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Automatic Receptacle Controls

Evaluating the clarity of receptacle markings

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Abstract

Plug loads and the electric loads of devices plugged into receptacles in commercial buildings play a significant and growing role in commercial buildings. Because plug loads are portable and are often placed in the building by the occupants, they are a challenging load to manage.

This report summarizes an analysis of commercially available automatic receptacle controls (ARCs). As a part of this study, generic versions of ARCs were presented to a general user audience via an online survey, wherein survey respondents indicated which markings more clearly indicated that the receptacle was controlled. A total of 210 responses were collected and included in the analysis presented in this report.

The results showed that receptacles with high-contrast markings were consistently clearer and more evident to the users than low-contrast markings. The survey responses also revealed that receptacles with a border drawn around each controlled receptacle were clearer and distinct to the users compared to other markings. These results led to the conclusion that for energy saving technology to be effective, consistent and easy to understand markings are necessary.

1.0 Introduction

Plugged electric devices draw power when left on or even while the device is sitting idle. As per the Energy Information Agency (EIA) of the U.S. Department of Energy, the plug and process loads account for 47% of the commercial building energy consumption (EIA, 2020). To reduce this, previous studies have attempted to map plug load profiles and evaluated different plug load reduction strategies (Institute for the Built Environment, 2013).

Plug load savings can be achieved by controlling receptacles using timers and occupancy sensing devices. A previous study found that plug loads can be reduced by 40% in an office using power management, advanced plug strips and timers, and occupant behavior measures (Mercier & Moorefield, 2011). Another study reported a total average of 27% energy savings attributed to the use of occupancy sensor plug strips, and 28% energy savings due to the use of load sensing plug strips (Acker et al., 2012). Note plug strips are not part of these study, but these studies demonstrate the savings potential from similar technologies that turn on/off based on occupancy.

Energy codes require that a portion of receptacles automatically turn off in certain spaces after the occupants leave the space. Although receptacles are commonly found in both buildings and homes, users may not be aware which receptacles function as automatic receptacle controls (ARCs). One of the underlying reasons for this lack of user awareness is attributed to user confusion related to receptacle controls, as suggested by a previous study (NREL, 2022).

The ARCs were introduced into energy codes in ASHRAE/IES Standard 90.1-2010 (ASHRAE/IES, 2010). Since 2010, ARCs were added to California Title 24 as well as the International Energy Conservation Code (IECC). The language across the energy codes are similar, but may vary slightly. The ARC requirements specified in ASHRAE/IES Standard 90.1-2022 have been presented in the box below (ASHRAE/IES, 2022).

8.4.2 Automatic Receptacle Control.
The following shall be *automatically* controlled:
a. At least 50% of all 125 V, 15 and 20 amp receptacles in all private offices, conference rooms, rooms used primarily for printing and/or copying functions, break rooms, classrooms, and individual workstations.
b. At least 25% of *branch circuit* feeders installed for modular furniture not shown on the *construction documents.*

This control shall function on
a. a scheduled basis using a time-of-day operated *control device* that turns receptacles off at specific programmed times—an independent program schedule shall be provided for controlled areas of no more than 5000 ft^2 and not more than one *floor* (the occupant shall be able to manually override the *control device* for up to two hours);
b. an *occupancy sensor* that shall turn receptacles off within 20 minutes of all occupants leaving a *space*; or
c. an automated signal from another control or alarm *system* that shall turn receptacles off within 20 minutes after determining that the area is unoccupied.

All controlled receptacles shall be permanently marked to visually differentiate them from uncontrolled receptacles and are to be uniformly distributed throughout the *space*. Plug-in devices shall not be used to comply with Section 8.4.2.

Exceptions to 8.4.2: Receptacles for the following shall not require an *automatic control device*:
1. Receptacles specifically designated for *equipment* requiring continuous operation (24/day, 365 days/year).
2. *Spaces* where an *automatic* control would endanger the safety or security of the room or *building* occupants.

Energy codes only state that the receptacle shall be permanently marked to visually differentiate them from uncontrolled receptacles, but do not specify the marking requirements. However, the National Fire Protection Association (NFPA) 70, National Electric Code (NEC) does specify the markings.

1.1 Marking requirements

Marking requirements were incorporated into the NEC in 2014. Table 1 shows the changes per year since adoption of the marking requirements.

Table 1. Changes to National Electric Code (NEC) controlled receptacle requirements since 2014.

Year	Changes
2014	National Electric Code (NEC) adopted markings for controlled receptacles. These receptacles should be marked with the power symbol (NFPA, 2014).
2017	NEC modified the language to require the inclusion of the power symbol and the term “controlled” along with the markings to be permanent and denote which contact device(s) was being controlled (NFPA, 2017).
2020	NEC did not modify this section (NFPA, 2020).
2023	The 2023 version of NEC only changed the section location to account for other receptacle requirements within NEC(NFPA, 2023).

The 2023 version of NEC have been presented in the box below.

406.3(F) Controlled Receptacle Marking.

All non-locking-type, 125-volt, 15- and 20-ampere receptacles that are controlled by an automatic control device, or that incorporate control features that remove power from the receptacle for the purpose of energy management or building automation, shall be marked with the symbol shown in Figure 406.3(F) and the word "controlled."

For receptacles controlled by an automatic control device, the marking shall be located on the receptacle face and visible after installation.

In both cases where a multiple receptacle device is used, the required marking of the word "controlled" and symbol shall denote which contact device(s) are controlled.

Exception: The marking shall not be required for receptacles controlled by a wall switch that provide the required room lighting receptacles as permitted by 210.70.

1.2 Receptacle orientation

Receptacle markings need to account for multiple receptacle orientations. Typically, receptacles are mounted with the long axis perpendicular to the floor. Even in this orientation, the receptacle could be ground pin up or ground pin down (see Figure 1). Beyond this vertical orientation, receptacles may also be mounted horizontally (see Figure 1) because of a limitation in the materials or mounting surface issue. The method of marking the receptacle ideally would allow for a multitude of orientations.

