities of electricity away from the appliances connected to the surge protector. Because they are resistant to low-voltage current, MOVs do not affect the ordinary flow of electricity to your electronic devices. Surge protectors are supposed to defend your appliances against power surges but that doesn't make them invulnerable. Every time a surge protector encounters a surge, the MOV loses its potency. This is true for both small and large surges. Eventually, the MOV will wear out. Once this happens, your surge protector will lose its surge protection capabilities. This can happen immediately because of one large surge or after several weeks and months because of a series of smaller surges. This is why a flickering light on a surge protector causes so much concern. It encourages people to wonder whether their surge protector has stopped working. The components in surge protectors that prevent dangerous electrical currents from reaching your equipment are not immune to surges. Every time they redirect a surge, they become weaker and less potent. If your surge protector has a green light that indicates the presence of surge protection mechanisms, that light must stay on. This is the only way to know for certain that the surge protection is still working. If the green light goes off, it means that your surge protector encountered a surge so powerful that it destroyed the components that allow it to defend your equipment. This doesn't always happen at once. Sometimes, a surge protector stops defending your equipment because it has encountered several small surges over the course of several weeks and months. With each surge it redirects, it becomes weaker and weaker until it stops working. At that point, the surge protector becomes an ordinary power strip. You can use it to power your appliances but it won't defend them against surges. If your protector's green light has gone off, you can assume that its surge protection mechanisms are no longer functional. But again, this is only true if the green light is connected to the surge protection. Don't jump to this conclusion, not without consulting the manual. As was noted before, the lights on your surge protector could mean any number of things. If the green light is the ground light and it has gone off, the electrical outlet has a problem. It might have poor grounding or no grounding at all. Either way, you should unplug the surge protector. There is no point in acting until you know what the green light means. Otherwise, you ran the risk of misinterpreting the signs and taking the wrong steps. People tend to respond to flickering lights by assuming that the surge protection is either defective or it has stopped working. But in some scenarios, you have loose connections and wires. This can cause both the green and red lights to flicker, blink, and dim. Loose connections are dangerous because they can cause fires. The most effective solution to flickering, blinking, dimming, and deadlights is to replace the surge protector. This is especially true where the green light is concerned. Power lights are not an issue because they are supposed to tell you whether or not the surge protector is on. They have nothing to do with the surge protection mechanisms. Greens lights, specifically those that indicate the status of the surge protection, should be illuminated at all times. Cyber Power has emphasized this issue. They argue that a surge protector whose green surge light isn't illuminated should be replaced because that surge protector can no longer defend against spikes, surges, and fluctuations. This sounds like an overreaction but it is the correct response. A surge protector whose surge protection has stopped working is just a power strip. It cannot stop a surge from destroying your equipment, so it serves no purpose. If you don't know for certain what your green light does, whether or not it indicates the status of the surge protection, and if it is truly dimming and flickering, you should replace your surge protector all the same. You cannot afford to take chances here. Some surges are so powerful that they produce tangible results. They will cause the surge protector to pop and hiss. In some situations, they will leave scorch marks. People that observe such signs won't hesitate to replace their protectors. Unfortunately, most surges are subtle. They do not produce dramatic results. You won't even know that they killed the surge protector's defensive mechanism. The only tool you can lean on to measure your surge protector's defensive capabilities is the indicator light. And if that light is flickering, blinking, dimming, or dead, take that as a sign that the surge protector needs replacement. Do not wait for a surge to ruin your equipment. If you've had the protector for two or three years, replace it even if the green surge light is on. You shouldn't keep these devices for too long. You cannot interpret the meaning behind a blinking, flickering or dead light without first determining what the light does. You need to check the manual. If the light is red and it is a power or switches light, then it designed to show that a surge protector has been turned on or off. Because such lights tend to feature neon bulbs, and neon bulbs degrade over time, the flickering, blinking, and dimming shouldn't concern you. The power or switch light has nothing to do with the surge protection mechanisms of your surge protector. This behavior should only worry you if the light is green or if the red light has been designed to represent your power strip's surge protection abilities. Check the manual or manufacturer's website for guidance before you act. Surge Protection for Refrigerators is more than just a precaution; it's an essential defense against unexpected power spikes that can wreak havoc on your kitchen's most vital appliance. Imagine this: you're away on a weekend getaway, and a thunderstorm hits your area. Without proper surge protection, your refrigerator is at risk of damage, potentially spoiling food and leading to costly repairs. In this article, we'll explore the critical importance of surge protection for your refrigerator, guiding you through the best practices and products to ensure that your food stays fresh and your appliance remains unharmed, no matter what mother nature throws your way. To make sure that an electrical surge won't leave you with a non-working refrigerator, you should really think about surge protection for refrigerators. A massive electrical surge can destroy your fridge outright, wrecking the electronics and rendering the fridge useless. It's like Emperor Palpatine (Darth Sidious) using light from his fingers to fry out Darth Vader to his death. But even weak surges can have an accumulative effect on your fridge, especially if they happen frequently. The damage builds up, and one day another weak surge may be the straw that breaks the camel's back! They're very affordable, and maybe even cheaper than getting an extra warranty. You won't have to spend more than $50 for one, and some of the best ones cost only $30 or so. They're basically plug and use, like an adaptor. In fact, they're like extension cords but with surge protection. All you need to do is to set them up somewhere out of the way, so people won't accidentally kick them and unplug the fridge. Not everyone is convinced of this need, admittedly. Even GE Appliances explicitly states that they don't recommend it. They say that their refrigerators already have a compressor that shuts itself off when there's an electrical surge. Afterwards, it will automatically restart itself. But a surge protector can disrupt that process, and keep the fridge from restarting. If this happens when you're asleep, then you may wake up with spoiled food inside. On the other hand, they don't actually say that the surge protector is bad for the fridge. It's just that it may lead to food spoilage. That's up to you, but the best ones are those explicitly designed for fridges and other high-voltage appliances. These are often portable outlets with several outlets for different appliances. However, you may want a separate plug-in surge protector just for the fridge. You need to at least check the joule rating and go for at least a joule rating of 2,000. Some premium surge protectors have a joule rating of 4,000 or even higher. Lower joule ratings may mean that you'll need to replace the surge protector after a major surge. After that, check the number of outlets. You only need one for your fridge, but you may want to plug in other devices like the microwave, blender, or the coffeemaker. The cord length is important too, especially if you're plugging in several appliances. A longer cord means that you don't have to set your appliances too close to the electrical outlet. Not really, according to experts. These experts recommend that you use the plug-in types with your whole hose surge protector. That's the best protection against surges possible. Keep in mind that plug-in surge protectors may not help with major surges, such as when lightning strikes close to your home. These surges can cause a massive tidal wave of excess voltage that regular plug-in surge protectors just can't handle. That's why it's best if you go with a whole house surge protector. That can deal with most of the excess voltage. Up to 15% of the excess voltage can still pass through, and your plug-in surge protectors can deal with that type of surge. That way, you can be sure you won't have to replace your fridge just because of an electrical storm and a massive electrical surge. Code Change Summary: A new code section was added to address surge protective devices (SPD's) for fire pump controllers. A surge is a transient wave of voltage or current. The duration is not consistent but is usually less than a few milliseconds. Transients and Surges can have peak values in excess of 10kA or 10kV. During a surge, the waveform has a very rapid rise to the peak and then falls off at a much slower rate. Transients and Surges can be caused by external sources such as lightning or short circuits, or from internal sources such as variable speed drives, contactor or capacitor switching. The study, "Data Assessment for Electrical Surge Protective Devices" commissioned by the Fire Protection Research Foundation, provides results of a 2014 survey of facility managers concerning surge damage. It shows that 12% had damage to fire pumps due to voltage surges. This damage could have been prevented with properly sized SPD's. The new code section provides necessary requirements for fire pumps which are extremely critical for life-safety. As seen in the NFPA Research Foundation report there are a significant number of fire pump installations that suffer damage that could have been prevented by a SPD. The purpose of the NEC® is the practical safeguarding of persons and property from hazards arising from the use of electricity. Surges are a hazard that occurs from the use of electricity and it makes sense to justify the code change based on the fact that a fire pump controller damaged by a surge may not perform as intended when it matters most. Below is a preview of the NEC®. See the actual NEC® text at NFPA.ORG for the complete code section. Once there, click on their link to free access to the 2017 NEC® edition of NFPA 70. 