NASCLA ACCREDITED ELECTRICAL EXAMINATION PROGRAM

TEST DEVELOPMENT REPORT

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Section 1: Background

This report documents the methodology and procedures used to conduct the job analysis and test development of the NASCLA Accredited Electrical Examination Program for examinations for Electrical Contractor/Master Electrician, Journeyman Electrician, and Residential Electrician/Residential Electrical Contractor classifications. The purpose of this Background Section is to outline the historical context and events that preceded the development of the NASCLA Accredited Electrical Examination Program.

Overview of NASCLA

The National Association of State Contractors Licensing Agencies (NASCLA) was formed in 1962, "dedicated to the mutual assistance of the member states in striving for better regulation of the construction industry to protect the health, safety, and welfare of the general public." It has now grown to include a membership of 41 contractor licensing agencies in 27 states, as well as in Washington, D.C., in the territories of the U.S. Virgin Islands and Guam, and in the nation of Kenya. The NASCLA constitution lists nine objectives that form the primary purposes for which NASCLA was created. One of these objectives is "To provide mutual assistance in the standardization of licensing examinations."

Overview of the NASCLA Accredited Examination Program

NASCLA members began internal discussions in 1998 on the possibility of creating an accredited examination program with the goal of reducing redundant requirements facing contractors who seek to be licensed in multiple states. The idea was that examinations could be created that participating states would be able to either administer or accept as meeting their own examination requirements, benefitting both the agencies and the contractors seeking licensure.

The agencies would benefit in that:

- pooled resources between agencies would reduce the cost to each agency for exam development.
- using a common standardized examination would allow agencies to have a common basis for assessing the competency of license applicants.
- agencies could streamline the licensing application process for out-of-state contractors and attract these contractors more easily when more contractors are needed due to:
    - the aftermath of natural disasters.
    - economic booms.
    - a shrinking workforce.

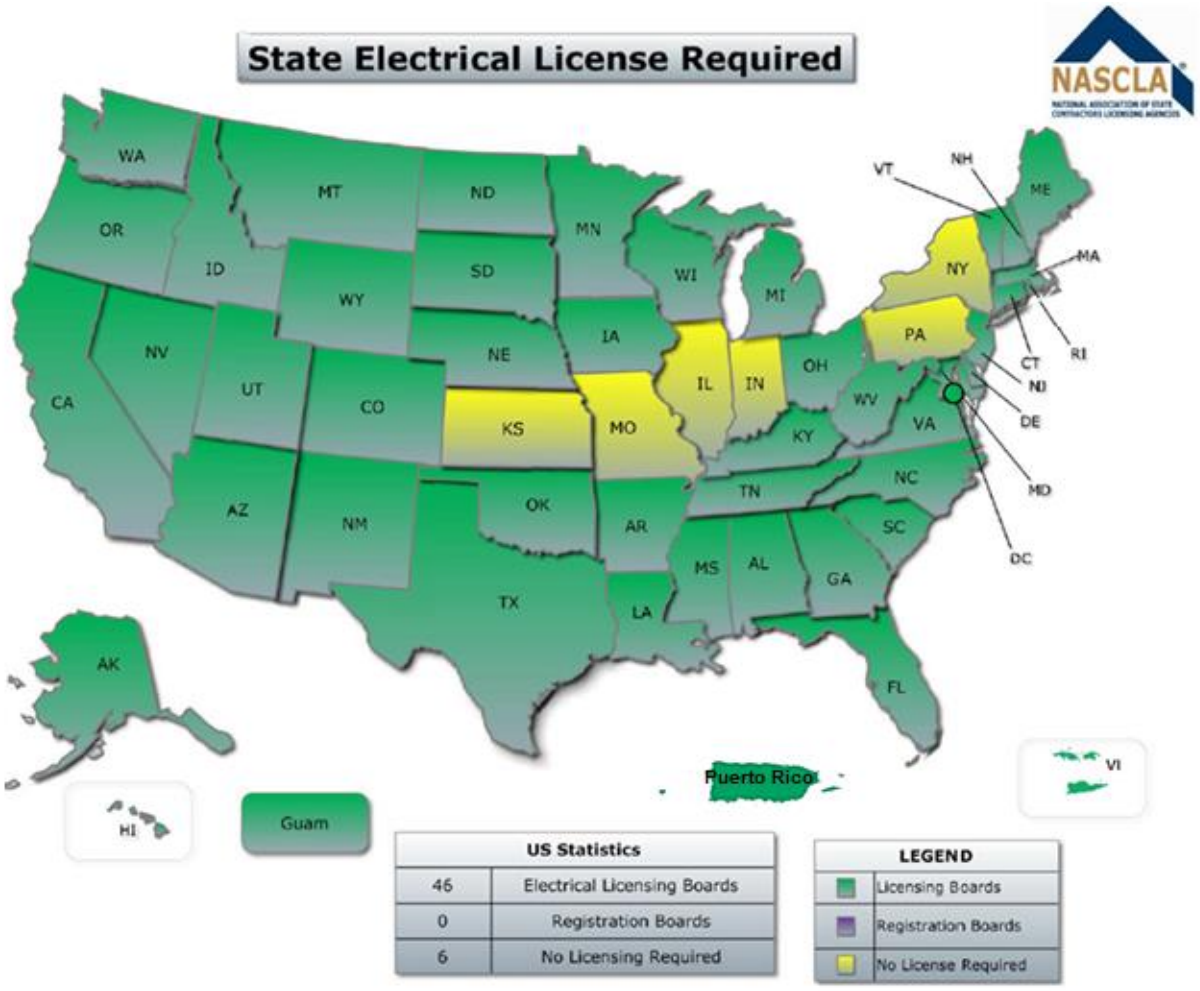
The contractors would benefit because they would be able to take one examination for multiple states. This would:

- allow the contractor to avoid the costs of travel
    - transportation.
    - meals.
    - hotels.
    - lost work time.
- eliminate the waiting time for exams to be given, thus expediting the license application process.
- eliminate the necessity for similar tests to be taken repeatedly.

The NASCLA Accredited Examination Program Committee analyzed major contractor classifications from states across the country for compatibilities and created common scopes of work as a basis for determining whether common examinations might be feasible. As a result, the committee decided to develop a national job analysis for general building construction contractors. The committee determined that rather than NASCLA developing and administering any examination, it would accredit companies who would develop and/or administer their own proprietary examination forms based on the NASCLA General Building Construction Contractor job analysis. As a first measure in that process, they completed a set of examination standards in 2001 from which to guide all consequent work. NASCLA then contracted with Professional Examination Service (PES) of New York City in 2004 to conduct the job analysis for the General Building Construction Contractor occupation. Since then, two companies have been approved both as an examination development provider and as an examination administration provider. These two companies were PSI, Inc., and PES. However, PES has chosen not to follow through as either an examination development provider or as an examination administration provider. In 2009, PSI, Inc. began administering a NASCLA Accredited Examination for Commercial General Building Contractors which they had developed based upon the job analysis. Then, as a result of NASCLA's policy of re-validating the job analysis every 5 to 7 years, the NASCLA Accredited Examination Program Committee revalidated the job analysis for the General Building Construction Contractors exam in 2012. In 2016, PROV, Inc. was also approved as an examination administration provider. PROV has not requested to become an examination development provider.

NASCLA Accredited Electrical Examination Program

In 2013, the NASCLA Accredited Examination Program Committee began to explore whether there might be other contractor trades that could benefit from a NASCLA examination. Following research conducted by NASCLA staff to determine which states have licensing Boards and related examinations for the various trades of plumbing, electrical work, mechanical work (HVACR, boilers, etc.), and home building, a survey was sent to the executive officers of the various Boards regulating each trade to determine their interest in a national or multi-state examination in each trade. The survey was sent both to members of NASCLA and to nonmembers.



Research prior to the survey revealed that there are 44 states that have statewide electrical licensing for electrical contractors/master electricians/unlimited electricians/electrical administrators, as well as Washington, DC, Guam, the Virgin Islands, and Puerto Rico.

After reviewing the results of the survey, the committee decided that the trade that would benefit most from a NASCLA examination would be that of electrical contractors. The United States Department of Labor, Bureau of Labor Statistics for May 2016 indicated that there were 1,487,890 individuals working in electrical professions in the U.S. (see Appendix A). This was the trade for which the survey indicated the most interest in an exam, and electricians are more commonly known for moving between states than the other trades that were being considered. After determining that there was currently no national electrical examination being administered or being actively pursued for the future by any testing company or electrical association, the committee resolved to pursue the development of a nationally recognized trade examination for electrical contractors. Furthermore, the committee decided that it should seek the cooperation of the electrical industry in general before moving forward. As a result, a meeting was set up in Washington, D.C. between members of the NASCLA Accredited Examination Program Committee and the National Electrical Contractors Association (NECA) in March 2014. Attending the meeting for NECA were Daniel G. Walter, Vice President and Chief Operating Officer, Michael J. Johnston, Executive Director, Standards and Safety, and Marco A. Giamberardino, MPA, Executive Director, Government Affairs. Attending the meeting for NASCLA were George Whalen, Executive Director, Rhode Island Contractors' Registration and Licensing Board and the President of NASCLA at the time, Victor Weston, President, Tri-State Road Boring and Board Member of the Louisiana State Licensing Board for Contractors, and Doug Traylor, NASCLA Accredited Examination Program Committee Chair and Director of Examinations and Assessment for the Louisiana State Licensing Board for Contractors. During the meeting, it was decided that the best course of action would be to create three separate, but related, examinations for electrical work: Electrical Contractor, Journeyman Electrician, and Residential Electrical Contractor. Thereafter, the NECA Executive Committee directed that the two organizations work together toward this end; the NASCLA Executive Committee made a similar resolve.

It was also determined that the cooperation of the major electrical industry organizations should be sought as additional partners, so that this would be a united effort. A number of electrical industry organizations were contacted regarding this effort. NASCLA invited these organizations to send representatives to their annual conference on August 25, 2014, in Newport, Rhode Island, for the NASCLA Accredited Examination Program Committee meeting to gather feedback from them regarding their potential concerns about the test development process. As a result, the following representatives attended and took part in this discussion at that meeting: Michael Johnston, Executive Director Standards & Safety, National Electrical Contractors Association (NECA); John Masarick, Vice President of Codes & Standards, Independent Electrical Contractors (IEC); Mark W. Earley, P.E., Chief Electrical Engineer, National Fire Protection Association (NFPA); John Cannon, Project Manager, Certifications, National Fire Protection Association; Jack Lyons, Northeast Field Representative, National Electrical Manufacturers Association (NEMA), and Bruce Hollands, Executive Director of the Uni-Bell

PVC Pipe Association, and by teleconference, Tracy Dalrymple, Training & Certification Operations Manager, Electronic Security Association; and Marianna Kramarikova, Manager of Technology and Standards, Telecommunications Industry Association (TIA). There were other organizations that were also interested in attending but were unable to do so due to scheduling conflicts. Also attending that meeting were a number of NASCLA state members and contractor member attendees, and a few additional interested parties. During the meeting, the NASCLA Accredited Examination Program Committee asked these various associations if they would nominate electrical practitioners over the next few weeks who might be able to serve as SMEs for this project. Also discussed were procedures to create a unified approach to possible electrical examinations.

Two of the most important conclusions that resulted from the discussion were:

- The various names for a master electrician, such as Unlimited Electrician, Master Electrician, Electrical Contractor, etc. should be given a single name under which all of these names can be identified. Such a name might be "Master Electrical Contractor."
- The examinations for Master Electrical Contractor, Journeyman Electrician, and Residential Electrical Contractor should be developed without creating a standardized requirement for experience. The various individual states and boards should be able to determine their own requirements as to experience, independent of the examinations.

In October 2014, the National Electrical Manufacturers Association (NEMA) Code and Standards Committee voted to provide assistance to NASCLA through the advisory capacity of one of its field representatives, Jack Lyons.

Following the August NASCLA meeting in 2014, preparations began for conducting the first panel meeting of Subject Matter Experts (SMEs) for the Electrical Contractor examination. At the NASCLA 2015 Mid Year Meeting on March 11th in Huntsville, Alabama, the NASCLA Accredited Examination Program Committee met again, and decided to change the model used for the electrical examinations from that of the Commercial General Building Construction Contractor examination. Under the General Building exam, there exists the potential to have multiple tests developed by multiple test providers and multiple test administration providers (i.e., test proctoring providers). Under the new model for the NASCLA electrical examinations, there would be one test provider, and one or multiple administration providers. This new model would allow for there to be a single unified exam item bank, while allowing each state to use its own pre-existing proctoring setup, assuming that the administrating entity for each proctoring setup is confirmed as an approved NASCLA administration provider.

In August of 2015, representatives of NASCLA attended the annual meeting for the National Electrical Reciprocal Alliance (NERA) in Santa Fe, New Mexico and spoke to the group regarding the NASCLA electrical examination efforts at their invitation. NERA is a coalition of

electrical Boards from a number of different states whose goal is to form and streamline reciprocal agreements between states for Master Electrician and Journeyman Electrician licenses. NASCLA members were able to gain additional insights as to the concerns and views of the NERA members regarding the licensing environment in general, and the NASCLA Accredited Electrical Examination Program development effort in particular.

Section 2: Overview of the Job Analysis Project

NASCLA conducted a national job analysis for electrical occupations from October 2014 through February 2016 for the following electrician classifications: Electrical Contractor/Master Electricians, Journeyman Electricians, and Residential Electrician/Residential Electrical Contractor. The purpose of this job analysis study was to define the work conducted by electrician classifications through identifying the tasks required to perform the job safely and competently, along with the knowledges and skills needed to perform those tasks. The job analysis defined the examination content and the level of competency that examination candidates must exhibit in order to receive a license. This effort was conducted under the oversight of the NASCLA Accredited Examination Program Committee and with the assistance of NASCLA's Psychometrician, Kara Schmitt, Ph.D.