Ground pin up | Ground pin down | Horizontal Orientation

Figure 1. Example of receptacle orientations.

1.3 Terminology

Within the electrical community, the term “receptacle” refers to the outlet where a plug-in device is plugged in. Figure 2 shows two types of receptacles: a single receptacle and a duplex receptacle. If a box contains more than two receptacles, they are a series of duplex receptacles installed within the box behind the cover. The electrical industry and the public often commonly use the term “receptacle” to denote single receptacle as well as duplex receptacle. Single receptacle and duplex receptacle are somewhat interchangeable and this analysis uses the term “receptacle” to denote both.

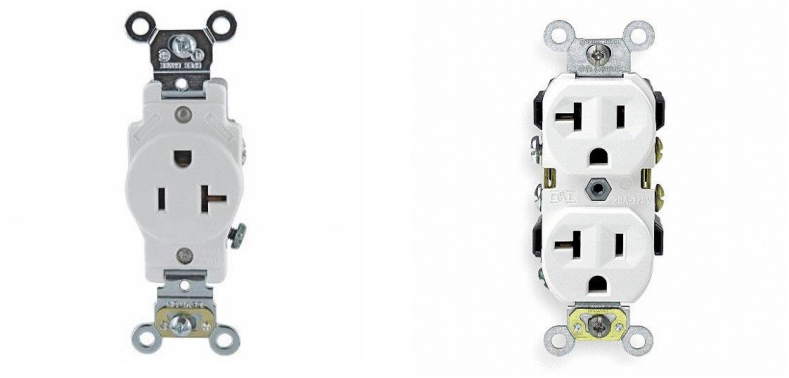

Figure 2. Examples of a single receptacle (left), and a duplex receptacle (right).

1.4 Review of commercially available and installed markings

An internet search of ARC receptacles available for purchase, and a review of sites that were involved in energy efficient building field evaluations was completed as part of this study. Significant variation in ARC markings were found on the internet and in the buildings evaluated.

1.4.1 Identifying common commercially available markings

Figure 3 is a representation of single-controlled ARCs. Single-controlled means that one of the receptacles (top or bottom) is controlled and the other is uncontrolled (always supplied with power). Figure 3(9) and (10) are “double D” style, which refers to the style of the receptacle. This style is older and may be familiar as it is the default residential style. In contrast Figure 3(1)–(8) are known as “square/décora/decorator” style, with both styles functioning the same way, representing different marking styles. However, because the NEC requires the markings to be permanent on the face of the receptacle, the text size is limited with both the word “controlled” and symbol to be imprinted on the double D receptacle and not the faceplate.

Figure 4 shows examples of double-controlled ARCs. Double-controlled means that both receptacles (top and bottom) are controlled. As per the NEC, both receptacles must be marked as controlled.

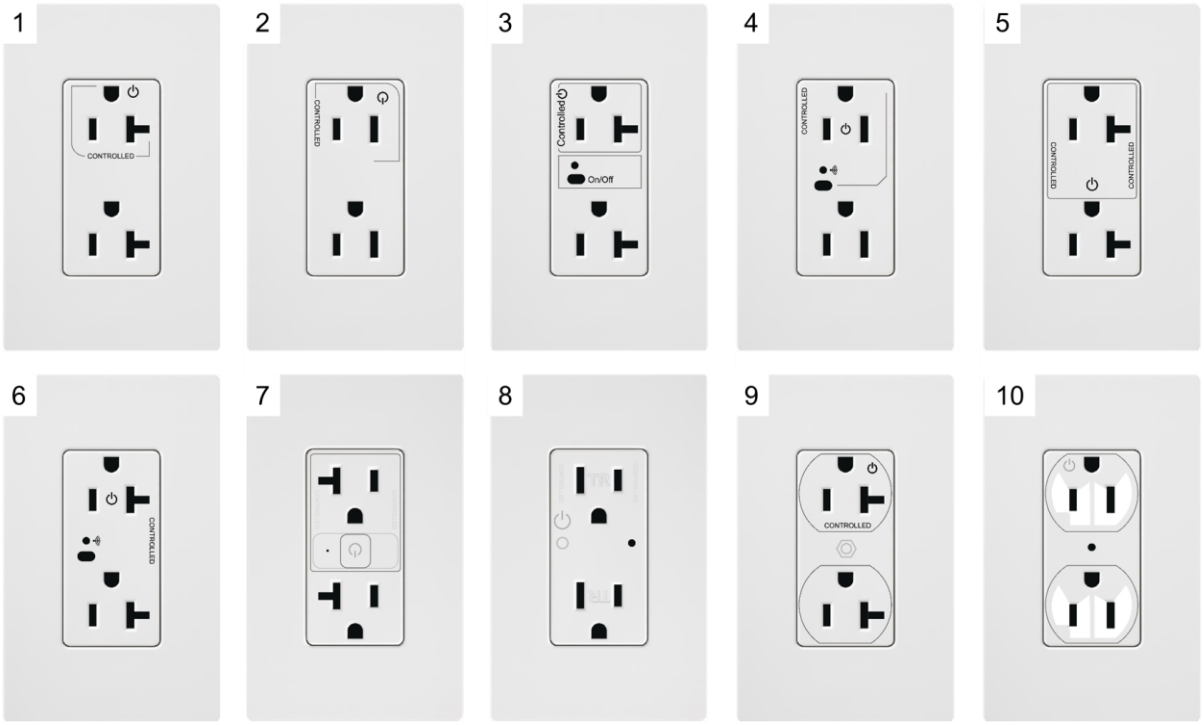

Figure 3. Examples of duplex receptacles with a single automatic receptacle control.