2017 Code Language: N 695.15 Surge Protection. A listed surge protection device shall be installed in or on the fire pump controller. Share — copy and redistribute the material in any medium or format for any purpose, even commercially. Adapt — remix, transform, and build upon the material for any purpose, even commercially. The licensor cannot revoke these freedoms as long as you follow the license terms. Attribution — You must give appropriate credit , provide a link to the license, and indicate if changes were made . You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. ShareAlike — If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original. No additional restrictions — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits. You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation . No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. Summary: The 2020 NEC featured a new article related to surge protection. Article 230.67 now requires all services supplying dwelling units to be provided with a surge protective device (SPD), as an integral part of equipment or located immediately adjacent. The SPD must be a Type 1 or Type 2 SPD. This requirement applies to residential service equipment being replaced as well. Read the full code below: Service Equipment – General 230.67 Surge Protection. (A) Surge-Protective Device. All services supplying dwelling units shall be provided with a surge-protective device (SPD). (B) Location. The SPD shall be an integral part of the service equipment or shall be located immediately adjacent thereto. Exception: The SPD shall not be required to be located in the service equipment as required in (B) if located at each next level distribution equipment downstream toward the load. (C) Type. The SPD shall be a Type 1 or Type 2 SPD. (D) Replacement. Where service equipment is replaced, all of the requirements of this section shall apply. * As per the NEC, a dwelling unit is a single unit, providing complete and independent living facilities for one or more persons, including permanent provisions for living, sleeping, cooking, and sanitation. The 2017 edition of the National Electrical Code (NEC) includes many changes covering traditional and alternative sources of electrical power. NFPA 70: National Electrical Code (NEC) is the benchmark for safe electrical design, installation, and inspection to protect people and property from electrical hazards in residential, commercial, industrial, and other markets. Below are the top things you need to know: 1. Increased shock protection. The 2017 NEC expands requirements for protection from shock hazards through application of panelboard barriers, tamper-resistant receptacles, and ground-fault circuit-interrupters (GFCIs). Updates include: 210.8(B) – GFCI protection of single-phase receptacles rated 150 volts (V) to ground or less expanded to include all 50 amperes (A) or less, instead of 20 A or less. Also, 3-phase receptacles 150 V to ground or less and 100 A or less. 210.8(B)(9) & (10) – GFCI protection of receptacles expanded from dwelling unit crawl spaces and unfinished basements to now include those same locations in non-dwelling units. 210.8(E) – GFCI is now required for lighting outlets in crawl spaces. 406.12 – Tamper-resistant receptacles have been expanded to 250 V non-locking-type receptacles to a list of new areas that include mobile homes, preschools and elementary education facilities, and other areas where children are likely to be present. 408.3(A)(2) – Barrier requirements are expanded to all service panelboards. No uninsulated, ungrounded service busbars or service terminals can be exposed to inadvertent contact by persons or maintenance equipment. 422.5 – The five appliances that are/have been required to have GFCI protection are now all grouped in this section with a total of five methods permitted to achieve this requirement. 555.3 – Overcurrent protective devices that supply marinas, boatyards, and commercial and non-commercial docking facilities that have ground fault protection not exceeding 30 mA. 682.15 – All outdoor receptacles, in or on floating buildings or structures within the electrical datum plane area, must now have GFCI protection. 690.12 – This section was modified to emphasize rapid shutdown requirements for reducing the shock hazard to emergency responders. Clarity was added to this section by dividing it into four separate subsections as well as other functionality details. 2. Product listing and suitability. Products are tested to standards compatible with the NEC, raising awareness on the importance of UL and similar agency standards. (Installs are not treated as separate structures, and solutions like electric vehicle chargers and marina pedestals are considered equipment and not structures.) Updates include: 100 – Structure – The words, "other than equipment," were added to the definition of a structure to help recognize that such products as electric vehicle chargers and marina pedestals are not structures and should be treated as equipment. 110.3 – New language provides clarity that products are to be listed to standards recognized as achieving equivalent and effective safety for equipment installed to comply with the NEC. 3. Arc flash awareness. To continue raising awareness of incident energy hazards, service entrance equipment rated 1200 A or more must now be clearly labeled for fuse and circuit breaker selections. Reduction requirements continue to reduce incident energy at service entrance panels. Updates include: 110.16(B) – Service entrance equipment rated 1200 A and higher must now include a label that shows the nominal system voltage, available short-circuit current, clearing time of the service overcurrent protective device based on that available short-circuit current, and the date the label was applied. The exception permits a 70E-type label to take the place of this information. 240.67 – For fuses rated 1200 A and above, this new requirement which doesn't go into effect until January 1, 2020, and mirrors the requirements of 240.67 mandating arc energy reduction methods to be employed when the arcing current clearing time is greater than 0.07 seconds. 240.87 – Use of a device's instantaneous trip unit was added as one of the methods to reduce arc energy when the arcing current is in the instantaneous region of the circuit breaker by design. This does not mean we can field modify the settings of the breaker to meet this language. 4. Short circuit current ratings (SCCR). The NEC 2017 edition increases awareness of the proper application of electrical distribution equipment with regard to SCCR and expands the types of equipment that require SCCR marking. Mandatory equipment SCCR marking: 409.110(4) Industrial Control Panels 430.8 Motor Controllers 430.98 Motor Control Centers 440.4(B) Air Conditioning & Refrigeration Equipment 620.16(A) Elevator Control Panel 670.3(A)(4) Industrial Machinery 700.5(E) Transfer Equipment for Emergency Systems 701.5(D) Transfer Equipment for Legally Required and Standby Systems 702.5 Transfer Equipment for Optional Standby Systems 708.24(E) Transfer Equipment for Critical Operations Power Systems. Requirements for equipment SCCR to be greater than the available short circuit current: 110.10 Circuit Impedance, Short-Circuit Current Rating, and other Characteristics 409.22(A) Industrial Control Panels 440.10(A) Air Conditioning & Refrigeration Equipment 620.16(B) Elevator Control Panels 670.5(1) Industrial Machinery. 5. Available short-circuit current. The proper application of electrical equipment includes rating the equipment to handle available short-circuit current levels and marking that level on the equipment after installation. Requirements for either marking available short-circuit current or documenting that value at equipment: 110.24 Service Entrance Equipment 409.22(B) Industrial Control Panels 440.10(B) Air Conditioning & Refrigeration Equipment 620.51(D)(2) Elevator Control Panels 670.5(2) Industrial Machinery. 6. Surge protection. For increased protection and reliability, the NEC 2017 expands requirements for safety-related circuits. Surge protection is required for fire pump controllers, critical operations data systems, industrial control panels, including machinery with safety interlock circuits, and disconnects that supply emergency system loads. Updates include: 620.51(E) – Surge protection is now required where any of the disconnecting means for elevators, dumbwaiters, escalators, moving walks, lifts and chairlifts have been designated as supplying an emergency system load. 645.18 – New requirement for surge protection in critical operations data systems. 670.6 – Surge protection is now required for industrial machinery with safety interlock circuits. 695.15 – A listed surge protective device must now be installed in or on fire pump controllers. 7. Maintenance. Maintenance requirements are expanding for emergency systems to ensure the entire system is maintained in accordance with manufacturer's instructions and industry standards. Provisions ensure backup power is available during maintenance or repairs when the emergency system relies on a single alternate power source. Updates include: 700.3(C) – New requirement that emergency system equipment must be maintained in accordance with manufacturer's instructions and industry standards. 700.3(F) – These new provisions provide us with performance-based requirements to ensure backup power is available when maintenance or repairs are being made to those installations where the emergency system relies on a single alternate source of power. Thomas Domitrovich is the vice president of technical sales at Eaton. He has more than 20 years of experience as an electrical engineer and is a LEED accredited professional. Thomas is active in various trade organizations on various levels with the Independent Electrical Contractors, International Association of Electrical Inspectors, Institute of Electrical and Electronic Engineers (IEEE), National Electrical Manufacturer's Association (NEMA), and the National Fire Protection Association (NFPA). Thomas is involved with, and chairs various committees for NEMA and IEEE and is an alternate member on NFPA 73. He is very active in the state-by-state adoption process of NFPA 70, working closely with review committees and other key organizations. Edited by Emily Guenther, associate content manager, Control Engineering, CFE Media, . MORE ADVICE Key Concepts New requirements for electrical safety. Critical changes to the NEC 2017 edition. Electrical safety measures for various types of facilities. Consider this What other changes should be noted in the NEC 2017 edition for specific building types? link to Can You Run 120V And 480V In The Same Conduit? Is it Safe? link to Can I Use 6/3 Wire For Hot Tub? link to 6-2 or 6-3 Wire For Stove (The Best Wire Size For Stove) link to Can You Put Two Wires On One Outlet Screw? link to Can You Run Electrical Wire Next To Plumbing? link to Can You Get Shocked By Touching One Wire? Hi, my name is Stellar Jackson and I'm an Electrical Engineer. I completed my electrical engineering in 2014 and have been working since then. During this tenure, I have gathered information related to electrical stuff like Generators, Circuits, Hydropower and Surge Protectors... And I am writing this blog to convey information that I know to help you to get the best information out of it. Featured In Prior to the 2020 NEC, you probably didn't come across a requirement for surge-protective devices (or SPDs) in the code unless you were in some special situations. In fact, the 2017 NEC only tells you what they are and where they are permitted (article 285), requires them for wind electric systems (694), fire pumps (695), industrial machinery (670), emergency systems panelboards (700), and critical operating power systems (or COPS) (708), and tells you to button them up in classified locations in 501.35 & 502.35. These requirements have expanded and moved around a lot in the code, so we will stick to referencing 2020 NEC unless noted otherwise below. The science behind surge protection has come a long way, and many more household appliances and electronics are sensitive to lighting strikes and downed power lines than in previous years. But what is a surge-protective device, and where is it required? How do you go about selecting the right one for your application? The answers to these questions have changed a lot in the recent years, with even bigger implications on the horizons. Surge-protective devices, sometimes called surge protectors or SPDs, are not just power strips, and many power strips that you see in the store provide no protection at all against lightning strikes or downed power lines. The main function of a surge-protective device is to protect against the transient voltages that lightning strikes and downed power lines produce. This transient voltage is especially dangerous to sensitive electronics which used to only include computers and TVs, but the rise of smart appliances has introduced a new area of vulnerability. That's just part of the reason why a surge protector power strip isn't enough anymore. Image: 1 Transient voltage waveform Where are SPDs Required? As we mentioned earlier, there were a handful of special situations that said you must use an SPD in the 2017 code, but as of this article's publication over half of the US is now on NEC 2020. These rules will apply to you if you're doing new construction or a big enough repair, but that also means that there are new technologies to consider that would protect your property even if they aren't legally required through your local building official's code adoption. Image: 2 Surge protector location by class Now that we know we need surge-protective devices, let's break down requirements by type: Type 1 Type 1 surge-protective devices are at the utility- or service-level. These would typically be installed at the supply-side of the service disconnect of your home or office. Because they are installed on the utility-side of your main breaker, they are not as common and harder to access and replace than type 2. NEC 2020 requires a type 1 or type 2 surge-protective device on dwelling units in 230.67. Type 2 Type 2 surge protectors are the most common form of whole-home surge protection. Check with your manufacturer's installation instructions, but these are typically wired on a new multi-pole breaker closest to where the SPD will be mounted, many times directly to the panelboard itself. As mentioned in the previous section, NEC 2020 requires a type 1 or type 2 surge-protective device on dwelling units in 230.67. Image 3: Example of a whole-home surge-protective device Type 3 Type 3 surge protectors are the most common that you can find. These are the "power strips" that are intended as the last line of defense that a consumer can buy and install before a sensitive piece of equipment. The NEC is silent on type 3 surge protectors, so it's up to you to decide if this added layer of protection is worth it. Type 4 Type 4 is the last category of surge-protective device and reserved for components inside of manufactured equipment. NEC 242.18 restricts installation of type 4 SPDs to the equipment manufacturer, so we won't go into any further details in this article. The Immediate Future, and What That Means for Surge Protection NEC 2023 is out and has some interesting developments for where surge protection is required. They are still silent on requirements for class 3 SPDs, but the occupancies where class 1 or 2 surge protection is required are expanding. Where protection was only required in dwelling units, NEC 2023 will also need SPDs installed in many places that could also be considered a residence, from dormitory units to hotels or motels, and even in the patient sleeping areas of nursing homes. There's also new language requiring surge protection for power going to fire panels in 760.33, but this feels more like clarification where a governmental authority having jurisdiction (or AHJ) hasn't already declared fire panels as COPS. What Rating of Surge-Protective Device Do I Need? Ratings of Class 1 and 2 SPDs To get the right SPD, first determine the class of protection that you need and then select an appropriate kA rating. Informational note! This kA rating (discharge current rating, or In) is not the same as the interrupting rating of overcurrent protection (amps interrupting current, or AIC). This is a lot of gray area, but Emerson has generated some helpful guidance for us. In their white paper "How to Properly Size Surge Protective Devices" they provide a "3, 2, 1 Rule of Thumb" recreated here for informational purposes, and a second version based on panel rating below it. Keep in mind that IEEE Standard 1100 recommends cascading protection, so sometimes a lower rating makes sense on the panels below. The white paper is worth a read if you have time to take it in, which is beyond the scope of this post. Ratings below are only for class 1 and 2 SPDs, and do not include information on class 3, which comes in the following paragraphs. Ratings of Class 3 SPDs While the FAQs in the Surge Protection Institute at NEMA says that more reputable manufacturers do not provide ratings in joules, most class 3 surge-protective devices still use this older method. Generally, the devices with a higher joule rating are better for more sensitive electronic devices. Because every wire in the house is a potential entrance point for surges, be sure that these devices include ports for COAX or ethernet to protect all the things in your home that are physically connected to the internet. For sizing, we can piggyback off Emerson's 1, 2, 3 Rule of Thumb and consider 1,000 joules for minimal protection, up to 2,000 joules for small appliances, and up and above 3,000 joules for more critical equipment like home theater, computers, gaming consoles and the like. Take these ratings with a grain of salt, however, as they can be skewed by misleading tests. Because of the way that UL defines Class 3 SPDs, note that these are not allowed to be installed within 10 meters (30 feet) of the service panel. Anything closer must be listed as a Class 2 SPD. Conclusion and Further Reading Getting the right surge-protective device to meet your needs shouldn't be a mystery. While a rule of thumb is good, keep an eye on official guidance from NEMA Surge Protection Institute and NEC code updates. As the technology is better understood, more definitive guidance will become available. What about your own personal experience? What best practices have you come across for surge protection, and what areas do you feel like will improve in the coming years? Emerson's guidance on surge protectors, including their "3, 2, 1 Rule of Thumb". NEMA Surge Protection Institute's guide to surge class, type, and location. An oldie with some outdated ideas, NIST offered Special Publication 960-6 to help us understand what surges are and how to protect from them. Sources: Image 1 Transient voltage waveform: Transients.svg Image 2 Surge protector location by class: Image 3 Example of a whole-home surge-protective device: About the Author Jeff has a B.S. in Electrical Engineering from Louisiana Tech University. Prior to coming to Hallam-ICS, Jeff had 7 years of experience working in prefab construction for mechanical and electrical buildings and skids. He holds a professional engineering license in multiple states, participates in all phases of the project design from concept through construction, and cooks a mean gumbo. Read My Hallam Story About Hallam-ICS Hallam-ICS is an engineering and automation company that designs MEP systems for facilities and plants, engineers control and automation solutions, and ensures safety and regulatory compliance through arc flash studies, commissioning, and validation. Our offices are located in Massachusetts, Connecticut, New York, Vermont and North Carolina and our projects take us world-wide. Protects electrical devices from voltage spikes Surge protection device (SPD) for installation in a low-voltage distribution system. A surge protector, spike suppressor, surge suppressor, surge diverter,[1] surge protection device (SPD), transient voltage suppressor (TVS) or transient voltage surge suppressor (TVSS) is an appliance or device intended to protect electrical devices in alternating current (AC) circuits from voltage spikes with very short duration measured in microseconds, which can arise from a variety of causes including lightning strikes in the vicinity. A surge protector limits the voltage supplied to the electrical devices to a certain threshold by short-circuiting current to ground or absorbing the spike when a transient occurs, thus avoiding damage to the devices connected to it. Key specifications that characterize this device are the clamping voltage, or the transient voltage at which the device starts functioning, the joule rating, a measure of how much energy can be absorbed per surge, and the response time. The terms surge protection device (SPD) and transient voltage surge suppressor (TVSS) are used to describe electrical devices typically installed in power distribution panels, process control systems, communications systems, and other heavy-duty industrial systems, for the purpose of protecting against electrical surges and spikes, including those caused by lightning. Scaled-down versions of these devices are sometimes installed in residential service entrance electrical panels to protect equipment in a household from similar hazards.[2] In an AC circuit, a voltage spike is a transient event, typically lasting 1 to 30 microseconds, that may reach over 1,000 volts. Lightning that hits a power line can cause a spike of thousands of volts. A motor when switched off can generate a spike of 1,000 or more volts. Spikes can degrade wiring insulation and destroy electronic devices like light bulbs, battery chargers, modems, TVs, and other consumer electronics. Spikes can also occur on telephone and data lines when AC main lines accidentally connect to them or lightning hits them, or if the telephone and data lines travel near lines with a spike and the voltage is induced. A long-term overvoltage surge, lasting seconds, minutes, or hours, caused by power transformer failures such as a lost neutral or other power company error, are not protected by transient protectors. Long-term surges can destroy the protectors in an entire building or area. Even tens of milliseconds can be longer than a protector can handle. Long-term surges may or may not be handled by fuses and overvoltage relays. This section may be too technical for most readers to understand. Please help improve it to make it understandable to non-experts, without removing the technical details. (June 2022) (Learn how and when to remove this message) A building's wiring adds electrical impedance that limits the surge current that reaches the loads when a voltage transient arrives at the service entrance (the point where the supply company's wiring enters a property). There is less surge current at longer wire distances and where more impedance is present between the service entrance and the load.[3] Category A loads are more than 60 feet of wire length from the service entrance to the load. Category A loads can be exposed to 6 kV and 0.5 kA surge currents. Category B loads are between 30 and 60 feet of wire length from the service entrance to the load. Category B loads can be exposed to 6 kV and 3 kA. Category C loads are less than 30 feet from the service entrance to the load. Category C loads can be exposed to 20 kV and 10 kA.[4] A coiled extension cord can be used to increase the wire length to more than 60 feet and increase the impedance between the service entrance and the load.[5] A power strip with built-in surge protector and multiple outlets A transient surge protector attempts to limit the voltage supplied to an electric device by either blocking or shorting current to reduce the voltage below a safe threshold. Blocking is done by using inductors that inhibit a sudden change in current. Shorting is done by capacitors which inhibit a sudden change in voltage or by spark gaps, discharge tubes, Zener effect semiconductors, and metal-oxide varistors (MOVs), all of which begin to conduct current once a certain voltage threshold is reached.[6] Some surge protectors use multiple elements. In the shorting method, the electrical lines are temporarily shorted together (as by a spark gap) or clamped to a target voltage (as by a MOV), resulting in a large current flow. The voltage spike is reduced as the shorting current flows through the resistance in the power lines. The spike's energy is dissipated in the power lines or the ground, or in the protector, converted to heat. Since a spike lasts only tens of microseconds, the temperature rise is minimal. However, if the spike is large enough or long enough, the protector can be destroyed and power lines damaged. Surge protectors for homes can be in power strips used inside, or a device outside at the power panel. Sockets in a modern house use three wires: line, neutral and ground. Many protectors will connect between all three in pairs (line–neutral, line–ground and neutral–ground), because there are conditions, such as lightning, where both line and neutral have high voltage spikes that need to be shorted to ground. Additionally, some consumer-grade protectors have ports for Ethernet, cable television and plain old telephone service, and plugging them in allows the surge protector to shield them from external electrical damage.[7] The characteristic of a TVS requires that it respond to overvoltages faster than other common overvoltage protection components such as varistors or gas discharge tubes. This makes TVS devices or components useful for protection against very fast and often damaging voltage spikes. These fast overvoltage spikes are present on all distribution networks and can be caused by either internal or external events, such as lightning or motor arcing.[8] Applications of transient voltage suppression diodes are used for unidirectional or bidirectional electrostatic discharge protection of transmission or data lines in electronic circuits. MOV-based TVSs are used to protect home electronics and distribution systems and may accommodate industrial-level power distribution disturbances, saving downtime and damage to equipment. The level of energy in a transient overvoltage can be equated to energy measured in joules or related to electric current when devices are rated for various applications. These bursts of overvoltage can be measured with specialized electronic meters that can show power disturbances of thousands of volts amplitude that last for a few microseconds or less. It is possible for a MOV to overheat when exposed to overvoltage sufficient for the MOV to start conducting, but not enough to totally destroy it, or to blow a house fuse. If the overvoltage condition persists long enough to cause significant heating of the MOV, it can result in thermal damage to the device and potentially start a fire.[9][10] Type Surge capability (A) Note Lifetime – number of surges Response time Shunt capacitance Leakage current (approximate) Min Max Resettable fuse 2 60 SMD mountable infinite >1 ms TVS diode 1 15000 SMD to 15 kA (large through-hole device) ? ≈1 ps (limited by pin lengths) 10 nF (large through-hole device) 1 µA Metal-oxide varistor (MOV) 1 70000 @100 A, 8 × 20 µs pulse shape, 1,000 surges ≈1 ns Typically 100–1,000 pF 10 µA Avalanche diode, Zener diode 50 @50 A, 8 × 20 µs pulse shape, infinite 20 surges