Validation Strategy

NASCLA used a content validation strategy to identify: (1) the variety of tasks performed by electrical contractors at the level of competency needed at the time of licensure, and (2) the knowledges and skills needed to accomplish those tasks. In order for an examination to be considered content valid, the test developer must demonstrate a clear relationship between the content of the job and the content of the examination. This relationship is typically established through a series of linkages. The first linkage involves establishing the relationship between the important job tasks performed on the job and the knowledges and skills needed to successfully perform those tasks. The second linkage involves establishing the relationship between the important knowledge and skills and the items on the examination. The content validation strategy utilizes the expertise of practitioners in the field to:

- develop statements that reflect the
    - tasks performed.
    - knowledges and skills needed to perform each task safely and competently.
- link the tasks with the knowledges and skills.
- form a basis upon which each examination item may be written and linked to those
    - task statements.
    - knowledge and skill statements.

Preliminary Research

NASCLA reviewed the various content outlines of licensure electrician examinations from various states. This process allowed NASCLA to establish all of the various content areas that

are being assessed for state licensure. Any available job analysis reports for these license types were also reviewed.

Legal Standards and Guidelines

The Electrical Contractor job analysis was developed in accordance with accepted professional psychometric standards and legal decisions regarding conducting job analyses and developing licensure examinations. Sources of guidance for developing evidence needed to demonstrate reliability and validity in the interpretations of test scores include the:

- ***Standards for Educational and Psychological Testing***, 2014, by the American Educational Research Association, the American Psychological Association, and the National Council on Measurement in Education.
- ***Principles for the Validation and Use of Personnel Selection Procedures***, 2003, by the Society for Industrial and Organizational Psychology, Inc.
- ***Uniform Guidelines on Employee Selection Procedures***, 1978, by the Equal Employment Opportunity Commission.
- ***Americans with Disabilities Act of 1991.***
- ***Titles VI and VII of the Civil Rights Act of 1964.***
- ***Griggs v. Duke Power Co.***, 401 U.S. 424, 432, 91 S. Ct. 849, 28 L.Ed.2d 158 (1971).
- ***Albemarle Paper Co. v. Moody***, 422 U.S. 405 (1975**).**
- ***Kirkland v. New York State Department of Correctional Services***, 520 F.2d 420.
- ***Guardian's Assn. v. Civil Service Commission of New York***, 630 F.2d 72, 79 (1980).
- ***Texas Department of Community Affairs v. Burdine***, 450 U.S. 248, 253-54, 101 S.Ct. 1089, 1093, 67 L.Ed.2d 207 (1981).
- ***Allen v. Alabama State Board of Education***, 816 F.2d 575 (11th Cir.1987).
- ***Tyler v. Vickery***, 517 F.2d 1089 (1975).
- ***Wards Cove Packing Co. V. Atonio***, 490 U.S. 642 (1989).
- ***Lanning v. Southeast Pennsylvania Transportation Authority (SEPTA)***, 181 F.3d 478 (3rd Cir. 1999), cert. denied, 120 S. Ct. 970 (2000).
- ***Lanning v. SEPTA***, 308 F.3d 286 (3rd. Cir. 2002).
- ***Gulino v. New York State Education Department***, 460 F.3d 361 (2nd Cir. 2006).
- ***Ricci v. DeStefano***, 557 U.S. 557 (2009).
- ***M.O.C.H.A. v. City of Buffalo***, 689 F.3d 263 (2nd Cir. 2012).

Section 3: Electrical Contractor/Master Electrician Job Analysis

The procedures and methodology used to conduct the Electrical Contractor/Master Electrician job analysis are described in this section.

Participation of Subject Matter Experts

A representative sample of electrical contractors served as Subject Matter Experts (SMEs) throughout the development of the job analysis. NASCLA sought SME nominations from the executive directors and staffs of the various member and nonmember licensing agencies throughout the country, from the various electrical associations, from NASCLA Contractor Members, from individuals who had volunteered when surveyed, and from NASCLA Accredited Examination Program Committee members. NASCLA staff sent information about NASCLA, the accredited examination program, and the workshops being planned to those electrical contractors who had shown interest in participating, along with an experience and training questionnaire. The electrical contractors selected to participate were chosen that best represented the most comprehensive and diverse backgrounds possible and the widest reach geographically to ensure that the results would be representative of current practice in electrical construction throughout the United States.

There were 19 different Subject Matter Experts (SMEs) who participated in the 2 panels specifically for the Electrical Contractor job analysis: 7 SMEs participated in the first panel only, 5 SMEs participated in the second panel only, and 7 SMEs participated in both panels. The 19 SMEs who participated in the Electrical Contractor job analysis workshops lived in 11 different states (California, Florida, Maryland, Massachusetts, Minnesota, Mississippi, New Hampshire, Oregon, Texas, Utah, and Wisconsin) and had worked in a total of 30 states, the District of Columbia, Iraq, and Kuwait. Most of the SMEs identified themselves as being white or Caucasian or American, with one identifying himself as being Hispanic, one as being Pacific Islander, and one as being German. Two SMEs identified themselves as being between the ages of 36-45 years old, 6 identified themselves as being between the ages of 46-55 years old, and 18 identified themselves as being 56 years old or above. All SMEs stated that they have been licensed as a master electrician or electrical contractor. The length of time of their licensure ranged from 1 year to 40 years, and the length of time they have been working full time in the electrical field, including their apprenticeship years, ranged from 13 years to 47 years. Demographic information for the SMEs that participated in both Electrical Contractor job analysis meetings is included in Appendix B. The lists of SMEs that participated in the two job analysis meetings and those SMEs that served as independent reviewers are included in Appendix C.

Initial SME Job Analysis Panel Meeting

The first panel meeting of Subject Matter Experts (SMEs) for the Electrical Contractor/Master Electrician job analysis was conducted at the offices of the Independent Electrical Contractors of Utah, Inc., in Midvale, Utah, a suburb of Salt Lake City, on March 25-26, 2015, led by the NASCLA Accredited Examination Program Committee Chair and by the NASCLA Psychometrician. The group consisted of 14 individuals from 7 states (Texas, Maryland, California, Mississippi, Oregon, Florida, and Massachusetts).

During this meeting, a discussion was held to determine the meaning of "minimally acceptable level of competence" for an "entry level" electrical contractor in reference to the level that would be needed at the time of licensure. Some confusion arose among the SMEs regarding the difference between an "Electrical Contractor" license in some states, and a "Master Electrician" in others, until it was explained that in most states, in order to acquire an "Electrical Contractor" license, the applicant would generally have to pass both the equivalent of a "Master Electrician" license exam, i.e., the trade exam, and a "Business and Law" exam for the state. It was further explained that the intention of this project was to determine the content that could be used as the trade portion of an examination for Electrical Contractor licenses or as the examination for Master Electrician licenses. Other states use the terms "Electrical Administrator," or "Unlimited Electrician" to refer to a similar job scope. The panel decided that it would be best to label this exam as an "Electrical Contractor" examination, and let each Board continue to determine the name for their license that would best suit their needs. The purpose of the job analysis was to create a standard that would help to define the meaning of "Electrical Contractor," and that would satisfy the majority of states that license electricians. A definition of Electrical Contractor was developed through this discussion, as follows:

One who conducts business in the installation, maintenance and repair of electrical work conforming to applicable standards and codes.

All decisions made by the SME panel were determined by consensus; as the discussion on each point ensued, if anyone disagreed with any decision being reached, they were allowed to state their disagreement and the reason for their dissent, and further discussion was allowed until all parties reached a mutual understanding or a modification which addressed all concerns to the satisfaction of all parties.

In a series of group discussions facilitated by the NASCLA Psychometrician and the NASCLA Accredited Examination Program Committee Chairperson, the SMEs developed a comprehensive outline of the major content domains, the important tasks conducted by job incumbents in those domains, and the related knowledges and skills for each task. Once the SMEs were able to identify the domains, they came to a consensus as to the percentage of questions to be preliminarily assigned to each domain. The SMEs then compared the newly developed domains to some representative content domain outlines obtained from the states of California, Florida, Georgia, North Carolina, and Texas to determine if there were any adjustments that the felt should be made to make the content domains better reflective of the content domains being used by the majority of states; only minor adjustments were made by the SMEs at this time. The SMEs also identified the tasks most important to the work of an electrical contractor and to the safety of the general public; each task was then linked to the domain to which it most closely fit. For each task, the knowledge and skills needed to perform the task were identified and linked to the task. An outline of the Content Domains, Tasks, and Knowledges and Skills was compiled.

Once the SME panel concluded its work and the initial job analysis outline of tasks, knowledge, and skills was completed, the outline was sent to the SME panel members for their individual input and review. The outline was also sent to another independent group of ten reviewers who also had at least 5 years of experience in the electrical field. The comments received were incorporated into the initial job analysis outline and the revised version was sent to the SME panel members for their review via e-mail. After all comments were received on the revisions, the resulting job analysis outline was used as the basis for the surveys that were conducted.

Initial Job Analysis Survey of SMEs

In July of 2015, the initial Electrical Contractor Job Analysis Survey was sent out to electrical contractors throughout the United States, requesting that they rate each task stated in the job analysis according to a Likert scale for frequency and importance, and to rate each related knowledge or skill for importance. The task frequency was rated as: 0 = not performed, 1 = rarely performed, 2 = sometimes performed, or 3 = frequently performed. The importance for each task, knowledge, and skill statement was also rated from 0 to 3; 0 = not important, 1 = minor importance, 2 = moderately important, or 3 = very important. This first survey was sent by NASCLA to 4,793 licensees of some of the NASCLA member states. Additionally, the survey was sent by Boards of some of the other NASCLA member states to their licensees, by the International Association of Electrical Inspectors to their members nationwide, by the National Electrical Contractors Association to their members nationwide, and by the Independent Electrical Contractors to their members nationwide. The total number of surveys sent out by the

various boards is unknown. A copy of the NASCLA Electrical Contractor Job Analysis Survey is included in Appendix D.

A total of 367 recipients responded to the survey. The respondents included contractors holding licenses in all 50 states and in Washington, D.C. The respondents also represented a wide range of experience; the amount of time the respondents had held a license ranged from 3 months to 51 years. The vast majority (98.7%) of the respondents currently or have at one time been licensed as an Electrical Contractor (Master Electrician/Unlimited Electrician). It should be noted that there are jurisdictions in the United States in which no licensure is required to perform as an electrical contractor or master electrician. The complete breakdown of the Electrical Contractor Job Analysis Survey respondent demographics is included in Appendix E.

Second SME Workshop

The second SME panel for the Electrical Contractor/Master Electrician job analysis was convened in San Diego, California, on September 2, 2015, led by the NASCLA Accredited Examination Program Committee Chair and by the NASCLA Psychometrician. There were 12 subject matter experts from 9 different states, including Florida, Minnesota, Massachusetts, California, Texas, Wisconsin, New Hampshire, Mississippi, and Maryland. Seven of the 12 SMEs had participated in the initial SME panel meeting; 5 of the SMEs were participating in their first SME meeting.

The SMEs were shown the survey results for each task and its associated knowledges and skills, and asked to discuss the results for each and determine whether any changes needed to be made to any task statement or knowledge/skill statement as a result of this information. The SMEs eliminated several tasks or knowledges/skills based on a low importance and/or frequency rating shown in the survey. They also modified several tasks or knowledges/skills statements to eliminate what they perceived as alternative interpretations to the statement based on a low rating that they believed should have been higher. Afterwards, the SMEs allocated the number of questions that should be assigned to each task or set of tasks and developed the examination plan. All decisions made by the SMEs during the meeting were made through the consensus process.

Second Job Analysis Survey of SMEs

The first survey received responses from throughout the United States, however, the states of Ohio and Louisiana had many more responses than the other states and may have possibly skewed the results. The sample size was also deemed to be somewhat small, given the number of surveys that were sent out. Based on these facts, it was decided that a second survey should be conducted to either corroborate the first results, or to identify discrepancies. The second survey was sent by NASCLA to 56,589 electrical contractors in October/November 2015,

compiled from licensee lists for nearly all of the states with statewide electrical licensure programs and some municipalities in states without statewide licensure programs, along with other targeted mailing lists of electrical contractors, assisted by LTAS Technologies. Additional surveys were sent out directly by a few individual states. Some electrical associations also sent out the surveys to their membership, including the Western Electrical Contractors Association, the International Association of Electrical Inspectors, the National Electrical Contractors Association, the Independent Electrical Contractors, and the National Electrical Training Alliance. The second survey was almost exactly like the first survey, except that the survey was split into one survey for the tasks, and a second survey for the knowledges and skills. The purpose of splitting up the survey was an attempt to increase the response rate by not overburdening the recipients by occupying too much of their time. The ethnicity question was also refined further in the second survey.

Many of the surveys were only partially completed by the respondents. A total of 327 respondents began the second survey for tasks, and 168 finished. A total of 216 respondents began the second knowledges and skills survey, and 68 finished. The resulting means of the second survey were remarkably close to the results of the first survey, often exactly the same. Out of all tasks and all KSAs (knowledges, skills and abilities), the greatest variance from the mean was 8 hundredths of a point (e.g., 2.82 vs. 2.90). Therefore, given how closely the results from both the first and second surveys were, it was concluded that the results from the first survey could be used for the final analysis. The results of the job analysis survey is included in Appendix F. The linkages between the tasks and knowledge/skills are also documented in Appendix D.

During the Residential Electrical Contractor/Residential Electrician SME panel meeting convened in Mesa, Arizona on February 17 – 18, 2016, a discussion was held to review the results of the second survey and their comparison to the first. There was a total of 13 Electrical Contractor SMEs present, representing 10 states, including Arizona, Louisiana, Florida, Wisconsin, Washington, Colorado, Hawaii, Massachusetts, Iowa, and New Hampshire. All SMEs but one had one or more years of experience as a licensed Journeyman Electrician and were experienced in various tasks associated with electrical contractor work. The one SME whose experience was limited to residential electrical work did not offer input into this discussion. At that meeting the SMEs reviewed the results of the second survey and their comparison to the first. The SMEs made a few modifications to the version of the job analysis completed by the SMEs at the second meeting in San Diego. These new modifications were mostly slight changes in wording to reduce possible alternative interpretations of statements as reflected by lower ratings than would have been expected by the SMEs. During this meeting, the SMEs completed the final version of the job analysis and test specifications for the Electrical Contractor examination. A copy of the final examination plan for the Electrical Contractor examination is included in Appendix G.

Section 4: Journeyman Electrician Job Analysis

The procedures and methodology used to conduct the Journeyman Electrician job analysis are described in this section.

Participation of Subject Matter Experts

A representative sample of electrical contractors served as Subject Matter Experts (SMEs) throughout the development of the job analysis. All SMEs had at least 5 years of full time hands-on experience in the electrical field. In a series of group discussions facilitated by the NASCLA Psychometrician and the Accredited Examination Committee Chairperson, the SMEs developed a comprehensive outline of the major content domains, the important tasks conducted by job incumbents in those domains, and the related knowledges and skills for each task.

NASCLA sought SME nominations from the executive directors and staffs of the various member and nonmember licensing agencies throughout the country, from the various electrical associations, from NASCLA Contractor Members, from individuals who had volunteered when surveyed, and from NASCLA Accredited Examination Program Committee members. NASCLA staff sent information about NASCLA, the accredited examination program, and the workshops being planned to those electrical contractors who had shown interest in participating, along with an experience and training questionnaire. The electrician SMEs selected to participate were chosen that best represented the most comprehensive and diverse backgrounds possible and the widest reach geographically to ensure that the results would be representative of current practice in electrical construction throughout the United States. All decisions made by this panel were determined by consensus; as the discussion on each point ensued, if anyone disagreed with any decision being reached, they were allowed to state their disagreement and the reason for their dissent, and further discussion was allowed until all parties reached a mutual understanding or a modification which addressed all concerns to the satisfaction of all parties.

There were 20 different Subject Matter Experts (SMEs) who participated in the 2 panels specifically for the Journeyman Electrician job analysis: 7 SMEs participated in the first panel only, 7 SMEs participated in the second panel only, and 6 SMEs participated in both panels. The 20 SMEs who participated in the Journeyman Electrician job analysis workshops lived in 15 different states (Alaska, Arizona, Arkansas, California, Colorado, Florida, Idaho, Louisiana, Maryland, Nevada, New Hampshire, Oregon, Texas, Utah, and Washington). Most of the SMEs identified themselves as being white or Caucasian or American, with one identifying himself as being African American. All of the SMEs were male. Three SMEs identified themselves as being between the ages of 20-35, one SME identified themselves as being between the ages of 36-45, seven SMEs identified themselves as being between the ages of 46-55 years old, and nine

SMEs identified themselves as being 56 years old or above. All but one of the SMEs stated that they have been licensed as a journeyman electrician; the exception practiced in a state that did not require licensure. The length of time of their licensure ranged from 5 year to 42 years, and the length of time they have been working full time in the electrical field, including their apprenticeship years, ranged from 10 years to 45 years. Additional demographic information for the SMEs that participated in both Journeyman Electrician job analysis meetings is included in Appendix H. The lists of SMEs that participated in the two job analysis meetings and those SMEs that served as independent reviewers are included in Appendix I.

Initial SME Job Analysis Panel Meeting

The first panel meeting of Subject Matter Experts (SMEs) for the Journeyman Electrician job analysis was conducted in Dallas, Texas on June 9 - 12, 2015, led by the NASCLA Accredited Examination Program Committee Chair and by the NASCLA Psychometrician. The group consisted of 13 individuals from 10 states (California, Florida, Idaho, Louisiana, Maryland, Nevada, Oregon, Texas, Utah, and Washington). During this meeting, a discussion was held to determine the meaning of "minimally acceptable level of competence" for an "entry level" journeyman electrician in reference to the level that would be needed at the time of licensure. One of the goals of this meeting was to create a standard that would help to define the meaning of "Journeyman Electrician" and that would satisfy the majority of states that license journeyman electricians. The following definition of Journeyman Electrician was developed through this discussion:

An individual who has demonstrated competency in knowledge and skills needed to properly perform the installation, maintenance and repair of electrical work conforming to applicable standards and codes.

The SME panel was asked to identify job content domains in which the work of journeyman electricians could be categorized. Once the SMEs were able to identify the domains, they came to a consensus as to the percentage of questions to be preliminarily assigned to each domain. The SMEs then compared the newly developed domains to some representative content domain outlines obtained from the states of California, Colorado, and Texas to determine if there were any adjustments that the felt should be made to make the content domains better reflective of the

content domains being used by the majority of states, and to the content domain outline previously established in the first NASCLA Electrical Contractor SME panel for Electrical Contractors/Master Electricians; only minor adjustments were made by the SMEs at this time. The SMEs also identified the tasks most important to the work of a journeyman electrician and to the safety of the general public; each task was then linked to the domain to which it most closely fit. For each task, those knowledges and skills needed to perform the task were identified and linked to the task. An outline of the Domains, Tasks, and Knowledges and Skills was compiled.

Once the SME panel concluded its work and the initial job analysis outline of tasks, knowledge, and skills was completed, the outline was sent to the SME panel members for their individual input and review. The comments received were incorporated into the initial job analysis outline and the revised version was used as the basis for the surveys that were conducted.

Initial Job Analysis Survey of SMEs

In July of 2015, the initial Journeyman Electrician Job Analysis Survey was sent out to electrical contractors throughout the United States, requesting that they rate each task stated in the job analysis according to a Likert scale for frequency and importance, and to rate each related knowledge or skill for importance. The task frequency was rated as: 0 = not performed, 1 = rarely performed, 2 = sometimes performed, or 3 = frequently performed. The importance for each task, knowledge, and skill statement was also rated from 0 to 3; 0 = not important, 1 = minor importance, 2 = moderately important, or 3 = very important. The surveys were sent to the Directors of all of the Electrical Boards to distribute to their licensees. NASCLA is aware of at least four states that distributed the surveys to their licensees (California, Louisiana, Ohio, and Colorado), although there could have been more. At least 2,000 surveys were sent out by the various states. Additionally, the survey was sent out by the following electrical organizations to their memberships: NECA, the Independent Electrical Contractors, the International Association of Electrical Inspectors, and the Electrical Training Alliance. NASCLA estimates that the total number of recipients who were sent the initial Journeyman Job Analysis survey was more than 40,000, however the exact number is not known. A copy of the NASCLA Journeyman Electrician Job Analysis Survey is included in Appendix I.

A total of 69 recipients responded to the initial survey. The respondents included contractors holding licenses in 36 states. The respondents also represented a wide range of experience; the amount of time the respondents had held a license ranged from 1 year to 43 years, with the average respondent having over 18 years of being licensed. The vast majority (96.8%) of the respondents currently or have at one time been licensed as a Journeyman Electrician. It should be noted that there are jurisdictions in the United States in which no licensure is required to

perform as a Journeyman Electrician. The complete breakdown of the Journeyman Electrician Job Analysis Survey respondent demographics is included in Appendix K.

Second SME Workshop

The second panel of subject matter experts (SMEs) was convened in San Diego, California, on September 1, 2015, led by the NASCLA Accredited Examination Program Committee Chair and by the NASCLA Psychometrician. There were 13 SMEs from 11 different states, including Alaska, Arizona, California, Colorado, Florida, Idaho, Maryland, Nevada, New Hampshire, Texas, and Washington. The SMEs were shown the survey results for each task and its associated knowledges and skills, and asked to discuss the results for each and determine whether any changes needed to be made to any task statement or knowledge/skill statement as a result of this information. The SMEs eliminated several tasks or knowledges/skills based on a low importance and/or frequency rating shown in the survey. They also modified several tasks or knowledges/ skills statements to eliminate what they perceived as alternative interpretations to the statement based on a low rating that they believed should have been higher. Afterwards, the SMEs allocated the number of questions that should be assigned to each task or set of tasks and developed the examination plan.

Second Job Analysis Survey of SMEs

The first survey received responses from throughout the United States, however, 44% of the responses were from the State of California and may have possibly skewed the results. The sample size was also deemed to be somewhat small, given the number of surveys that were sent out. Based on these facts, it was decided that a second survey should be conducted to either corroborate the first results, or to identify discrepancies. The survey was then split into two separate surveys, one with the tasks only and one with the knowledges/skills only and re-sent out in January/February 2016. The reasoning behind splitting up the survey was that NASCLA thought that a shorter survey might increase participation. The second task survey was sent out by the same states and electrical organizations as were the first survey, with additional surveys sent out by the Western Electrical Contractors Association. NASCLA estimates that the second survey may have been sent out to as many as 100,000 recipients.

A total of 135 respondents began the second survey for tasks, and 80 finished. A total of 100 respondents began the second knowledges and skills survey, and 48 finished. The survey results for the Journeyman Electrician tasks, knowledge statements, and skill statements are included in Appendix L.

During the Residential Electrical Contractor/Residential Electrician SME panel meeting convened in Mesa, Arizona on February 17 – 18, 2016, a discussion was held to review the results of the second survey and their comparison to the first. All SMEs but one had one or more

years of experience as a licensed Journeyman Electrician and were experienced in various tasks associated with electrical contractor work. The one SME whose experience was limited to residential electrical work did not offer input into this discussion. There was a total of 14 SMEs present, representing ten states, including Arizona, Louisiana, Florida, Wisconsin, Washington, Colorado, Hawaii, Massachusetts, Iowa, and New Hampshire. The SMEs made a few modifications to the version of the job analysis completed by the SMEs at the second meeting in San Diego. These new modifications were mostly slight changes in wording to reduce possible alternative interpretations of statements as reflected by lower ratings than would have been expected by the SMEs. During this meeting, the SMEs completed the final version of the job analysis and blueprint specifications for the Journeyman Electrician examination. A copy of the final examination plan for the Journeyman Electrician examination plan is included in Appendix M.

Section 6: Residential Electrician/Residential Electrical Contractor Job Analysis

The procedures and methodology used to conduct the Residential Electrician/Residential Electrical Contractor job analysis are described in this section.

Participation of Subject Matter Experts

A representative sample of residential electrical contractors served as Subject Matter Experts (SMEs) throughout the development of the job analysis. NASCLA sought SME nominations from the executive directors and staffs of the various member and nonmember licensing agencies throughout the country, from the various electrical associations, from NASCLA Contractor Members, from individuals who had volunteered when surveyed, and from NASCLA Accredited Examination Program Committee members. NASCLA staff sent information about NASCLA, the accredited examination program, and the workshops being planned to those electrical contractors who had shown interest in participating, along with an experience and training questionnaire. The residential electrical contractors selected to participate were chosen that best represented the most comprehensive and diverse backgrounds possible and the widest reach geographically to ensure that the results would be representative of current practice in electrical construction throughout the United States.

In a series of group discussions facilitated by the NASCLA Psychometrician and the NASCLA Accredited Examination Committee Chairperson, the SMEs developed a comprehensive outline of the major content domains, the important tasks conducted by job incumbents in those domains, and the related knowledges and skills for each task. All decisions made by this panel were determined by consensus; as the discussion on each point ensued, if anyone disagreed with any decision being reached, they were allowed to state their disagreement and the reason for their dissent, and further discussion was allowed until all parties reached a mutual understanding or a modification which addressed all concerns to the satisfaction of all parties.

There were 22 different Subject Matter Experts (SMEs) who participated in the 2 panels specifically for the Residential Electrical Contractor job analysis: 8 SMEs participated in the first panel only, 7 SMEs participated in the second panel only, and 7 SMEs participated in both panels. The 22 SMEs who participated in the Residential Electrician/Residential Electrical Contractor job analysis workshops lived in 15 different states (Arizona, California, Colorado, Florida, Hawaii, Iowa, Louisiana, Maryland, Massachusetts, New Hampshire, New York, South Carolina, Texas, Washington, and Wisconsin). The lists of SMEs that participated in the two Residential Electrician/Residential Electrical Contractor job analysis meetings and those SMEs that served as independent reviewers are included in Appendix O.

All SMEs had at least 5 years of full time hands-on experience in the electrical field. Most of the SMEs identified themselves as being white or Caucasian or American, with one identifying himself as being a Pacific Islander. One of the SMEs was female, while the others were all male. Two SMEs identified themselves as being between the ages of 20 - 35 years old, 3 SMEs identified themselves as being between the ages of 36-45 years old, 3 SMEs identified themselves as being between the ages of 46-55 years old, and 11 SMEs identified themselves as being 56 years old or above. All SMEs stated that they have been licensed as either a master electrician or residential electrical contractor. The length of time of their licensure ranged from 2 years to 40 years, and the length of time they have been working full time in the electrical field, including their apprenticeship years, ranged from 5 years to 42 years. Additional demographic information for the SMEs that participated in both of the Residential Electrician/Residential Electrical Contractor job analysis meetings is included in Appendix N.

Initial SME Job Analysis Panel Meeting

The first panel meeting of Subject Matter Experts (SMEs) for the Residential Electrician/Residential Electrical Contractor job analysis was conducted in Phoenix, Arizona on October 28 - 29, 2015, led by the NASCLA Accredited Examination Program Committee Chair and by the NASCLA Psychometrician. The group consisted of 15 individuals from 11 states (Arizona, California, Colorado, Florida, Hawaii, Louisiana, Maryland, New Hampshire, New York, South Carolina, and Texas).

During this meeting, a discussion was held to determine the meaning of "minimally acceptable level of competence" for an "entry level" residential electrical contractor in reference to the level that would be needed at the time of licensure. The SMEs were instructed that in most states, in order to acquire a Residential Electrical Contractor license, the applicant would generally have to pass both the equivalent of a Residential Electrician license examination, i.e., the trade exam, and a Business and Law examination for the state. It was further explained that the intention of this job analysis was to determine the content that could be used as the trade portion of an examination for Residential Electrical Contractor licenses. The panel decided that it would be best to label this exam as a "Residential Electrician/Residential Electrical Contractor" examination, and let each Board continue to determine the name for their license that would best suit their needs. The purpose of the job analysis was to create a standard that would help to define the meaning of "Residential Electrical Contractor," and that would satisfy the majority of states that license electricians. The definition of a Residential Electrician/Residential Electrical Contractor was developed through this discussion, as follows:

One who demonstrates competency in performing electrical installations, service, repair and maintenance typically encountered in a permanent dwelling unit.

The SME panel was asked to identify job content domains in which the work of residential electrical contractors could be categorized. Once the SMEs were able to identify the domains, they came to a consensus as to the percentage of questions to be preliminarily assigned to each domain. The SMEs then compared the newly developed domains to some representative content domain outlines obtained from the states of Alaska, Colorado, Iowa, and Texas to determine if there were any adjustments that the felt should be made to make the content domains better reflective of the content domains being used by the majority of states; only minor adjustments were made by the SMEs at this time. The SMEs also identified the tasks most important to the work of a residential electrical contractor and to the safety of the general public; each task was then linked to the domain to which it most closely fit. For each task, those knowledges and skills needed to perform the task were identified and linked to the task. An outline of the Content Domains, Tasks, and Knowledges and Skills was compiled.

Once the SME panel concluded its work and the initial job analysis outline of tasks, knowledge, and skills was completed, the outline was sent to the SME panel members for their individual input and review. The comments received were incorporated into the initial job analysis outline and the revised version was used as the basis for the surveys that were conducted.

Initial Job Analysis Survey of SMEs

In December of 2015, the Residential Electrician/Residential Electrical Contractor Job Analysis Survey was sent out to electrical contractors throughout the United States, requesting that they rate each task stated in the job analysis according to a Likert scale for frequency and importance, and to rate each related knowledge or skill for importance. The task frequency was rated as: 0 = not performed, 1 = rarely performed, 2 = sometimes performed, or 3 = frequently performed. The importance for each task, knowledge, and skill statement was also rated from 0 to 3; 0 = not important, 1 = minor importance, 2 = moderately important, or 3 = very important. The surveys were sent to the Directors of all of the Electrical Boards to distribute to their licensees. NASCLA is aware of at least four states that distributed the surveys to their licensees (California,

Louisiana, Ohio, and Colorado), although there could have been more. At least 2,000 surveys were sent out by the various states. Additionally, the survey was sent out by the following electrical organizations to their memberships: NECA, the Independent Electrical Contractors, the International Association of Electrical Inspectors, and the Electrical Training Alliance. NASCLA estimates that the total number of recipients who were sent the initial Residential Electrician/Residential Electrical Contractor Job Analysis survey was more than 40,000, however the exact number is not known. A copy of the NASCLA Residential Electrician/Residential Electrical Contractor Job Analysis Survey is included in Appendix P.

Second Job Analysis Survey of SMEs

A second Residential Electrician/Residential Electrical Contractor Job Analysis Survey was sent out in January/February 2016 in an attempt to get more respondents. The second survey was identical to the first survey. The second task survey was sent out by the same states and electrical organizations as were the first survey, with additional surveys sent out by the Western Electrical Contractors Association. NASCLA estimates that the second survey may have been sent out to as many as 100,000 recipients.

The results of both the initial and second surveys were combined. A total of 93 respondents began the survey for tasks, with 56 answering all of the survey questions. A total of 70 respondents began the second knowledges and skills survey, with 30 answering all of the survey questions. The respondents included contractors holding licenses in 20 states. The respondents also represented a wide range of experience; the amount of time the respondents had held a license ranged from 1 year to 50 years, with the average respondent having over 21 years of being licensed. The vast majority (85.7%) of the respondents currently or have at one time been licensed as a Residential Electrical Contractor. It should be noted that there are jurisdictions in the United States in which no licensure is required to perform as a Residential Electrician. The complete breakdown of the Residential Electrician/Residential Electrical Contractor Job Analysis Survey respondent demographics is included in Appendix Q. The survey results for the Residential Electrician/Residential Electrical Contractor tasks, knowledge statements, and skill statements are included in Appendix R.

Second SME Workshop

The second panel of subject matter experts (SMEs) was convened in Mesa, Arizona on February 17 - 18, 2016, and led by the NASCLA Accredited Examination Program Committee Chair and by the NASCLA Psychometrician. There were 14 subject matter experts from 11 different states, including Arizona, California, Colorado, Florida, Hawaii, Iowa, Louisiana, Massachusetts, New Hampshire, Washington, and Wisconsin. The SMEs were shown the survey results for each task and its associated knowledges and skills, and asked to discuss the results for each and determine whether any changes needed to be made to any task statement or knowledge/skill

statement as a result of this information. The SMEs eliminated several tasks or knowledges/skills based on a low importance and/or frequency rating shown in the survey. They also modified several tasks or knowledges skills statements to eliminate what they perceived as alternative interpretations to the statement based on a low rating that they believed should have been higher. Afterwards, the SMEs allocated the number of questions that should be assigned to each task or set of tasks and developed the examination plan.

During the second SME panel meeting, a discussion was held to review the results of the Residential Electrician/Residential Electrical Contractor survey. The SMEs made a few modifications to the version of the job analysis; the new modifications were mostly slight changes in wording to reduce possible alternative interpretations of statements as reflected by lower ratings than would have been expected by the SMEs. During this meeting, the SMEs completed the final version of the job analysis and blueprint specifications for the Residential Electrical Contractor examination. A copy of the final examination plan for the Residential Electrical Contractor examination plan is included in Appendix S.

Section 6: Test Development and Standard Setting

This section describes the procedures and methodology used to develop the test items/examination forms and to determine the legally defensible cutscores used for the 3 examinations within the NASCLA Accredited Electrical Examination Program.

Psychometric Guidelines for the NASCLA Accredited Electrical Examination Program

Prior to developing items for the examination, the NASCLA Psychometrician developed the following psychometric guidelines for the NASCLA Accredited Electrical Examination Program through discussion with the SME job analysis development panels for each of the examinations. These guidelines were ratified afterwards by the NASCLA Accredited Electrical Examination Program Committee:

- Open book examination
- Items referenced to the last two revisions of the National Electric Code
- 4-choice Multiple Choice (items can also be in the format of 4- choice "hot spot")
- No more than 5% negatively worded items
- Cut score based on standard setting workshop
- Number of scored items on exam: 100
- Number of pre-test items: 10
- The % of non-code items must be at least equal to 100% minus the % cutscore plus 1%.
- Number of items relating to visual aids: 15%
- No “none of the above” or “all of the above” items
- Items must be referenced
- All items based on skill statements from the KSAs should be written at the application and analysis level
- No true/false or essay items
- Generally, avoid absolute items with words such as “always,” “all,” or “never” - may use “shall” or “shall not”
- No weighted items
- Clones should be created when feasible although they must be designated as such so that clones do not appear on the same version of an examination.
- Other "Enemies" should be marked and set so that they do not appear on the same version of an examination.

Test Development

The items for the 3 examinations within the NASCLA Accredited Electrical Examination Program were developed by Subject Matter Experts (SMEs). In January of 2017, NASCLA assembled a panel of 17 SMEs at their office in Phoenix, Arizona, for the purposes of writing the test items. A list of the SMEs that attended the meeting and their qualifications are included in Appendix T. Prior to attending the meeting, the SMEs were provided with the Examination Plans for the 3 electrical exams. The Examination Plans consisted of the examination content areas, the number of items in each content area, and the KSAs that have been linked to each examination content area. The SMEs were given a half-day of item writing training by the NASCLA Psychometrician, Brian Moritsch, and the Chairperson for the NASCLA Accredited Examination Program Committee, Doug Traylor. The training consisted of an overview of the NASCLA Accredited Electrical Examination Program job analysis process and results, multiple choice test item components and formats, item writing techniques, identifying common item writing clues and errors, and item editing procedures. Each SME was required to sign a confidentiality agreement prior to participating in the items writing session.

The SMEs spent the remainder of the workweek writing test items in the NASCLA offices. Reference materials were provided to the SMEs from which to base the test items on. All of the test items were linked to one or more of the KSAs on the Examination Plans. Test items could be linked to each of the 3 electrical examinations, provided the SME who wrote the test item provided an appropriate KSA linkage for each exam. Hence, many of the test items were linked to more than one of the electrical examinations. During that week, the SMEs developed a total of 950 test items: 723 of the test items were linked to the Electrical Contractor/Master Electrician examination; 651 test items were linked to the Journeyman Electrician examination; and 509 test items were linked to the Residential Electrician/Residential Electrical Contractor examination. All of the test items were reviewed by the NASCLA Psychometrician for clarity, format, and completeness. All of the items were then assembled into a spreadsheet and sorted by KSA to identify potentially duplicate items.

In July 2017, some of the SMEs that were involved in the January item writing session were asked to write some additional test items to ensure that NASCLA had a sufficient number of items in each of the examination content areas. The SMEs were allowed to develop the test items from their resident states and securely transferred the items electronically to NASCLA; per their confidentiality agreements, the SMEs were not allowed to retain copies of the newly developed test items. A total of 47 new items were developed.

Standard Setting

In February 2017, NASCLA assembled a panel of 14 SMEs to review the newly developed electrical examination test items. The 5-day panel meeting was held at the NASCLA offices in Phoenix, Arizona. A list of the SMEs that attended the meeting and their qualifications are included in Appendix U. Prior to attending the meeting, the SMEs were provided with the Examination Plans for the three electrical exams. The Examination Plans consisted of the examination content areas, the number of items in each content area, and the KSAs that have been linked to each examination content area. The SMEs were given a half-day of standard setting training by the NASCLA Psychometrician, Brian Moritsch, and the Chairperson for the NASCLA Accredited Examination Program Committee, Doug Traylor. The training consisted of describing the modified Angoff methodology; group discussions on what constituted a minimally qualified, a highly qualified, and a non-qualified candidate for each of the three NASCLA electrician classifications; training on the item rating sheets and the rating scales (Relevance Scale, Application/Recall Scale, and the Angoff Scale); and a discussion on the open book/closed book status for the various references used to create the test items.

On the rating sheets, the SMEs were also asked to confirm the keyed response and the Knowledge/Skill linkages for each test item. The SMEs were also asked to either accept the item as written, delete the item, or accept the item with edits. The SMEs were also asked to identify any items that they felt needed to be edited for content or format; when such items were encountered they were typically edited by the entire group. The SMEs were also asked to determine whether the test item was a Recall item (e.g., a knowledge-based test item) or an Application test item that requires the candidate to apply a knowledge or skill (e.g., blueprint reading). The following Relevance Scale used to assess the item: 0 = no relevance, 1 = little relevance, 2 = moderate relevance, 3 = very relevant, and 4 = extremely relevant. The SMEs were informed that test items that did not achieve an average score of 2.0 on the Relevance Scale would not be included on the test. The modified Angoff ratings reflected the score that the SMEs thought that a minimally qualified candidate would achieve on a particular test item. The modified Angoff rating is a reflection on how difficult the SMEs believed a test item was. The SMEs were told to rate the Angoff score in increments of 5, between 25 (chance score) and 100 (all candidates get the item correct). The rating sheet contained sections for rating each test item separately for each of the three examinations within the NASCLA Accredited Electrical Examination Program. A sample copy of the rating sheet is included in Appendix V.

Upon completion of the training, the SMEs were asked to rate the first test item on their own. The NASCLA Psychometrician inspected each SME's rating sheet to ensure they were properly filling out each section of the form. The SMEs were then asked to share their ratings aloud to the rest of the group. The purpose for sharing ratings was to calibrate the group, i.e., to get them to rate consistently between raters. If two of the SMEs' Angoff ratings were greater than 15 points

apart then they were asked to discuss the factors they considered when determining their ratings. The SMEs were instructed that they could change their ratings anytime based on the rating discussions, but they were not to feel compelled to change their ratings if they did not want to. The first 20 test questions were discussed in this same manner, after which the NASCLA Psychometrician felt confident that the group was rating consistently between SMEs. On the second day of rating, the SMEs were split into 2 groups of 7 SMEs in order to assess a greater number of items. In August 2017, a group of nine SMEs were convened via webinar to rate the new 47 items developed the previous month. All of the SMEs had participated in the previous Angoff rating session. At the beginning of the webinar, the NASCLA Psychometrician gave refresher training to the SMEs on the rating sheet and the modified Angoff rating methodology. Test items that did not achieve a relevancy rating of at least 2.0 were eliminated from the rating pool. Upon completion of the standard setting rating process, the initial item banks for the 3 examinations within the NASCLA Accredited Electrical Examination Program were as follows: 511 test items for the Electrical Contractor/Master Electrician examination; 516 test items for the Journeyman Electrician examination; and 408 test items for the Residential Electrician/Residential Electrical Contractor examination. The average modified Angoff ratings for the items pools were as follows: 76.72 for the Electrical Contractor/Master Electrician examination; 72.50 for the Journeyman Electrician examination; and 69.66 for the Residential Electrician/Residential Electrical Contractor examination.

In November 2017, the NASCLA Accredited Examination Program Committee met to discuss where to set the cutscores for the 3 examinations. Information considered during the NASCLA Accredited Examination Program Committee meeting included the mandated cutscores of various states and the average modified Angoff ratings for the electrical examinations item pools. The NASCLA Accredited Electrical Examination Program Committee set the following cutscores for the NASCLA Accredited Electrical Examination Program: 75 out of 100 for the Electrical Contractor/Master Electrician examination; 70 out of 100 for the Journeyman Electrician examination; and 70 out of 100 for the Residential Electrician/Residential Electrical Contractor examination.

Item Banking

In April 2017, a Request for Proposal (RFP) was sent out to various item banking companies to house the 3 examinations within the NASCLA Accredited Electrical Examination Program and forms. Seven companies sent proposals to NASCLA. The NASCLA Accredited Examination Program Committee evaluated the proposals and selected 2 finalists. At the NASCLA 2018 Annual Conference in Denver, Colorado, the NASCLA Accredited Examination Program Committee met with representatives from the 2 finalist item banking companies. In October 2017, NASCLA entered into an agreement with Assessment Systems to house the NASCLA electrical items and examination forms. In November 2017, the NASCLA Psychometrician and

members of the NASCLA administrative staff attended a series of online training workshops with Assessment Systems staff on the use of the test assembly and test administration platforms. In December 2017, NASCLA administrative staff uploaded the electrical items, examination forms, and graphics into the Assessment Systems platform.

Test Assembly

The NASCLA Psychometrician assembled 3 fixed versions of each of the 3 examinations within the NASCLA Accredited Electrical Examination Program. Per the examination plans, each form of the tests had 100 items and 10 experimental items. Each form also had between 16 – 33 anchor items, i.e., the same item in each form, so as to be able to assess if the forms are equated. Each of the 3 forms of a particular test had identical average Angoff ratings based on the cutscores determined by the NASCLA Accredited Examination Program Committee: the average Angoff ratings for the three forms of the Electrical Contractor/Master Electrician examination is 75.00; the average Angoff ratings for the three forms of the Journeyman Electrician examination is 70.00; and the average Angoff ratings for the three forms of the Residential Electrician/Residential Electrical Contractor examination is 70.00. When selecting the items to be included in each form of the examination, the NASCLA Psychometrician ensured that no 2 enemy items were included on the same form.

Pretesting of Test Items/Forms

In February 2018, 15 of the SMEs used in the Test Development and Standard Setting phases were enlisted to pretest the test items/forms through the Assessment Systems platform. The primary purposes of the pilot tests were to: assess the Assessment Systems test administration platform's ability to adequately present the NASCLA electrical items; assess the ease of the test administration process (such as logon and logoff procedures, toggling between items, accessing the calculator and reference library, etc.); identify any problem test items with regard to wording, formatting, or key issues; assess the clarity of the graphics and plan sets; ensure the score reporting procedures are working properly; and identify any concerns or issues the SMEs had with the test administration process. The SMEs used to pilot test the examinations were given a checkoff sheet for reviewing the examination forms (see Appendix W). Each of the 9 examination forms were reviewed by the NASCLA Psychometrician and at least 3 SMEs.

Operational Administration of the NASCLA Accredited Electrical Examination Program

In August 2018, the NASCLA Accredited Electrical Examination Program became operational.

Appendix A

Employment Statistics for Electrical Contractors and Personnel

Occupational Employment Statistics Research Estimates for Electricians	
Electricians	916,870
Helpers--Electricians	371,680
Construction Managers for Electrical Contractors and Other Wiring Installation Contractors	16,420
Cost Estimators for Electrical Contractors and Other Wiring Installation Contractors	14,890
Electrical and Electronics Repairers, Commercial and Industrial Equipment	22,040
Security and Fire Alarm Systems Installers	13,190
Solar Photovoltaic Installers	21,050
Telecommunications Equipment Installers and Repairers, Except Line Installers	111,750
Total	**1,487,890**

The above statistics were gleaned from the United States Department of Labor, Bureau of Labor Statistics for May of 2016. The Department reported that there are 607,120 electricians nationwide. However, a review of the statistics by state reveals a larger number. The numbers above do not include electricians stating that they are self-employed, and personnel who work on power plants, electrical transmission/distribution lines, or electrical power substations.

Appendix B

Electrical Contractor Job Analysis Meeting SME Panel Demographics

Electrical Contractor SME Panel Demographics

The tables listed below detail the demographics of the SMEs who participated in the panel meetings for the NASCLA Electrical Contractor/Master Electrician job analysis.

The number of years that the SMEs reported that they spent supervising electricians, estimating, or preparing contracts each ranged from 0 years to 40 years. Table 1 depicts their estimate of the average cost of contracts their company undertakes, ranging from less than $10,000 per job to over $100,000 per job, as follows:

Table 1
Size of Job Undertaken by SMEs' Companies

Average Size of Job	No. of SMEs
Less than $10K	**8**
$10K to $50K	**5**
$50K to $100K	**2**
Greater than $100K	**8**

Not all SMEs answered this question, as a few of them now work for electrical associations or licensing or code authority agencies or other public agencies, and do not perform independent contract work. Their estimated number of total employees for their firms ranged from 1 to 700 both total full time employees, and 0 to 30 part time employees. Four of the SMEs listed their business as a sole proprietorship, 1 as a Limited Liability Company, and 15 as a corporation.

Fifteen of the SMEs noted types of work that their companies perform other than electrical work as follows:

Table 2
Types of Work Performed by SMEs' Companies

Type of Work Performed	No. of SMEs
Building	12
Home Building	4
Home/Building Renovations	11
Mechanical Work	7
Plumbing	7
Earthwork	2
Deep Foundations	2
General Concrete	5
Paving	2
Hazardous Materials	1
Drainage	2
Underground Distribution Pipelines	4
Power Plants	4
Industrial Plants	4
Demolishing	5
Bridges	2
Mining	1
Oil fields	1
Offshore	0

The SMEs were also asked the number of jobs of each type of work below that they have performed during their career. Table 3 depicts the diversity and breadth among the SMEs throughout the electrical field.

Table 3
Types of Electrical Work Experience of SMEs

Type of Electrical Work	Zero Jobs	1-5 jobs	6-10 jobs	11-25 jobs	More than 25 jobs
Residential	**1**		**1**	**4**	**16**
Commercial		**1**	**1**	**4**	**16**
Industrial	**1**	**2**	**2**	**2**	**12**
Instrumentation	**5**	**4**	**1**	**1**	**7**
Fire alarms		**4**	**3**	**3**	**11**
Security alarms	**1**	**7**	**1**	**1**	**10**
Door/gate access	**2**	**2**	**4**	**3**	**8**
Telecommunications	**1**	**1**	**3**	**5**	**10**
Temporary Installations		**1**	**3**	**4**	**12**
Equipment		**3**	**1**	**4**	**10**
Towers	**11**	**3**	**1**	**1**	**1**
Underground Conduit			**2**	**3**	**16**
Fiber optic cable	**7**	**1**	**2**		**8**
Electrical Signs	**2**	**7**	**1**	**3**	**6**
Traffic signals	**11**	**4**	**1**	**1**	
Electrical Transmission Lines	**10**	**1**	**4**	**1**	**3**
Electrical substations	**13**	**1**	**2**		**2**
Transformers	**1**	**1**	**2**	**6**	**11**
Electrical inspections	**3**	**1**	**2**	**5**	**8**
Fuel cell systems	**14**	**2**		**2**	
Photovoltaic systems	**4**	**6**	**5**	**2**	**3**
Wind energy systems	**13**	**1**	**2**	**2**	**1**
Battery systems	**3**	**5**	**3**	**3**	**4**

Tables 4 and 5 indicate where the SMEs reside and the locations in which the SMEs have worked as an electrical contractor.

Table 4
State of Residence of the SMEs

State of Current Residence	No. of SMEs
Arizona	1
California	5
Florida	6
Hawaii	1
Louisiana	1
Massachusetts	1
Maryland	1
Mississippi	1

State of Current Residence	No. of SMEs
New Hampshire	1
New York	1
Oregon	1
South Carolina	1
Texas	4
Utah	1
Wisconsin	1

Table 5
States in Which the SMEs Have Practiced as an Electrical Contractor

State	No. of SMEs Who Have Worked There
Alabama	2
Arizona	3
Arkansas	2
California	9
Colorado	2
Connecticut	1
Florida	7
Georgia	2
Hawaii	1
Idaho	3
Louisiana	1
Maine	2
Massachusetts	1
Mississippi	1
Nebraska	1
Nevada	1
New Hampshire	1

State	No. of SMEs Who Have Worked There
New York	3
Oklahoma	1
Oregon	1
Pennsylvania	2
South Carolina	1
Tennessee	1
Texas	4
Utah	2
Vermont	1
Washington	1
West Virginia	1
Wisconsin	1
Wyoming	1
Washington, DC	1
Iraq	1
Kuwait	1

Appendix C

List of Electrical Contractor SME Participants

First Electrical Contractor Meeting

March 25 – 26, 2015, Salt Lake City, Utah
Location: Independent Electrical Contractors (IEC) of Utah

Jose Barragan
Owner, Barragan Construction Services
California City, CA

Jay Cannava
President, P.I. Electric, Inc.
Lake Park, FL

Les Converse
President, Converse Construction, Inc.
Redding, CA

Pete Gregson
President, Advance: Solar, Hydro, Wind Power Co Inc.
Redwood Valley, CA

Robert Jones
Deputy Executive Director, Independent Electrical Contractors, (IEC) of Texas Gulf Coast
Houston, TX

Jack Lyons
Northeast Field Representative, National Electrical Manufacturers Association (NEMA)
West Chesterfield, MA

David Mims
President, Georgia-Florida Alarm Company
Tallahassee, FL

Nathan Philips
Owner, Integrated Electronic Systems
Eugene, OR

Mike Querry
Construction Inspector Supervisor, Trinity River Authority
Arlington, TX

Hamp Smith
VP/Division Manager, JESCO, Inc.
Tupelo, MS

Brad Stevens
Executive Director, Independent Electrical Contractors (IEC) of Utah
Midvale, UT

Michael Tamburro
Owner, Current Solutions Electric
Rohnert Park, CA

Joseph Wages Jr.
Technical Advisor, Education, Codes and Standards, International Association of Electrical Inspectors (IAEI)
Richardson, TX

Wesley Lamar Wheeler
National Director of Safety, National Electrical Contractors Association (NECA)
Bethesda, MD

Second Electrical Contractor Meeting

September 2, 2015, San Diego, California
Location: Omni San Diego Hotel

Daniel Bierly
Senior Education Advisor, Western Electrical Contractors Association (WECA)
Flower Mound, TX

Jay Cannava
President, P.I. Electric, Inc.
Lake Park, FL

Pete Gregson
President, Advanced: Solar, Hydro, Wind Power Co, Inc.
Redwood Valley, CA

Matthew Hadsell
Senior Power Systems Engineer, Blattner Energy, Inc.
Avon, MN

Joseph Hertel
Owner, Joseph A. Hertel Consulting
Madison, WI

Robert Jones
Deputy Executive Director, Independent Electrical Contractors (IEC) of Texas Gulf Coast
Houston, TX

Jack Lyons
Northeast Field Representative, National Electrical Manufacturers Association (NEMA)
West Chesterfield, MA

Jeffrey Sargent
Regional Electrical Code Specialist, National Fire Protection Association (NFPA)
Hampton Falls, NH

Hamp Smith
VP/Division Manager, JESCO, Inc.
Tupelo, MS

Michael Tamburro
Owner, Current Solutions Electric
Rohnert Park, CA

Clarence Tibbs
President, STE Electrical Systems, Inc.
Apopka, FL

Wesley Lamar Wheeler
National Director of Safety, National Electrical Contractors Association (NECA)
Bethesda, MD

Independent Reviewers of the Job Analyses, Tasks and KSA Lists

Brian Bordelon
President
Triad Electric and Controls
Baton Rouge, LA

Scott Cline
McMurtrey Electric Inc.
Monterey Park, CA

Stan Folz
Morse Electric, Inc.
Las Vegas, NV

Karl Jaeger
Examination Specialist
Contractors State License Board
Sacramento, CA

Bobby Gray
Hoydar Buck, Inc.
Yakima, WA

Rudy Middleton
E.G. Middleton, Inc.
Norfolk, VA

Michael Owen
Branch Manger
White Electrical Construction Company
Chattanooga, TN

Doug Pirkle
Pirkle Electric Company
Winston, GA

Mike Weaver
President
M & W Electric, Inc.
Albany, OR

Mark Melancon
Owner
Intelligent Transportation Systems
Baton Rouge, LA

Appendix D

NASCLA Electrical Contractor Job Analysis Survey

Electrical Contractors Job Analysis (Domains & Tasks) Survey

Survey Instructions

The National Association of State Contractors Licensing Agencies (NASCLA) is asking for your help!

NASCLA is currently developing a nationally recognized **Electrical Contractor** (also known as Master Electrician, Unlimited Electrician, or Electrical Administrator) licensing trade examination. This exam would allow an electrical contractor who passes this exam to use the exam grade for all participating states without a further exam, and would save the electrical contractor the time and expense normally needed to take another exam. The contractor would still need to apply for the license in each state he or she goes to, and meet their requirements, but it would make it a more streamlined process.

We need your participation in this survey to help us make sure that the examination will reflect the work actually performed in the field and that it is representative of the work done in every area of the country, including your area. Your contributions will help ensure that new contractors are qualified to be licensed, and that the exam will be fair. When we have compiled the results from all of the surveys, we will send a copy of the results to everyone who participated. Thank you in advance for your assistance.

Definition of an Electrical Contractor: *An electrical contractor is defined as an individual who conducts business in the installation, maintenance and repair of electrical work conforming to applicable standards and codes.*

***Please note** that you can come back later to edit your responses or finish the survey if you choose to do so. Once you begin the survey, you will have to click “Next” and then click “Exit” at the top to leave the survey in order for your results to be saved. *If you do not click "Next",* your responses to that page will not be saved. After you have saved and exited the survey, you can go back in to the original survey to edit your responses or to finish, by copying and pasting the survey URL (that was sent to you in the original email) into your web browser from the same computer that was used to begin the survey. From there, you will be taken to the exact page that you last left.

Please also note that once you click ***“Done”*** at the end of the survey, you will **not** be able to reenter to change your answers.

This survey is to rank the importance and frequency of the Domains and Tasks needed as an entry level Electrical Contractor.

Electrical Contractors Job Analysis (Domains & Tasks) Survey

Survey Description

This survey will ask you to rate tasks common to entry level Electrical Contractors (also known as Master Electricians, Unlimited Electricians, or Electrical Administrators). ***Entry level*** means the level at which an electrical contractor would work when receiving his/her license.

The committee that determined these tasks identified 9 domains (major categories of work) into which all of the main tasks associated with an electrical contractor's profession would fall. These are:

1. Project Design and Management
2. Safety
3. Electrical Theory and Principles
4. General Code Requirements
5. Wiring and Protection
6. Wiring Methods and Materials
7. Equipment for General Use
8. Special Occupancies, Special Equipment and Special Conditions
9. Communication Systems

Each of these major areas have specific tasks associated with them that will be rated in this survey. Another survey will have the specific knowledge and skills viewed as necessary for performing each task.

Electrical Contractors Job Analysis (Domains & Tasks) Survey

Demograhics

The information you provide here is voluntary and confidential and will be used only for the purpose of providing a description of survey participants.

If you have not worked in the Electrical Trade for at least five (5) years, including at least one (1) year at the Master Electrician, Electrical Contractor, Electrical Administrator or Unlimited Electrician Level or equivalent, please do not respond to this survey.

Are you currently or have you ever been licensed as an Electrical Contractor (Master Electrician/Unlimited Electrician/Electrical Administrator)?

- ◯ Yes
- ◯ No

If YES, how many years have you been licensed as such?

Are you currently or have you ever been licensed as a Journeyman Electrician (or equivalent)?

- ◯ Yes
- ◯ No

If YES, how many years have you been licensed as such?

Do you belong to an association for your electrical trade? If yes, please list the association name(s) below:

Electrical Contractors Job Analysis (Domains & Tasks) Survey

In what state do you currently reside in?

- ◯ Alabama
- ◯ Alaska
- ◯ Arizona
- ◯ Arkansas
- ◯ California
- ◯ Colorado
- ◯ Connecticut
- ◯ Delaware
- ◯ District of Columbia
- ◯ Florida
- ◯ Georgia
- ◯ Hawaii
- ◯ Idaho
- ◯ Illinois
- ◯ Indiana
- ◯ Iowa
- ◯ Kansas
- ◯ Kentucky
- ◯ Louisiana
- ◯ Maine
- ◯ Maryland
- ◯ Massachusetts
- ◯ Michigan
- ◯ Minnesota
- ◯ Mississippi
- ◯ Missouri
- ◯ Montana
- ◯ Nebraska
- ◯ Nevada
- ◯ New Hampshire
- ◯ New Jersey
- ◯ New Mexico
- ◯ New York
- ◯ North Carolina
- ◯ North Dakota
- ◯ Ohio
- ◯ Oklahoma
- ◯ Oregon
- ◯ Pennsylvania
- ◯ Rhode Island
- ◯ South Carolina
- ◯ South Dakota
- ◯ Tennessee
- ◯ Texas
- ◯ Utah
- ◯ Vermont
- ◯ Virginia
- ◯ Washington
- ◯ West Virginia
- ◯ Wisconsin
- ◯ Wyoming

In what state(s) are you licensed as an electrical contractor?

- [ ] Alabama
- [ ] Alaska
- [ ] Arizona
- [ ] Arkansas
- [ ] California
- [ ] Colorado
- [ ] Connecticut
- [ ] Delaware
- [ ] District of Columbia
- [ ] Florida
- [ ] Georgia
- [ ] Hawaii
- [ ] Idaho
- [ ] Illinois
- [ ] Indiana
- [ ] Iowa
- [ ] Kansas
- [ ] Kentucky
- [ ] Louisiana
- [ ] Maine
- [ ] Maryland
- [ ] Massachusetts
- [ ] Michigan
- [ ] Minnesota
- [ ] Mississippi
- [ ] Missouri
- [ ] Montana
- [ ] Nebraska
- [ ] Nevada
- [ ] New Hampshire
- [ ] New Jersey
- [ ] New Mexico
- [ ] New York
- [ ] North Carolina
- [ ] North Dakota
- [ ] Ohio
- [ ] Oklahoma
- [ ] Oregon
- [ ] Pennsylvania
- [ ] Rhode Island
- [ ] South Carolina
- [ ] South Dakota
- [ ] Tennessee
- [ ] Texas
- [ ] Utah
- [ ] Vermont
- [ ] Virginia
- [ ] Washington
- [ ] West Virginia
- [ ] Wisconsin
- [ ] Wyoming

As of October 2015, approximately how many years have you worked in the electrical profession for at least 30 hours per week (include any apprenticeship training)?

How many years' experience have you had supervising electricians?

How many people are employed in your organization?

- ◯ Less than 6 people
- ◯ 6 - 25 people
- ◯ 25 - 50 people
- ◯ More than 50 people

How would you describe your role in the majority of contracts in which you were involved?

- ◯ Supervise work, perform some work myself
- ◯ Supervise work, make site visits
- ◯ Supervise work from office only
- ◯ Perform business management function only

Which of the following options best represents the average cost ofeach electrical project that your firm undertakes?

- ◯ Less than $10,000
- ◯ Between $10,000 and $50,000
- ◯ Between $50,000 and $100,000
- ◯ Over $100,000

What is your gender?

- ◯ Male
- ◯ Female

What is your national origin, if other than the U.S.?

What is the race/ethnicity that you most closely identify yourself as?

- ☐ AfricanAmerican (nonHispanic)
- ☐ Asian
- ☐ Native Hawaiian or Pacific Islander
- ☐ Caucasian (non-Hispanic)
- ☐ Hispanic
- ☐ Native American or Alaskan Native
- ☐ Middle Eastern
- ☐ Other

What is your age (check one)?

- ◯ 20 - 25 years
- ◯ 26 - 35 years
- ◯ 36 - 45 years
- ◯ 46 - 55 years
- ◯ 56 - 65 years
- ◯ Over 66 years

You have now completed the SECTION I of this survey.

Electrical Contractors Job Analysis (Domains & Tasks) Survey

Rating Scale for the TASKS Performed as an Electrical Contractor

Rating TASK Frequency and Importance Instructions

Electrical Contractors licensed in 15 states identified the tasks as well as the knowledge and skills that you will be asked to rate. The following section includes different tasks performed by electrical contractors. You will be asked to rate each task in terms of:

(1) the **frequency** with which **you OR the employees you supervise** perform each task

AND

(2) the **importance** of a **newly licensed Electrical Contractor** being able to perform the task **competently**

Rating scale for FREQUENCY of performing the task

In my work and/or the work of my employees:

0 - This task is NOT performed
1 - This task is RARELY performed
2 - This task is SOMETIMES performed
3 - This task is FREQUENTLY performed

Rating scale for IMPORTANCE of performing the task

For a newly licensed Electrical Contractor:

0 - This task is NOT important
1 - This task is MINIMALLY important
2 - This task is MODERATELY important
3 - This task is VERY important

Electrical Contractors Job Analysis (Domains & Tasks) Survey

Domain 1. Project Design and Management

Domain 1. Project Design and Management

	Frequency	Importance
1. Develops, Reads, and Interprets Plans and Specifications		
2. Complies with Requirements of the Authority Having Jurisdiction (AHJ)		
3. Selects and Procures Materials		
4. Estimates Bids, Proposals, and Contracts		
5. Maintains Documentation		
6. Coordinates with Other Trades		
7. Conducts Site Analysis		

Domain 2: Safety

	Frequency	Importance
8. Complies with NFPA 70E		
9. Complies with OSHA Regulations		
10. Provides Safety Training Programs		
11. Uses and Maintains Tools and Trains Employees to do the Same		
12. Complies with Federal Regulations Regarding Asbestos and Lead Based Paint		
13. Handles and Disposes of Hazardous and Toxic Materials		
14. Complies with Manufacturer's Procedures		

Electrical Contractors Job Analysis (Domains & Tasks) Survey

Domain 3: Electrical Theory & Principles

Domain 3: Electrical Theory & Principles

	Frequency	Importance
15. Uses Ohm's Law in Calculations Pertaining to Resistance in Series/Parallel		
16. Calculates Energy Efficiency and Conservation		
17. Uses Kirchhoff's Laws in Calculations		
18. Applies Power Factor		
19. Calculates Short Circuit Current		
20. Calculates the Primary and Secondary Parameters of Various Transformer Connections		

Domain 4: General Code Requirements

Domain 4: General Code Requirements

	Frequency	Importance
21. Determines Working Space Requirements		
22. Selects Enclosure for the Application		
23. Selects Equipment with the Interrupting Rating		
24. Determines the Conductor Insulation Needed for the Application		
25. Executes the Work		
26. Protects Integrity of Electrical Equipment and Connections		
27. Evaluates Equipment for Suitability Based on Listing and Labeling		

Domain 5: Wiring & Protection

	Frequency	Importance
28. Installs Grounding Electrode Conductors, Equipment Grounding Conductors and Bonding Conductors		
29. Installs Overcurrent Protection Device		
30. Installs Branch Circuits		
31. Installs GFCI/AFCI (Ground Fault Circuit Interrupter/Arc Fault Circuit Interrupter) Protection		
32. Installs Receptacles		
33. Installs Service Equipment and Service Conductors		
34. Installs Feeders and Disconnecting Means		
36. Installs Tap Conductors		
37. Installs Grounding Electrodes		
38. Installs Grounding and Bonding of Separately Derived Systems		
39. Installs Surge Arrestors and Surge Protective Devices		

Domain 6: Wiring Methods & Materials

	Frequency	Importance
40. Selects and Installs Cabinets, Boxes, Fittings, Conduit Bodies and other Enclosures		
41. Installs Conductors in Raceways, Cables and other Wire Handling Systems		
42. Installs Electrical Material in Underground Installations		
43. Installs Electrical Equipment and Systems		
44. Selects Conductors		
45. Installs Cables		
46. Installs Raceways		
47. Installs Auxiliary Gutters and Wireways		
48. Installs Busways		
49. Installs Open Wiring Systems		

Electrical Contractors Job Analysis (Domains & Tasks) Survey

Domain 7: Equipment for General Use

Domain 7: Equipment for General Use

	Frequency	Importance
50. Installs Fixture Wires, Flexible Cords or Flexible Cables		
51. Selects and Installs Switches		
52. Selects and Installs Receptacles, Cord Connectors and Attachment Plugs		
53. Selects, Sizes and Installs Switchboards, Switchgear, and Panelboards		
54. Selects, Sizes and Installs Industrial Control Panels		
55. Selects, Locates, Mounts and Wires Luminaries, Lampholders, and Lamps		
56. Selects, Locates, Mounts and Wires Low Voltage Lighting Systems		
57. Installs, Constructs, Uses and Protects Appliances		
58. Installs, Constructs, Uses and Protects Fixed Electric Space Heating Equipment		
59. Installs, Constructs, Uses and Protects Electric Deicing and Snow Melting Equipment		
60. Installs, Constructs, Uses and Protects Fixed Electric Pipeline and Vessel Heating Equipment		
61. Selects, Sizes, Installs and Protects Feeders, Branch Circuits, Control Circuits, Disconnecting Means, and Controllers for Motors		
62. Selects, Sizes, Installs and Protects Feeders, Branch Circuits, Control Circuits, Disconnecting Means, and Controllers for Refrigeration and Air-Conditioning Equipment		
63. Installs Generators		
64. Installs Transformers		
65. Installs Phase Converters		
66. Installs Capacitors		
67. Installs Resistors and Reactors		
68. Installs Electrical and Electronic Industrial Instrumentation		
69. Selects and Installs Storage Batteries		
70. Selects and Installs Equipment Over 1,000 Volts		

Domain 8: Special Occupancies, Special Equipment and Special Conditions

	Frequency	Importance
71. Installs Electrical and Electronic Equipment and Wiring for Hazardous (Classified) Locations		
72. Installs Electrical Equipment and Wiring in Special Occupancies other than Hazardous (Classified) Locations		
73. Installs Electrical Equipment and Wiring For Emergency Systems, Legally Required or Optional Standby Systems, and Critical Operation Power Systems		
74. Installs Interconnected Electric Power Production Systems		
75. Installs Circuits Operating Less Than 50 Volts, and Class 1, Class 2 and Class 3 Remote Control Signaling and Power Limited Circuits		
76. Installs Energy Management Systems		
77. Installs Optical Fiber Cables and Raceways		
78. Installs Instrumentation Tray Cables (ITC)		
79. Installs Fire Resistive Cable Systems		
80. Installs Security Systems		
81. Installs Fire Alarm Systems		
82. Installs Electric Signs and Outline Lighting		
83. Mounts and Installs Electric Cranes and Hoists		
84. Installs Electric Vehicle Charging Stations		
85. Installs Welders		

	Frequency	Importance
86. Installs Electrical Wiring, Equipment and Bonding for Swimming Pools, Fountains, and Similar Installations		
87. Installs PV (Photovoltaic) Systems		
88. Installs Wind Electric Systems		
89. Installs Fuel Cell Systems		
90. Commissions Alternative Energy Systems		
91. Installs Informational Technology Equipment and Modular Data Centers		
92. Installs Fire Pumps		

Electrical Contractors Job Analysis (Domains & Tasks) Survey

Domain 9: Communication Systems

Domain 9: Communication Systems

	Frequency	Importance
93. Installs Communication Cable for Specific Locations		
94. Installs Grounding for Specific Communication Systems		
95. Installs Communication Cable Inside a Building		
96. Installs Communication Cable Outside a Building		
97. Installs SPDs (Surge Protection Devices)		
98. Installs Communication Cables		
99. Removes or Tags Abandoned Cables		
100. Maintains Required Separation Between Communication Cables and Other Electrical Sources		
101. Determines Antenna Mounting Requirements		

Are there any additional Tasks statements that you believe were forgotten? If so, please list your ideas below:

You have now completed the SECTION II of this survey.

Electrical Contractors Job Analysis (Domains & Tasks) Survey

Determining the Number of Items that Should be Tested in Each Domain

The next 9 lines reflect the domains (main content areas) that will be covered in the nationally recognized Electrical Contractor examination. Please provide your input as to the approximate number of questions that should be tested in each of these areas. Assume the exam consists of 100 questions. Therefore, the total of your estimate for these 9 domains must equal 100. If your answers do not equal 100 an error message will pop up asking you to adjust.

***Please note, the number of actual examination questions has not yet been determined, the 100 example is simply for an even number to calculate.**

Project Design and Management	
Safety	
Electrical Theory and Principles	
General Code Requirements	
Wiring and Protection	
Wiring Methods and Materials	
Equipment for General Use	
Special Occupancies, Special Equipment and Special Conditions	
Communication Systems	

You have now completed SECTION III of this survey. Thank you so much for your input!

Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Survey Instructions

The National Association of State Contractors Licensing Agencies (NASCLA) is asking for your help!

NASCLA is currently developing a nationally recognized **Electrical Contractor** (also known as Master Electrician, Unlimited Electrician, or Electrical Administrator) licensing trade examination. This exam would allow an electrical contractor who passes this exam to use the exam grade for all participating states without a further exam, and would save the electrical contractor the time and expense normally needed to take another exam. The contractor would still need to apply for the license in each state he or she goes to, and meet their requirements, but it would make it a more streamlined process.

We need your participation in this survey to help us make sure that the examination will reflect the work actually performed in the field and that it is representative of the work done in every area of the country, including your area. Your contributions will help ensure that new contractors are qualified to be licensed, and that the exam will be fair. When we have compiled the results from all of the surveys, we will send a copy of the results to everyone who participated. Thank you in advance for your assistance.

Definition of an Electrical Contractor: *An electrical contractor is defined as an individual who conducts business in the installation, maintenance and repair of electrical work conforming to applicable standards and codes.*

***Please note** that you can come back later to edit your responses or finish the survey if you choose to do so. Once you begin the survey, you will have to click “Next” and then click “Exit” at the top to leave the survey in order for your results to be saved. *If you do not click "Next",* your responses to that page will not be saved. After you have saved and exited the survey, you can go back in to the original survey to edit your responses or to finish, by copying and pasting the survey URL (that was sent to you in the original email) into your web browser from the same computer that was used to begin the survey. From there, you will be taken to the exact page that you last left.

Please also note that once you click ***“Done”*** at the end of the survey, you will **not** be able to reenter to change your answers.

This survey is to rank the importance of the Knowledge and Skills related to the Tasks needed as an entry level Electrical Contractor.

Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Survey Description

This survey will ask you to rate knowledges and skills common to entry level Electrical Contractors (also known as Master Electricians, Unlimited Electricians, or Electrical Administrators). ***Entry level*** means the level at which an electrical contractor would work when receiving his/her license.

The committee that determined these knowledges and skills identified 9 domains (major categories of work) into which all of the main tasks associated with an electrical contractor's profession would fall. These are:

1. Project Design and Management
2. Safety
3. Electrical Theory and Principles
4. General Code Requirements
5. Wiring and Protection
6. Wiring Methods and Materials
7. Equipment for General Use
8. Special Occupancies, Special Equipment and Special Conditions
9. Communication Systems

Each of these major areas have specific tasks associated with them and the tasks then have specific knowledge and skills viewed as necessary for performing the tasks.

Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Demographics

The information you provide here is voluntary and confidential and will be used only for the purpose of providing a description of survey participants.

If you have not worked in the Electrical Trade for at least five (5) years, including at least one (1) year at the Master Electrician, Electrical Contractor, Electrical Administrator or Unlimited Electrician level or equivalent, please do not respond to this survey.

Are you currently or have you ever been licensed as an Electrical Contractor (Master Electrician/Unlimited Electrician/Electrical Administrator)?

- ◯ Yes
- ◯ No

If YES, how many years have you been licensed as such?

Are you currently or have you ever been licensed as a Journeyman Electrician (or equivalent)?

- ◯ Yes
- ◯ No

If YES, how many years have you been licensed as such?

Do you belong to an association for your electrical trade? If yes, please list the association name(s) below:

Electrical Contractors Job Analysis (Knowledge & Skills) Survey

In what state do you currently reside in?

- Alabama
- Alaska
- Arizona
- Arkansas
- California
- Colorado
- Connecticut
- Delaware
- District of Columbia
- Florida
- Georgia
- Hawaii
- Idaho
- Illinois
- Indiana
- Iowa
- Kansas
- Kentucky
- Louisiana
- Maine
- Maryland
- Massachusetts
- Michigan
- Minnesota
- Mississippi
- Missouri
- Montana
- Nebraska
- Nevada
- New Hampshire
- New Jersey
- New Mexico
- New York
- North Carolina
- North Dakota
- Ohio
- Oklahoma
- Oregon
- Pennsylvania
- Rhode Island
- South Carolina
- South Dakota
- Tennessee
- Texas
- Utah
- Vermont
- Virginia
- Washington
- West Virginia
- Wisconsin
- Wyoming

In what state(s) are you licensed as an electrical contractor?

- [ ] Alabama
- [ ] Alaska
- [ ] Arizona
- [ ] Arkansas
- [ ] California
- [ ] Colorado
- [ ] Connecticut
- [ ] Delaware
- [ ] District of Columbia
- [ ] Florida
- [ ] Georgia
- [ ] Hawaii
- [ ] Idaho
- [ ] Illinois
- [ ] Indiana
- [ ] Iowa
- [ ] Kansas
- [ ] Kentucky
- [ ] Louisiana
- [ ] Maine
- [ ] Maryland
- [ ] Massachusetts
- [ ] Michigan
- [ ] Minnesota
- [ ] Mississippi
- [ ] Missouri
- [ ] Montana
- [ ] Nebraska
- [ ] Nevada
- [ ] New Hampshire
- [ ] New Jersey
- [ ] New Mexico
- [ ] New York
- [ ] North Carolina
- [ ] North Dakota
- [ ] Ohio
- [ ] Oklahoma
- [ ] Oregon
- [ ] Pennsylvania
- [ ] Rhode Island
- [ ] South Carolina
- [ ] South Dakota
- [ ] Tennessee
- [ ] Texas
- [ ] Utah
- [ ] Vermont
- [ ] Virginia
- [ ] Washington
- [ ] West Virginia
- [ ] Wisconsin
- [ ] Wyoming

As of October 2015, approximately how many years have you worked in the electrical profession for at least 30 hours per week (include any apprenticeship training)?

How many years' experience have you had supervising electricians?

How many people are employed in your organization?

- ◯ Less than 6 people
- ◯ 6 - 25 people
- ◯ 25 - 50 people
- ◯ More than 50 people

How would you describe your role in the majority of contracts in which you were involved?

- ◯ Supervise work, perform some work myself
- ◯ Supervise work, make site visits
- ◯ Supervise work from office only
- ◯ Perform business management function only

Which of the following options best represents the average cost ofeach electrical project that your firm undertakes?

- ◯ Less than $10,000
- ◯ Between $10,000 and $50,000
- ◯ Between $50,000 and $100,000
- ◯ Over $100,000

What is your gender?

- ◯ Male
- ◯ Female

What is your national origin, if other than the U.S.?

What is the race/ethnicity that you most closely identify yourself as?

- ☐ AfricanAmerican (nonHispanic)
- ☐ Asian
- ☐ Native Hawaiian or Pacific Islander
- ☐ Caucasian (non-Hispanic)
- ☐ Hispanic
- ☐ Native American or Alaskan Native
- ☐ Middle Eastern
- ☐ Other

What is your age (check one)?

- ◯ 20 - 25 years
- ◯ 26 - 35 years
- ◯ 36 - 45 years
- ◯ 46 - 55 years
- ◯ 56 - 65 years
- ◯ Over 66 years

You have now completed the SECTION I of this survey.

Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Rating Scale for the KNOWLEDGE and SKILLS Required of an Electrical Contractor

Rating KNOWLEDGE and SKILLS Importance Instructions

Electrical Contractors licensed in 15 states identified the tasks as well as the knowledge and skills that you will be asked to rate.

In order for a newly licensed Electrical Contractor to perform the task **competently**, how important is the following knowledge or skill?:

Rating scale for IMPORTANCE of performing the task

0 - NOT important
1 - Of MINOR importance
2 - MODERATELY important
3 - VERY important

Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Domain 1: Project Design and Management

Task: Develops, Reads, and Interprets Plans and Specifications

	Importance Rating
1. Knowledge of electrical symbols	
2. Skill in interpreting blueprints and plans	
3. Skill in interpreting specifications	
4. Skill in identifying conflicts in specifications, blueprints, plans, etc.	
5. Skill in applying blueprints/plans to contracts	

Task: Complies with Requirements of the Authority Having Jurisdiction (AHS)

	Importance Rating
6. Knowledge of Authority Having Jurisdiction (AHJ)	
7. Knowledge of the documents to submit for a permit	
8. Knowledge of basics of bonding, liability insurance and other common requirements for state and local permits	
9. Knowledge of code enforcement (requirements, penalties, fines)	
10. Skill in preparing one-line diagrams for plan review	

Task: Selects and Procures Materials

	Importance Rating
11. Knowledge of how to order and schedule delivery of materials	
12. Knowledge of project scheduling and coordination of material lead times	
13. Knowledge of product substitutions and submittals	
14. Skill in maintaining material compliance with specifications (Quality Assurance)	
15. Skill in applying product standards to equivalent materials	
16. Skill in delivery, handling and storage methods	

Task: Estimates Bids, Proposals, and Contracts

	Importance Rating
17. Knowledge of basic accounting concepts (cash flow, invoicing, collection, etc.)	
18. Knowledge of business law and regulations on contracts	
19. Skill in estimating time and materials	
20. Skill in reading and understanding bids and proposals	

Task: Maintains Documentation

	Importance Rating
21. Knowledge of forms or documentation to track job (change orders, time cards, materials, material receipts, job logs, preconstruction meetings, as built drawings, RFIs [requests for information], billing, punch lists, closeouts)	
22. Knowledge of terminology used in documentation to track job	
23. Knowledge of legally-required employee notices (posters, letters, etc.)	
24. Knowledge of document retention requirements	
25. Knowledge of performance and warranties requirements	
26. Skill in recordkeeping	
27. Skill in maintaining document control (current revision, redlines)	
28. Skill in documenting impacts of scheduling delays	

Task: Coordinates with Other Trades

	Importance Rating
29. Knowledge of sequencing activities	
30. Knowledge of overall construction scheduling	
31. Knowledge of scope of work with respect to the electrical work required versus the entire project	
32. Knowledge of inspection scheduling	
33. Skill in scheduling using the critical path method	
34. Skill in labor management	

Task: Conducts Site Analysis

	Importance Rating
35. Knowledge of preconstruction documentation	
36. Knowledge of requirements for utility locations	
37. Knowledge of potential unforeseen job conditions to look for	
38. Knowledge of contractor lay down areas and temporary facilities availability, location and requirements	
39. Knowledge of inspection requirements	
40. Knowledge of any special requirements for the job (PPE [personal protective equipment], entry requirements, screening, etc)	
41. Skill of setting up job trailer on-site	

Task: Complies with NFPA 70E

	Importance Rating
42. Knowledge of PPE (Personal Protective Equipment)	
43. Knowledge of electrical lockout/tagout	
44. Knowledge of incident energy	
45. Knowledge of risk analysis (shock and arc flash)	
46. Knowledge of maintenance requirements related to electrical equipment	
47. Knowledge of preconstruction and construction documentation concerning arc flash hazards	
48. Knowledge of shock hazard, flash hazard, blast hazard	
49. Knowledge of limit-of-approach boundaries	
50. Knowledge of labeling	
51. Knowledge of other construction hazards that might affect the electrician	
52. Skill in administering NFPA 70E training	

Task: Complies with OSHA Regulations

	Importance Rating
53. Knowledge of OSHA requirements regarding ladders and scaffolds	
54. Knowledge of OSHA requirements regarding trenches and excavations	
55. Knowledge of OSHA requirements regarding confined spaces	
56. Knowledge of OSHA requirements regarding control of hazardous energy	
57. Knowledge of OSHA requirements regarding general electrical requirements	
58. Knowledge of OSHA requirements regarding classification and labeling of chemicals	
59. Knowledge of OSHA requirements regarding barriers, signs, etc. at work site	
60. Knowledge of OSHA record keeping requirements	

Task: Provides Safety Training Programs

	Importance Rating
61. Knowledge of Injury Illness Prevention Program Requirements	
62. Knowledge of assured grounding program or use of GFCI (ground fault circuit interrupter) protection	
63. Knowledge of electrical safety programs	
64. Knowledge of first aid, CPR, basic life support, etc.	
65. Knowledge of environmental hazard considerations (sun exposure, heat, cold, lightning, insects, snakes, etc.)	
66. Knowledge of safety requirements for installing and maintaining electrical systems	
67. Knowledge of fall protection standards	
68. Knowledge of incident management and reporting procedures	
69. Skill in developing safety program curriculum	
70. Skill in conducting job safety analysis	

Task: Uses and Maintains Tools and Trains Employees to do the Same

	Importance Rating
71. Knowledge of use of tools (conduit benders, wire pullers, test equipment, etc.)	
72. Knowledge of how to maintain tools	
73. Knowledge of selection of correct tool/ piece of equipment to perform task	
74. Knowledge of training sequences to prepare employees to use and maintain tools	
75. Skill in creating tool inventory, training, and maintenance program	

Task: Complies with Federal Regulations regarding Asbestos & Lead Based Paint

	Importance Rating
76. Knowledge of working around potential areas of asbestos and lead contamination	
77. Knowledge of disposal	
78. Knowledge of LBP (lead based paint) containment	
79. Skill in disposal of contaminated materials	

Task: Handles and Disposes of Hazardous and Toxic Materials

	Importance Rating
80. Knowledge of disposal method of batteries, transformers, fluorescent lamps, HID (high intensity discharge) lamps	
81. Knowledge of disposal of electrical equipment	
82. Knowledge of cleanup protocol or spill response	

Task: Complies with Manufacturer's Procedures

	Importance Rating
83. Knowledge of using the equipment per manufacturer's instructions included in the listing	
84. Skill in interpreting labels	

Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Domain 3: Electrical Theory and Principles

Task: Uses Ohm's Law in Calculations pertaining to Resistance in Series/Parallel

	Importance Rating
85. Knowledge of units of measurement	
86. Knowledge of Ohm's Law	
87. Knowledge of the basic Ohm's law formulas	
88. Skill in calculating conversions	
89. Skill in calculating resistance	
90. Skill in calculating current	
91. Skill in calculating volts	
92. Skill in calculating power	
93. Skill in calculating voltage drop	

Task: Calculates Energy Efficiency and Conservation

	Importance Rating
94. Knowledge of energy codes	
95. Knowledge of lighting retrofits and lighting controls	
96. Knowledge of energy storage	
97. Skill in providing energy conservation techniques with energy saving products	

Task: Uses Kirchhoff's Laws in Calculations

	Importance Rating
98. Knowledge of Kirchhoff's Laws	
99. Skill in applying Kirchhoff Law calculations to troubleshooting	

Task: Applies Power Factor

	Importance Rating
100. Knowledge of the ratio of true power to apparent power	

Task: Calculates Short Circuit Current

	Importance Rating
101. Knowledge of nameplate information	
102. Skill in applying series rated systems values for distribution equipment	

Task: Calculates the Primary and Secondary Parameters of Various Transformer Connections

	Importance Rating
103. Knowledge of wye and delta voltage and current configurations	
104. Knowledge of sizing and application of autotransformers	
105. Knowledge of sizing and application of isolation transformers	
106. Knowledge of sizing and application of step up and step down transformers	
107. Skill in calculating wye and delta voltage, current and ratios	
108. Skill in applying sizing for step up/step down transformer to electrical loads	

Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Domain 4: General Code Requirements

Task: Determines Working Space Requirements

	Importance Rating
109. Knowledge of voltage and amperage of equipment being used	
110. Knowledge of working space requirements	
111. Knowledge of the configuration of the equipment	
112. Knowledge of equipment accessibility requirements other than ADA (Americans with Disabilities Act)	
113. Skill in applying working clearances around equipment	
114. Skill in applying space requirements to electrical rooms and egresses	

Task: Selects Enclosure for the Application

	Importance Rating
115. Knowledge of the location of the application	
116. Knowledge of the environmental conditions	
117. Knowledge of the NEMA (National Electrical Manufacturers Association) ratings	
118. Skill in applying NEMA enclosure rating to environment	
119. Skill in applying NEC (National Electrical Code) rules to application of enclosures	

Task: Selects Equipment with the Interrupting Rating

	Importance Rating
120. Knowledge of interrupting rating of equipment	
121. Knowledge of interrupting rating of overcurrent protection devices	
122. Skill in applying available fault current to interrupting rating	

Task: Determines the Conductor Insulation Needed for the Application

	Importance Rating
123. Knowledge of environmental conditions (wet, damp, dry) surrounding use of the electrical application and their effect on the choice of insulation	
124. Knowledge of temperature limitation	
125. Knowledge of the types of insulation	
126. Knowledge of characteristics of cable construction	
127. Skill in applying NEC insulation tables to wire and cable applications	

Task: Executes the Work

	Importance Rating
128. Knowledge of Standard for Good Workmanship in Electrical Construction (NECA 1-2010)	
129. Skill in closing unused openings	
130. Skill in neat-and-workmanlike installation of materials	

Task: Protects Integrity of Electrical Equipment and Connections

	Importance Rating
131. Knowledge of contamination prevention for electrical equipment	
132. Knowledge of bonding and termination techniques	
133. Knowledge of torque values	
134. Knowledge of effects of damage related to improper installation of dissimilar metals	
135. Knowledge of materials and methods for making electrical connections	
136. Skill in applying torque values on terminations	

Task: Evaluates Equipment for Suitability based on Listing and Labeling

	Importance Rating
137. Knowledge of equipment selection relative to the product listing	
138. Knowledge of the impact of the product listing with field modifications to equipment	
139. Knowledge of the nationally recognized testing laboratory's (NRTL's) Product Safety Standards	
140. Knowledge of counterfeit parts	

Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Domain 5: Wiring & Protection

Task: Installs Grounding Electrode Conductors, Equipment Grounding Conductors and Bonding Conductors

	Importance Rating
141. Knowledge of various types of equipment grounding conductors	
142. Knowledge of various types of grounding electrode conductors	
143. Knowledge of where bonding conductors are required	
144. Knowledge of when equipment is required to be connected to an equipment grounding conductor	
145. Knowledge of ground loops	
146. Skill in applying installation rules for grounding electrode conductors, equipment grounding conductors and bonding conductors.	
147. Skill in applying the sizing of grounding electrode conductors, equipment grounding conductors and bonding conductors	
148. Skill in applying Article 250 to bonding and grounding installations	

Task: Installs Overcurrent Protection Device

	Importance Rating
149. Knowledge of overcurrent protection device, rating and locations	
150. Knowledge of system coordination and series rated systems	
151. Knowledge of response time of overcurrent protection device	
152. Skill in applying AIC (amperes interrupting current) ratings to overcurrent protection device	
153. Skill in determining size of overcurrent protective device	

Task: Installs Branch Circuits

	Importance Rating
154. Knowledge of the ampacity and number of branch circuits	
155. Skill in applying voltage limitations of branch circuits	
156. Skill in determining size of branch circuit conductors	

Task: Installs GFCI/AFCI (Ground Fault Circuit Interrupter/Arc Fault Circuit Interrupter) Protection

	Importance Rating
157. Knowledge of GFCI	
158. Knowledge of AFCI	
159. Knowledge of location requirements for GFCI and AFCI	
160. Skill in diagnosing and installing GFCI/AFCI circuitry	

Task: Installs Receptacles

	Importance Rating
161. Knowledge of the number, placement and types of receptacles	
162. Knowledge of the use of the space in which the receptacles are being placed	
163. Knowledge of environments in which receptacles are being used	
164. Knowledge of individual branch circuit limitations	
165. Skill in applying NEC Article 210 for receptacle placement	

Task: Installs Service Equipment & Service Conductors

	Importance Rating
166. Knowledge of the rating and installation requirements for service equipment and service conductors for a specific application	
167. Knowledge of service clearances	
168. Skill in determining the size of a service (includes size of conductors, raceway, and overload protection)	
169. Skill in installation of service equipment	

Task: Installs Feeders and Disconnecting Means

	Importance Rating
170. Knowledge of the rating and installation requirements of feeders and disconnecting means required for a specific application	
171. Knowledge of the tap rules regarding feeder taps	
172. Skill in determining the size of a feeder (includes size of conductors, raceway, and overcurrent protection)	

Task: Installs Tap Conductors

	Importance Rating
173. Knowledge of the tap rules regarding tap conductors	
174. Knowledge of overcurrent protection for transformers using the tap rules	
175. Skill in determining size of tap conductor	
176. Skill in determining size of overload protection for transformer secondary conductors	

Task: Installs Grounding Electrodes

	Importance Rating
177. Knowledge of type of and installation requirements for grounding electrode	
178. Knowledge of interconnection of grounding electrodes to form a grounding electrode system	
179. Knowledge of connection to the electrode	
180. Skill in installing and connecting grounding electrode systems	

Task: Installs Grounding and Bonding of Separately Derived Systems

	Importance Rating
181. Knowledge of the method for grounding and bonding separately derived systems	
182. Skill in calculating the size of grounding and bonding conductors for separately derived systems	

Task: Installs Surge Arresters and Surge Protective Devices:

	Importance Rating
183. Knowledge of the selection requirements for surge arresters and surge protective devices	
184. Knowledge of the installation requirements for surge arresters and surge protective devices	
185. Skill in applying the correct type of surge protective devices	

Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Domain 6: Wiring Methods & Materials

Task: Selects and Installs Cabinets, Boxes, Fittings, Conduit Bodies and other Enclosures

	Importance Rating
186. Knowledge of the selection requirements for the number of wires for a box size	
187. Knowledge of location requirements for boxes, fittings and conduit bodies	
188. Knowledge of selection, sizing and installation requirements for cabinets, boxes, conduit bodies, fittings and other enclosures	
189. Knowledge of fireproofing requirements and methods at penetrations	
190. Skill in determining conductor box fill	

Task: Installs Conductors in Raceways, Cables and other Wire Handling Systems

	Importance Rating
191. Knowledge of grouping and arrangement of conductors in raceways, cables and other wire handling systems	
192. Knowledge of appropriate methods for protection of conductors, cables and raceways from physical damage	
193. Skill in calculating the minimum size conduit with respect to the size and number of conductors	
194. Skill in the various techniques of wire pulling and tooling	

Task: Installs Electrical Material in Underground Installations

	Importance Rating
195. Knowledge of manholes and other electrical enclosures intended for personnel entry	
196. Knowledge of burial depth, ampacities, spacings, and conductor requirements for underground installations	
197. Knowledge of the use of equipment (backhoes, trenches, etc.) to install underground electrical conduit	
198. Skill in the techniques of installing underground wiring	

Task: Installs Electrical Equipment and Systems

	Importance Rating
199. Knowledge of effects of corrosion, deterioration, and of temperature on electrical equipment	
200. Skill in selecting methods for protecting electrical equipment from corrosion, deterioration and effects of temperature	

Task: Selects Conductors

	Importance Rating
201. Skill in calculating conductor ampacities based on condition of use	
202. Skill in identifying conductor ampacity, size, material and insulation type	

Task: Installs Cables

	Importance Rating
203. Knowledge of requirements for use and installation for specific type of cable	
204. Skill in installing support for cables used for the appropriate application	

Task: Installs Raceways

	Importance Rating
205. Knowledge of the requirements for use and installation for specific type of raceway	
206. Knowledge of the calculations and tools necessary to make bends in raceways	
207. Skill in determining size and installation requirements for raceway systems	

Task: Installs Auxiliary Gutters and Wireways

	Importance Rating
208. Knowledge of the requirements for use and installation for specific types of auxiliary gutters and wireways	
209. Skill in determining auxiliary gutter size and wireways	

Task: Installs Busways

	Importance Rating
210. Knowledge of the requirements for use and installation for specific types of busways	

Task: Installs Open Wiring Systems

	Importance Rating
211. Knowledge of the requirements for use and installation for specific types of open wiring systems	

Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Domain 7: Equipment for General Use

Task: Installs Fixture Wires, Flexible Cords or Flexible Cables

	Importance Rating
212. Knowledge of source circuits, control circuits, sensing circuits and power circuits for solar, hydro, and wind electrical systems	
213. Knowledge of seismic and vibration restraints and isolation for electrical equipment	
214. Skill in selecting and installing the type, size and use of a particular type of fixture wire, flexible cord or flexible cable	

Task: Selects and Installs Switches

	Importance Rating
215. Knowledge of Electrical Code rules governing switches	
216. Knowledge of ADA (Americans with Disabilities Act) requirements for location of switches	
217. Skill in selecting and installing switches based on requirements	

Task: Selects and Installs Receptacles, Cord Connectors and Attachment Plugs

	Importance Rating
218. