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Safety In Emerging Electrical Entertainment

Does electricity change? Does the job of an electrician change? These are all questions that are always on the mind of the entertainment electrician. The process of creating electricity does not change much, but everything surrounding it does. Cable, grounding, theater, buildings, equipment, electrical storage and other systems are changing and improving as this paper is being written. In entertainment, it is of the utmost importance to continue to stay current with everything surrounding electricity. Some of the best ways to stay up to date are found within the NFPA, which is the National Fire Protection Agency, the organization that wrote the NEC, which is the National Electrical Code. Certain standards can be found from ANSI, which is the American National Standards Institute, and a subsidiary of them, NEMA, the National Electrical Manufacturers association. Other ways to find useful information are from the Entertainment Technician Certification Program, or ETCP, and IATSE, which is the International Alliance of Theatrical Stage Hand Employees, which is the union that is composed of the people who work in theater, including theatrical electricians. Another group that converses about and deals with safety is OSHA, which is the Occupational Safety and Health Administration. Along with the concepts championed by these aforementioned groups, lasers and pyrotechnics are becoming more of an expanding role in entertainment. Lasers are under the jurisdiction and rules of the Food and Drug Administration and pyrotechnics follow laws set by the Bureau of Alcohol, Tobacco and Firearms and also have rules set by the NFPA. These groups are at the forefront of

electrical safety and are the best sources for keeping electricians, the audience, and everyone involved safe.

The first and most extensively compiled place to find information is the NEC, the National Electrical Code. It is standard 70E from the NFPA and can be found free online. NEC/ Standard 70E contains detailed information about everything electrical. They start with wiring buildings, which, although does not seem to apply directly to entertainment, is important to the places in which electricians work. This includes high-leg systems, arcing warning, and dealing with workspace and equipment space. The first few chapters mention the NECA, which is the National Electrical Contractors Association. Following installation, the NFPA gets into wiring and protection. This is when it starts to converge with entertainment. The NEC 70 discusses fuses and breakers, which deals with every fixture and piece of equipment worked on by theatrical employees. It also mentions article 520, which directly deals with theaters. 240 is important for overcurrent protection and also dealing with phases and voltages.

Following installation and protection, the article that acts as the holy grail of information for general use of electricity is article 400. It holds information surrounding all types of cable cord. It has information on voltages, AWG/size, number of conductors, types of covering, and their uses. It also covers the ampacity of the cable based on AWG/size. This is important to have handy if dealing with high wattage that cannot be dealt with low ampacity cable. Standard size is 12 AWG in theaters, but it is important to know what size is needed for lights with a higher power intake. Article 400 also covers temperature rating of cable, adjustment factors for high numbers of conductors, markings, uses, overcurrent protection, the grounding conductor, and other fine details of cables. Article 400 acts as the holy grail of electrical information because all of the values, tables, and information in this article tell what cable and size is necessary for a

specific voltage, wattage, or light. These rules are necessary to follow because if the maximum threshold of wattage in a cable is passed, the cable can overheat, causing damage to the cable, which makes it unusable, and can dangerously hurt the electrician. Article 400 is important because it holds all the information about cables, their types, their uses, and the limitations about each cable and should not be dismissed because of the danger electricity can cause when the cables that transfer it are broken.

Arguably the most important article to the entertainment electrician is number 520; titled "Theaters, audience areas of motion picture and television studios, performance areas, and similar locations". It covers much of what an entertainment electrician would deal with, from breakouts, footlights, portable equipment, power distros, types of dimmers, two-fers and more. The article delineatesa significant number of rules, including how to use portable equipment and the protection of live parts. It jumps into a discussion about the placement and necessity of overcurrent protection. 520.25 explicitly talks about the types and use of dimmers in a theatrical setting. Following dimmers, it covers the use of Feeder power into patch panels or power distros. 520.43 talks about specifics in footlights, which is seen in most big shows, but it is important to mention that footlights are also changing through their type, LED or incandescent. An important rule from 520 is that "cords and cables for supply to border lights, drop boxes, and connector strips shall be listed for extra hard usage" (Article 520). This means that, other than specific exceptions, Extra hard usage cable (SO, seen in Article 400) shall be used in theater. Other mentions include overcurrent protection based on AWG/size, enclosure of open bulbs, load circuits, supply power, and more.

Article 520.53 holds all the specifics of information about portable power distribution. Rules here include the enclosure, types of dimmers, size exceptions of the feeder cable

(520.52.H.3), order in which feeder should be inserted and taken out, terminals, and those who should be powering those portable power distros. More information about this is seen in 520.62. Other portable equipment, such as Arc lamps, portable strips, and festoons are also brought up and discussed in the 520.60-.65 range. 250.68.A.4 allows an important exception to the type of cable used. It allows the use of junior hard service cable (SJ) in a breakout when specific safety conditions are met. 250.69 covers adapters, which are used heavily with LED fixtures. Lastly, Article 520 covers dressing rooms and specific grounding where necessary.

Article 520 is so important to the entertainment electrician because it outlines every rule for every thing used in a theater, and how everything should be built. The rules mentioned in Article 520 are there to keep everyone safe and to prevent danger from occurring in a theater. Many of the limitations on cable, wattage, feeders, and portable stuff are created because of the lives that have been lost. Much of this section has been written in fire and blood. Electricity is an amazing, yet dangerous thing, which always requires handling of the utmost care. Article 520 holds a lot of the information about safety when dealing with electricity, so having knowledge about it, and having it easily accessible can save lives.

Article 520 deals specifically with theater work, but other articles in the 500 range discuss electrical rules about other aspects of buildings, entertainment, and housing, just to name a few. Other aspects of electrical work in buildings are discussed in articles throughout the 500s range. Permanent buildings, such as garages, hangars, storage plants, health care,and other occupational places can be found in 511-518. Amusement parks and other entertainment venues can be found in 522 and 525. Motion picture work can be found in 530 and 540. Temporary buildings, Recreational vehicles, and park trailers can be found from 545 through 555. Lastly,

temporary installations and all rules involving those can be found in 590. All of these different articles exist as rules to keep electricians, operators, and guests safe in all forms of entertainment.

Along with the NEC/ standard 70E, the NFPA, although not 100 percent attached to theater technology, has blogs and articles about electrical safety as a whole. There are blog articles on the NFPA website about electrical safety, lessons learned, and other ideas from many different electricians. In a blog article from a general electrician named Corey Hannahs, he talks about how your safety is your job, about Standard 70E/ NEC, and that one should always learn and never be complacent with what they have learned. These ideas do not just apply to building electricians but to all types of electricians. Other articles include dealings with safety, basics of the job, and better understandings of Standard 70E. As a whole, the National Fire Protection Agency holds many important pieces of information that are important to the entertainment electrician because of the safety information, guides, and articles written by them.

The American National Standards institute is another great place to find a lot of information and a lot of pieces of information about symbols and electricity. ANSI is an organization that standardizes everything, from washing machines, to clothes, to water bottles. These standards are a part of every source of energy, batteries, and power, which means that every piece of communicated paperwork should be similar in their symbols and meaning. A standardized system of symbols creates a safer way when dealing with creating or using an electrical device in the industry. These symbols can be seen on any moving light or laser, which creates an easy understanding for the user to know the dangers, capabilities, and limitations of a new light. A subsidiary of ANSI, NEMA, creates standards more specific to the entertainment electrician. NEMA, the National Electrical Manufacturers Association, has more information for

the electrician. It narrows down the information from ANSI into what information is necessary for an electrician.

Another place to find information, get certification and find certified people is the ETCP, which stands for Entertainment Technician Certification Program. It is a program through ESTA, which is the Entertainment Services and Theatrical Association. It certifies people in rigging, being an entertainment electrician, and portable power distribution technician. The ETCP has minimum requirements of hours and other experience and requires testing in each subject to certify people who are eligible to be in this elite group. Once the test is passed, you are certified for 5 years, which gives every member an advantage in job searches and recognition in safety. After 5 years, recertification is necessary. Certification is necessary not only for safety in one's specialty, but it also serves as ab impetus to attend a training that one might not have attended if not for recertification. The ETCP and its certification program is one of the best places to test one's knowledge about theater safety and find those that are qualified to work on important and dangerous jobs.

Another group that focuses on training and safety is IATSE. IATSE is the stagehands' union. The reason IATSE is so important to the entertainment electrician is because the union itself has been around since 1886 and has been fighting for safety since its inception.. It began when stagehands went on strike, a famous actor was hurt, and would not act again until the striking stage hands were hired again. IATSE provides safe working places and fights for fair wages for every entertainment stagehand, whether in carpentry, electrics, Hair and make-up or other aspects of theater.. They have education on safety, leadership, and the stagehand's craft. They lobby for the workers and work on bargaining campaigns for the workers. The union reaches between borders and works not just with electricians, but with all costumers, scenic

artists, workers in movies, and much more. IATSE supports mental health, feminism, DEI, pride, and other aspects of people's lives. The reason IATSE is so important to safety is that working in the union allows the ability to refuse unsafe jobs, get a good pay that prevents over exhaustion of the workers. It has trustee training, leadership development, webinars, training and much more. Certain locals require more for enlistment than others, such as local 28 in Portland, Oregon, which requires a journeyman's license to work on any electrics crew call. The international union works with both ETCP and OSHA to make sure everyone knows how to be safe and knows how to diagnose and fix problems that could arise and cause issues. Every area or city, such as D.C, New York, Chicago, and others have their own Local numbers with their own training and rules. The advantage to joining a union outweighs any dues or other problems that might arise. All the information can be found online at the IATSE website for more information about locals, training, and other parts of the union if interested.

As the industry grows, the term electrician has a greater area of jobs than just electricity and electrical effects. A new area that is being added onto the job is working with lasers. When looking to work with lasers in a show, the government agency you must contact is the FDA, Food and Drug Administration. There are four different classes of lasers, but the main ones that are used in theater are classes three and four, which are the most dangerous. All standards of these can be found on the FDA website. These standards include reports, necessity of notification of defects, repairs, and importation. Most regulations from the FDA are held in 21 CFR Part 1040. The website also holds resources to other helpful guides and organizations that help with laser safety. The board of laser safety is an organization that certifies safety professionals to work on lasers. Other organizations that have mentions in the use and safety of lasers are ANSI, NFPA, International Standards Organization, and the International Electrotechnical commision.

These groups all have their own statements and regulations that must be followed for their own areas of reach. The NFPA has standards in article 115. The IEC has most standards found in statement 60825. The ISO has statements in lasers when dealing with the safety of machinery. These rules should be followed because of the danger a laser can cause

One might think, they are just lasers, just do not point them at someone's eye. That is a grand oversimplification of the danger of lasers. That is a true statement, but the lasers used in performance, along with industry, medicine, and research, hold much more power. Class three, along with immediate eye damage, creates a skin hazard from a direct beam. Class four, along with the dangers of class three lasers, also has damage from a reflected beam. Class four also presents a fire hazard. When using a laser in a show, the people using it must have a variance from the FDA. The information in this variance must have location, indoor/outdoor, and if the laser terminates. Assuming a variance is received, setting up the laser is the most dangerous time because the lasers could have shifted in transport, causing the laser to be in an unexpected place. All of this information is important to know because it can cause permanent damage to either the engineer, user, or audience. Follow all rules from the FDA, OSHA, ANSI, NFPA, and others so that the risk of permanent damage to anyone is significantly reduced. As the industry grows and the job of an entertainment electrician increases, learning to work and be safe with lasers is an important part of keeping not only the electrician safe, but the audience safe as well.

Another part of the ever expanding role of an electrician is the creation, use, and disposal of pyrotechnics. Pyrotechnics involve fireworks and flames on stage. This can involve any form of fire creation, such as firecrackers, mortars, aerial shells, and others. Anything bigger falls into 1.3 G pyrotechnics, which involves contact with the ATF. When working with Pyro, A license is necessary. Many rules can be found in articles 1123 and 1126. The other aspect of Pyro is

onstage, live flame. The rules for each county and state vary, so researching the requirements is necessary. The reason this is important to the electrician is that the expanding role includes pyrotechnics. Many of these rules have been written in blood. Pyrotechnics are extremely dangerous, have caused irreparable burns on actors, and, in some cases, killed hundreds of people in the audience. All of these rules are set by the NFPA and local government officials because these rules are there to keep people safe and prevent any fires from hurting anyone.

The role, understanding , and safety rules of an electrician are all expanding over time. The basis of the rules, seen in articles 100, 200, 400, and 520 of the NEC act as the basis for everything that is done in a theatrical space. The NFPA gives good advice through its blogs. ANSI creates standards necessary for safe communication. IATSE and the ETCP have good resources for education and good people to get advice from or to hire. Lastly, the safety precautions surrounding both lasers and pyro are important to know for the ever increasing job of the entertainment electrician. By following all of these groups, articles, and safety rules, the audience, actors, and electricians are kept safe.

https://www.nfpa.org/news-blogs-and-articles/blogs/2024/01/25/7-tips-for-the-next-generation-of-electrical-apprentices