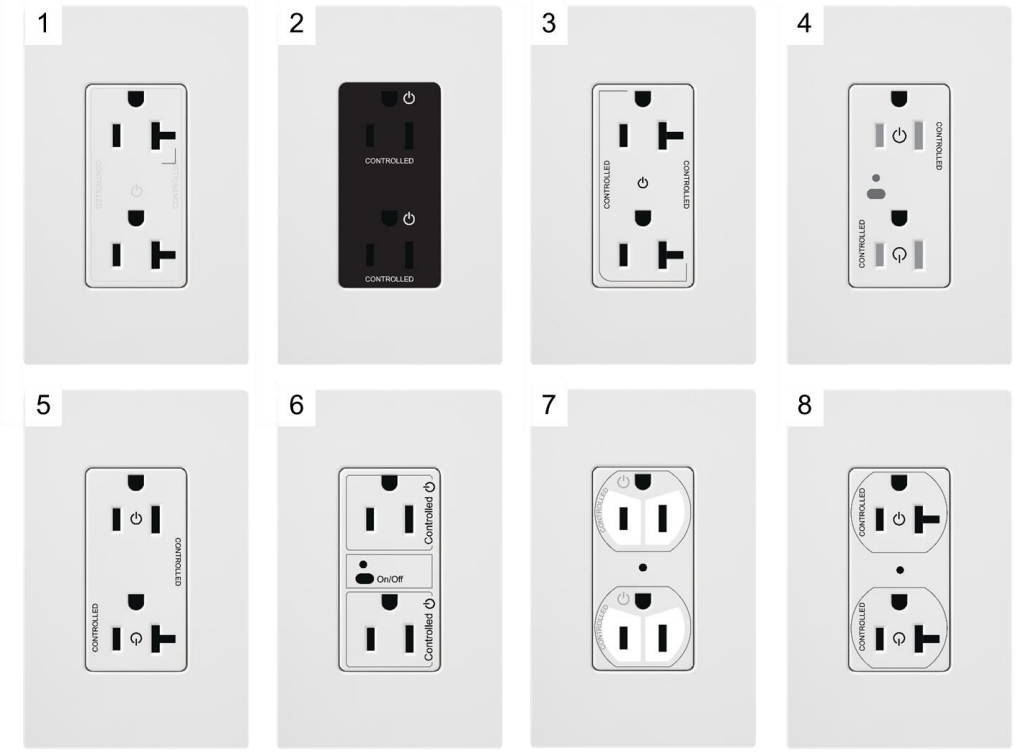

Figure 4. Examples of duplex receptacles with double automatic receptacle control.

Comparing Figure 4 and Figure 5 indicated four major elements of the markings:

1. **Location —** proximity of markings (word and symbol) to the actual controlled receptacle.

   Figure 3(1) has both the symbol and the word “controlled” placed in proximity to the receptacle. In contrast, Figure 3(6) the word “controlled” is imprinted between the two receptacles, which may be difficult for a user to interpret, as to whether the top receptacle is the controlled one since the symbol is adjacent to the blade portion of the receptacles.

   Figure 4(4) has the term “controlled” by each receptacle. In contrast, Figure 4(3) has the term “controlled” between both receptacles, whereby it may not be intuitive to the user that both receptacles are controlled.

2. **Orientation —** orienting the word “Controlled” either horizontally or vertically.

   Figure 3(1) and (2) appear very similar. However, (1) has the word “controlled” placed horizontally while (2) has the word oriented vertically. Receptacles can be mounted in two orientations when vertical — ground pin up (Figure 3[1]) or ground pin down (Figure 3[8]). If the word is oriented horizontally, when installed in either ground pin up versus down, the word could be upside down.

   Figure 4(2) was the only example double-controlled receptacle with the term written horizontally. However, if this unit was installed ground pin down, the term would be upside down.

3. **Border —** use of a border to indicate which receptacle(s) is controlled.

   In Figure 3(1)–(5), some products use a border to indicate which receptacle is controlled. Figure 4(3) shows a border around both receptacles. In contrast, Figure 4(4) does not include a border.

4. **Contrast level —** contrast of the markings with the face/body of the receptacle varied.

   Figure 3(7), (8), and (10) show that some manufacturers do not use high-contrast methods to mark the controlled indications. However, in Figure 3, receptacles (2) and (6) show that some products do use high-contrast markings.

   Figure 4(1) shows that some manufacturers do not use high-contrast methods to mark the controlled indications. However, Figure 4(2) and (3) show that some products do use high-contrast markings.

1.4.2 Examples of receptacle markings

In addition to a review of commercially available markings, the ARCs installed in commercial buildings were documented. Figure 5 shows three different examples of receptacles found at the installed sites.

Figure 5 (left) is a quad junction box that contains uncontrolled receptacles single-controlled ARC (left side) and (right side). The receptacles have different styles because one of the areas had undergone a retrofit. The right side “double D” (ovals) were replaced with

square/decora/decorator style ARC. The ARC (left receptacles) in Figure 5 (left) is marked as controlled, but the low-contrast markings make it illegible.

Figure 5 (middle) shows a single-controlled ARC installed at a site. This site provided an instruction sheet about the technology. In that instruction sheet, the receptacle was shown ground pin up and the users were told the bottom receptacle was controlled. However, as shown the receptacle was installed ground pin down. Although users are using the receptacle shown on their information sheet, this configuration was using the always-on portion of the receptacle defeating the purpose of the energy saving features of the ARC.

Figure 5 (right) shows a ground-fault circuit interrupter (GFCI) on the same site as Figure 5 (center). The GFCIs are typically installed near water sources and are designed to protect individuals from electrical shocks. However, a visual comparison of Figure 6 (center) and (right) shows that both receptacles contain green light-emitting diodes (LEDs) and a central button. Figure 5 (right) was originally included because the site team shared it along with other controlled receptacle photos incorrectly identifying it as a controlled receptacle.

ARC and standard receptacles | Decora/square style ARC | GFCI receptacle

Figure 5. Examples of automatic receptacle controls (ARCs) and other receptacle types from the field. Left image: Quad junction box with decora/square style ARC (left) and standard “double D” style uncontrolled receptacles (right). Center image: Stand-alone decora/square style ARC. Right image: Ground-fault circuit interrupter (GFCI) receptacle.

1.5 Study goals

Given the variability in the location, orientation, border, and contrast levels used in commercially available controlled receptacles, this study aimed to: 1) evaluate the clarity of commonly used marking configurations; and 2) compare the clarity of high vs. low-contrast markings. The goal was to identify the most clear markings that can be recommended for extensive use to improve the utilization of controlled receptacles in buildings.

2.0 Method

To assess the clarity of markings, an online questionnaire presented different common markings to participants, and they were each asked to evaluate the clarity of these markings. The receptacle pictures used in the questionnaire were identified through an online search for controlled receptacles. This search aimed to identify common configurations of markings used

commonly by different manufacturers in the US. The questionnaire was created on the online platform Survey Monkey and shared via Amazon Mechanical Turk (MTurk) in March 2023.

2.1 Evaluation of receptacle markings

The receptacle marking pictures used in this study consisted of 16 receptacles with eight receptacles having a single-controlled receptacle (Figure 6) and eight receptacles containing double-controlled receptacles (Figure 7). These pictures were identified through an online search for controlled receptacles and our search primarily aimed to identify common configurations of markings used commonly by different manufacturers in the US (see Section 1.4). This study primarily focused on duplex receptacles given their prevalence over single receptacles.

As seen in Figure 7, three receptacle pairs (A-F, B-G, C-H) had the same position for the power symbol and the word controlled and the only difference was the presence or absence of the outlining border. Markings C and D were similar except for the position of the word “Controlled.” Markings A and B feature different position and orientation of the power symbol the word “Controlled.”

Once identified, these markings were reproduced to use the same wall receptacle picture to control for other design elements such as differences in receptacle shape, color, size, and orientation. Marking size plays a critical role in reading/visual understanding and interpretation. Size was not varied as part of this study because NEC requires the word and symbol to be permanent which required it to be on the receptacle and not the plate, which limits variations in the size of the text.

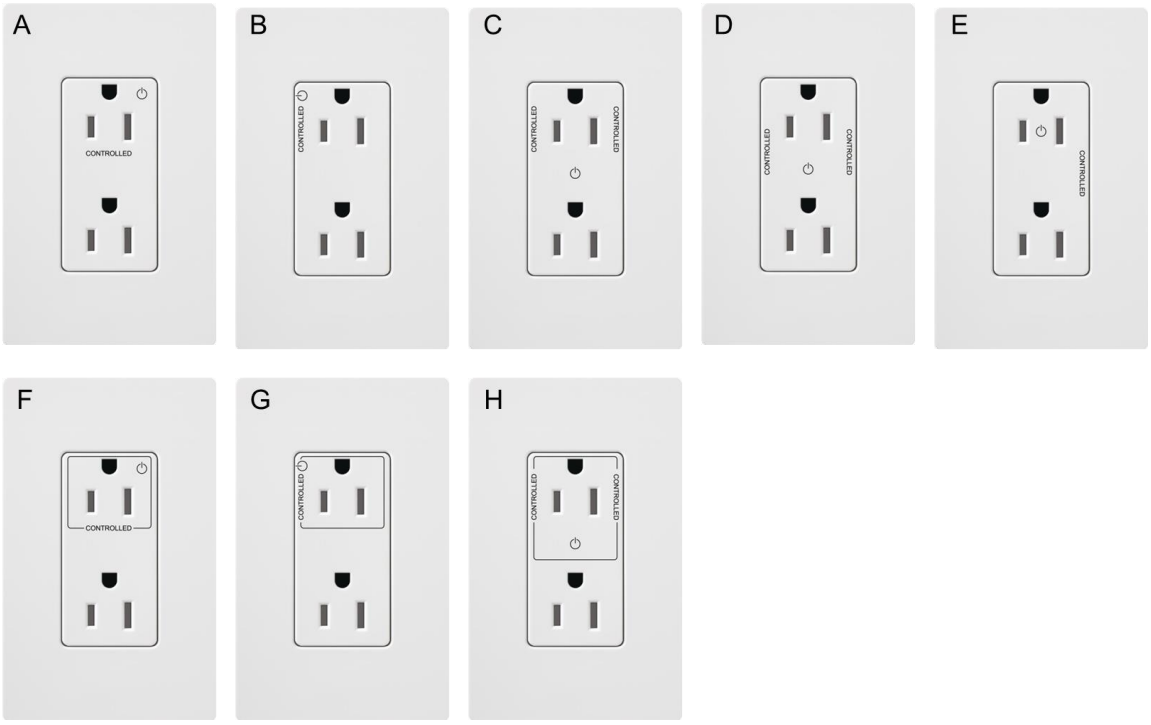

Figure 6. Receptacles with a single-controlled receptacle.

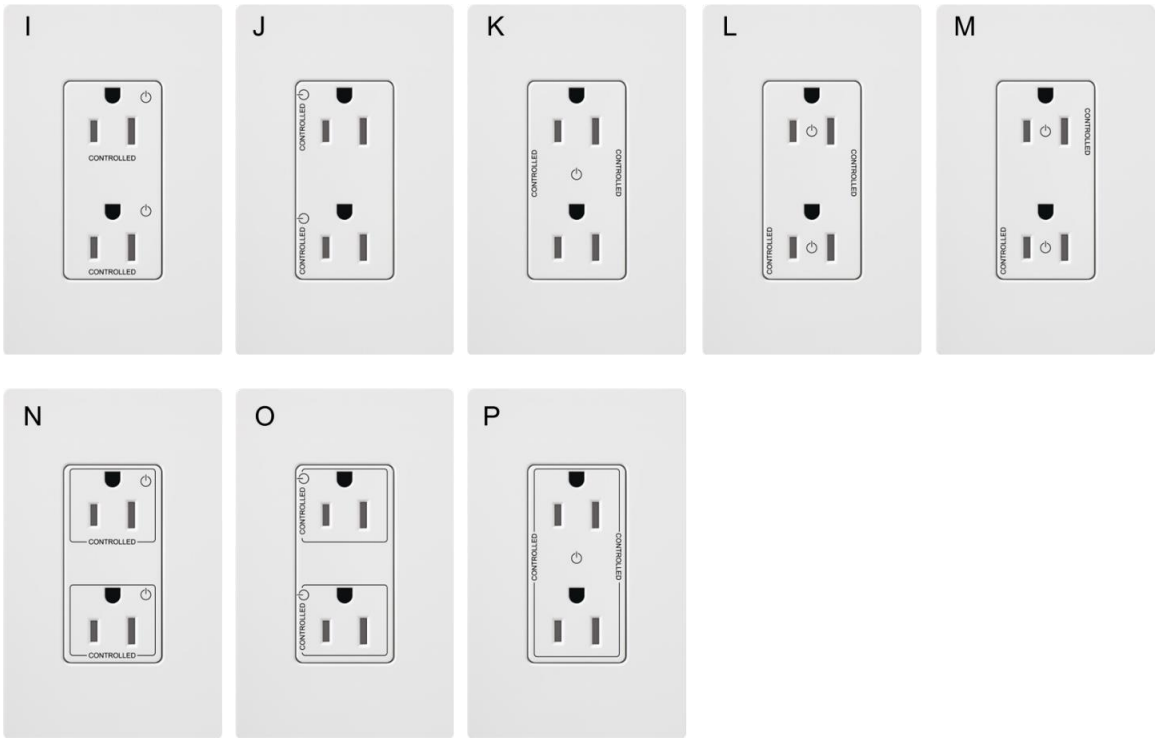

Figure 7. Receptacles markings on double-controlled receptacles.

2.2 Procedure

This study was reviewed and approved by the Pacific Northwest National Laboratory (PNNL) institutional review board (IRB No. 2023-05). Participants were first asked to review and agree to a consent form to participate in the study. Next, general questions were asked about the make of the computer screen, internet browser, participant's age, and whether they needed corrective lenses or eyeglasses.

Given that this study was conducted online, there was a need to ascertain that all participants could distinguish between different shades of grayscale bars. This was based on previous studies that utilized this grayscale to check contrast levels of questionnaire participant's screens (Abboushi et al., 2022; Sprow et al., 2009). The question displayed grayscale bars ranging from white to black and asked the survey responders to click on the brightest bar that they could distinguish from the white background.

Two attention check questions were used to check if participants are reading each question in its entirety, as previously reported and tested (Oppenheimer et al., 2009). These were instructional manipulation checks placed at the end of the question, which provided specific instructions on which answer should be selected. Participants were disqualified if they answered both questions incorrectly.

To make sure that the size of the displayed images were consistent among participants, an image of a driver's license was shown on the screen and participants were asked to hold their driver's license or credit card against the screen and zoom in or out to adjust the display size to match the size of the real card. Participants were then provided with a definition of controlled receptacles and were shown examples of single and double-controlled receptacles.

The two-alternative forced-choice procedure was used to present the pictures using an online questionnaire platform (Survey Monkey). As a part of the survey process, each image of one or two controlled receptacles was paired with every other image in the same category. This produced 28 combinations of single-controlled receptacles and 28 combinations of double-controlled receptacles. We also presented the participants with a high-contrast (100%, grayscale value=0) and a low-contrast (6%, grayscale value= 218) version of each receptacle.

The body of the receptacle had a grayscale value of 233. For the single receptacles, the question was: “Select the receptacle with markings that more clearly indicate that the top receptacle is controlled.” For the double-controlled receptacles, the question was: “Select the receptacle with markings that more clearly indicate that both receptacles are controlled.” The order of presenting single or double receptacles, and the order of questions were randomized across participants. The left and right positions of images were counter-balanced across participants to account for any potential left/right bias.

Lastly, a survey question asked the participants to write down a complete sentence to describe their usual breakfast preference. This was used to check for inattentive responses or bot-like answers.

2.3 Study participants

Survey participants recruited using Amazon MTurk were required to be located in the US and pass a few quality requirements established by MTurk. Participants were compensated US $1.70 for participating in the study.

A total of 256 survey responses were collected. The following list describes the responses that were excluded from analysis.

- 5 participants failed both the attention check questions included in the survey.
- 26 participants were excluded because they provided answers that did not address the “breakfast” question presented toward the end of the survey. Those responses include answers such as: “yes”, “its healthy”, “Itly”, etc.
- 14 participants were excluded because responses were copied from a website or provided by multiple MTurk workers, indicating a bot-like behavior.
- 1 survey response was excluded because it was a second response from the same participant.

These exclusions resulted in 210 survey responses that were included in the analysis. Table 2 presents data related to the characteristics of the participants, their computer screens and internet browser used to complete the questionnaire.

Table 2. The distribution of survey participants over the parameters of age groups, the need of corrective lenses, type of computer screen, and internet browser used.

Parameter	Category	Number of participants	Portion of participants*
Age group	18–29	36	17%
	30–39	105	50%
	40–49	42	20%
	50–59	19	9%
	60–69	8	4%
Need corrective lenses?	No	146	70%
	Yes, and wearing them	61	29%
	Yes, but not wearing them	3	1%
Computer screen (brand)	Acer	46	22%
	Dell	54	26%
	HP	40	19%
	Lenovo	47	22%
	Mac	5	24%
	Microsoft	18	9%
Internet browser	Google Chrome	185	88%
	Mozilla Firefox	19	9%
	Microsoft Edge	6	3%

*May sum to more than 100% because of rounding.

3.0 Results

The number of times each participant selected each marking was calculated, then the mean number of times each marking was selected as being clearer across all participants was calculated. Because responses were not normally distributed for all markings, a Friedman test was used to examine whether there was a significant different among the markings. Post hoc Wilcoxon signed-ranks test was then used to examine differences between different marking pairs. The Holm's correction was applied to account for the multiple comparisons.

3.1 Single-controlled receptacles

Figure 8 shows that the three markings with borders (F, G, and H) were selected as being clearer and distinct compared to other markings. The highest mean value was for marking F and the lowest was for marking D. A Friedman test indicated a significant difference among the markings (Friedman $\chi^2 = 371.16$, df = 7, $p<0.01$). Post hoc comparisons using paired Wilcoxon signed-rank test showed that the markings with borders F, G, and H were each rated significantly clearer than comparable markings without borders A, B, and C, respectively, ($p<0.01$).

There was a significant difference between markings A and B ($p<0.01$). These two markings differ in the position and orientation of the power symbol and the word "Controlled." Similarly, there was a significant difference between markings C and D. Comparisons between markings with borders showed that marking F was significantly more distinct compared to G and H ($p<0.01$). The difference between G and H was not significant.

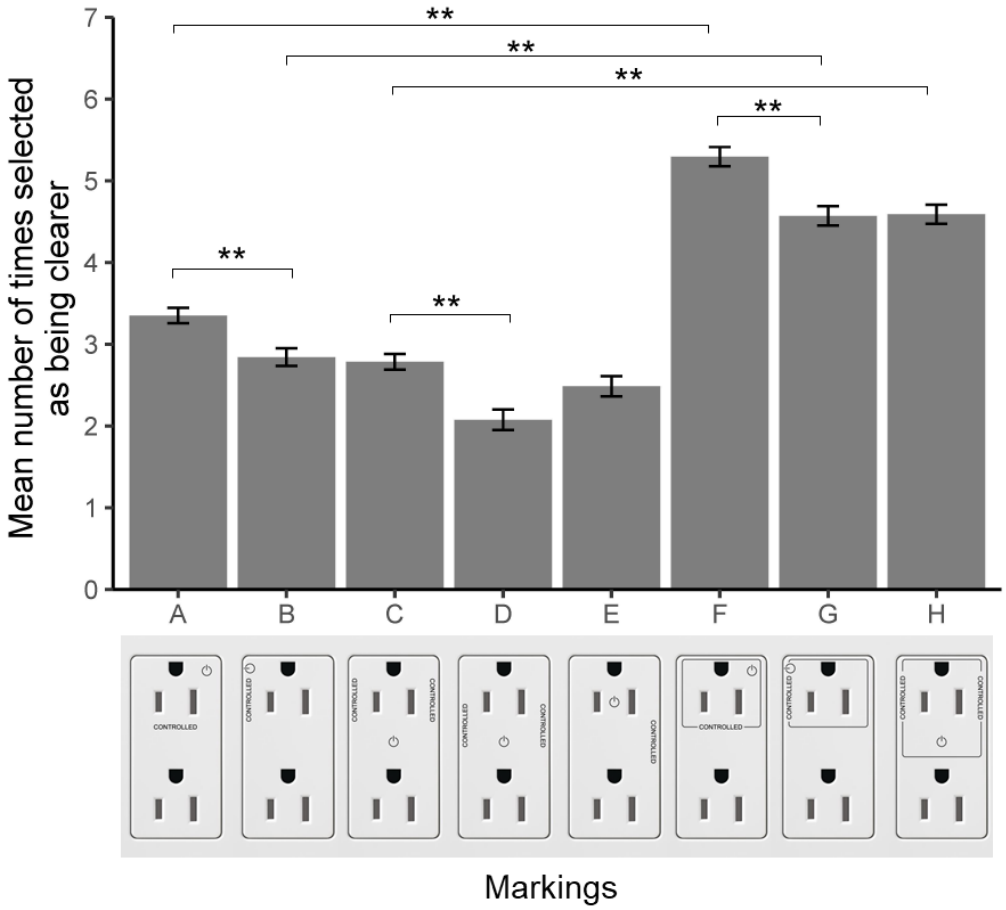

Figure 8. Mean number of times each single receptacle marking was selected as being clearer in the two-alternative comparisons. The whiskers represent the standard error. **Indicates significance at the Holm's adjusted 1% level.

3.2 Double-controlled receptacles

Figure 9 shows marking K received the lowest clarity rating whereas marking N received the highest clarity rating. Friedman test shows that there was a significant difference among the markings (Friedman $\chi^2 = 382.9$, df = 7, $p<0.01$). Wilcoxon signed-ranks test showed that markings with borders (N, O, and P) were significantly more distinct than comparable markings (same position for symbol and word controlled) without borders (I, J, and K) respectively ($p<0.01$).

Markings with differences in the position of the word "Controlled" and power symbol were rated significantly different in terms of clarity. For example, marking I was rated clearer than J, and marking M was rated clearer than L. Comparisons between markings with borders showed significant differences between markings N, O, and P.

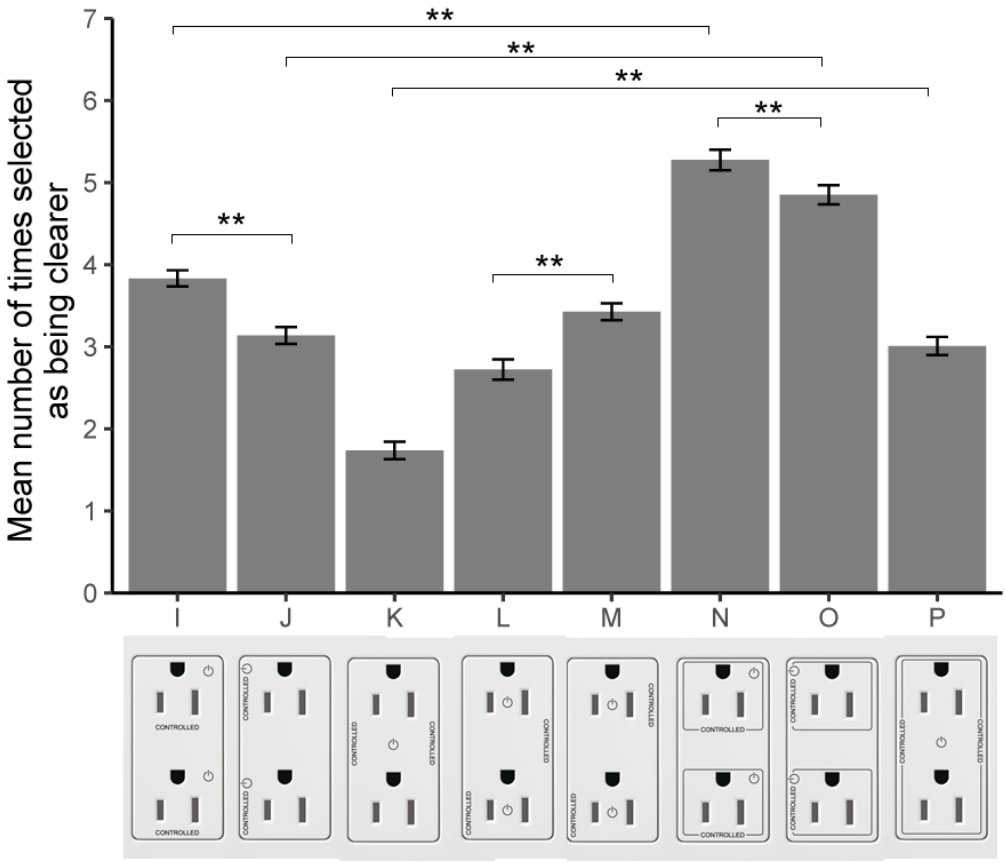

Figure 9. Mean number of times each double receptacle marking was selected as being clearer in the two-alternative comparisons. **Indicates significance at the Holm's adjusted 1% level.

3.3 High vs. low-contrast markings

The number of times high-contrast markings were selected (as being distinct) was higher than that for low-contrast markings. Paired Wilcoxon signed-ranks test revealed a significant difference between high and low-contrast markings for both single and double receptacles (p<0.01). Figure 10 shows an example comparison depicting the two contrast levels.

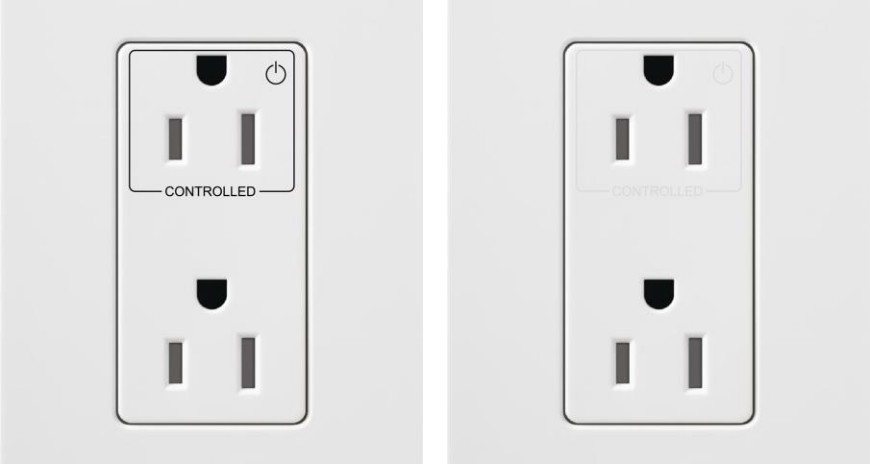

Figure 10. Example pair of images with a high-contrast (left) image and one with low-contrast (right).

Figure 11 shows the results of the survey respondents based on contrast settings.

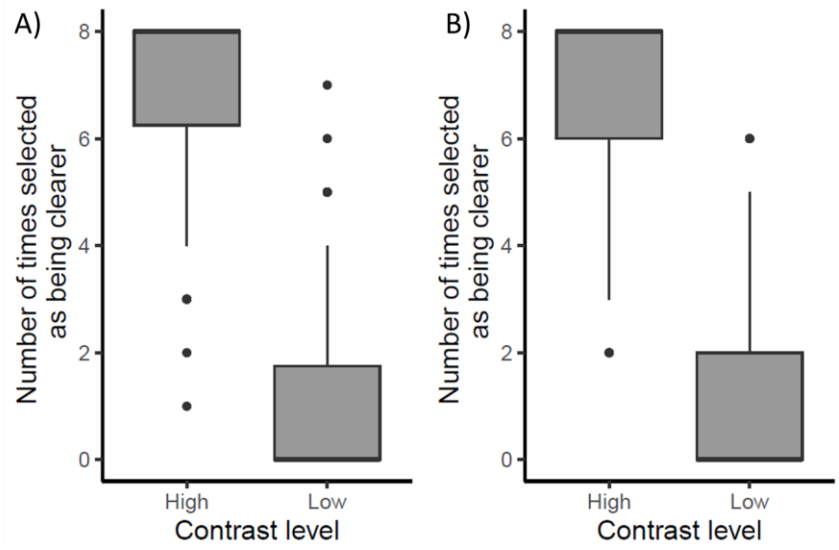

Figure 11. Boxplots of the number of times high-contrast markings were selected as being more distinct compared to low-contrast markings. Panel A shows results for single-controlled receptacles and panel B shows results for double-controlled receptacles. The whiskers extend to smallest and largest values, at most 1.5 × interquartile range. Values beyond the whiskers have been plotted individually (outlying points).

4.0 Discussion

For both single and double-controlled receptacles, it was found that markings that included a border around the controlled receptacle(s) were rated clearer than comparable markings without a border. The markings with borders had, in most cases, the highest mean number of times selected as being clearer; one exception was marking P where the border surrounded both controlled receptacles. Double-controlled “P” has a border around the two receptacles and was rated lower than marking I and M despite including a border. This suggests that the use of borders drawn around each individual receptacle helped improve the clarity of markings.

It was also found that clarity ratings were higher when the word “Controlled” and power symbol were horizontally oriented, compared to receptacles where these two marking elements were vertically oriented. This was the case for both single and double-controlled receptacles with a border (F compared to G, and N compared to O), and without a border (A compared to B, and I compared to J).

The position of the word “Controlled” and power symbol seemed to affect the clarity of markings. For single-controlled receptacles, markings D and E had the lowest mean number of selections which might be due to the words “Controlled” not being aligned with the top controlled receptacle. Marking E had higher mean value compared to D, which may be attributed to the power symbol in E being positioned on the controlled receptacle. The reduced clarity of markings due to misalignment of the word “Controlled” with the controlled receptacle could also be observed for double-controlled receptacles. Marking K had the lowest mean value.

One limitation of this study is that we did not test different ground pin orientations of the receptacles. Receptacles may be installed ground pin down, ground pin up, or horizonal where the blades are parallel to the floor. For single-controlled receptacles, marking F was rated highest in clarity followed by markings G and H (Figure 12/left). It can be hypothesized that if marking F was installed upside down, the orientation of the word “Controlled” could considerably reduce its clarity compared to markings G and H. Markings G and H feature the word “Controlled” in a vertical orientation which can help maintain its clarity even if installed upside down.

The same applies to double-controlled receptacles. Marking N was rated highest but is prone to reduced clarity if mounted upside down (Figure 12/right). Marking O can be suggested as an alternative that can be applied in either orientation while maintaining clarity.

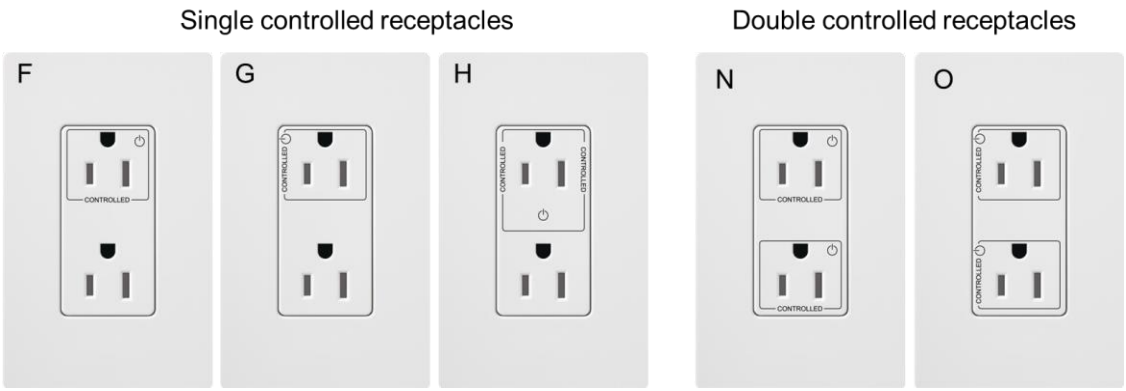

Figure 12. Markings of a single-controlled receptacle (left) and double-controlled receptacle (right) that most clearly indicated the controlled receptacle(s).

5.0 Conclusion

Receptacle users have clear preferences for some ARC markings over others. Standardizations of marking patterns beyond NEC's requirements of symbol and "Controlled" could significantly reduce user confusion and improve proper use of ARC, saving significant energy. This research yields three recommendations for standardization.

1. **Contrast** — Any standards for ARCs should require that both the symbol and word controlled have a contrast level of at least 50% compared to the background color of the receptacle. This will aid in visual identification of the controlled aspect of the receptacle.

2. **Border(s)** — Any standard for ARCs should require that controlled receptacle(s) be surrounded by a border. Results for both single- and double-controlled receptacles were higher for options that contained a border.

3. **Text orientation** — Any standard for ARCs should require that the term "Controlled" be oriented parallel to the longer axis of the receptacle. "Longer axis" was chosen because vertical may seem odd if the receptacle is oriented horizontally. Although horizonal orientations did result in higher scores, the orientation of receptacles can be in any orientation and aligning with the longer axis should result in improved understanding and more accurate interpretation of the marking.

Additional research could include a similar survey, but orientation of the receptacle would be changed. This can help determine if placing the term "Controlled" parallel to the long axis is ranked higher compared to when placed parallel to the short axis. If so, this would support the optimal orientation of the term "Controlled."

The user interface design could be further explored using color and other symbols that may improve their visual clarity. Additional research could explore and evaluate educational materials used to inform building users and occupants about ARCs. For example, how would a video resource fare compared to pamphlets and brochures used typically for educational or training purposes aimed at accurate identification of ARCs? Other research could explore users understanding of ideal devices for use with ARCs. This can be explored by showing different devices (e.g., cell phone charger, coffee maker, monitor, etc.) and asking respondents which device they would plug into the controlled receptacle. A second set of questions could involve showing the device, along with the power rating of the device to evaluate if power is a factor influencing user choices while connecting devices to the controlled receptacles. A third set of questions could involve showing the device, but this time showing the warm-up time when the device is starting when the power is off. This set of questions could help determine how device warm-up time might affect use of the controlled receptacle.

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Appendix

In 2014, NEC adopted markings for controlled receptacles (NEC 2014):

406.3(E) Controlled Receptacle Marking.

All nonlocking-type, 125-volt, 15- and 20-ampere receptacles that are controlled by an automatic control device, or that incorporate control features that remove power from the outlet for the purpose of energy management or building automation, shall be marked with the symbol shown in Figure 406.3(E) and located on the controlled receptacle outlet where visible after installation.

Exception: The marking is not required for receptacles controlled by a wall switch that provide the required room lighting outlets as permitted by 210.70.

The 2017 NEC modified the language to require the term “controlled” and for the markings to be permanent and denote which contact device(s) are controlled (see Figure 13). Changes from 2014 into 2017 are shown in gray highlight (NEC 2017):

406.3(E) Controlled Receptacle Marking.

All nonlocking-type, 125-volt, 15- and 20-ampere receptacles that are controlled by an automatic control device, or that incorporate control features that remove power from the receptacle for the purpose of energy management or building automation, shall be permanently marked with the symbol shown in Figure 406.3(E) and the word “controlled.”

For receptacles controlled by an automatic control device, the marking shall be located on the receptacle face and visible after installation.

In both cases where a multiple receptacle device is used, the required marking of the word “controlled” and symbol shall denote which contact device(s) are controlled.

Exception: The marking shall not be required for receptacles controlled by a wall switch that provide the required room lighting outlets as permitted by 210.70.

Figure 13. The National Electric Code (NEC) requires both the symbol and word “Controlled” to be placed on the receptacle.

The 2020 version of the NEC did not modify this section of the 2017 NEC.

The 2023 version of NEC only changed the section location to account for other receptacle requirements within NEC. The 2023 version of NEC only changed the section location to account for other receptacle requirements within NEC.

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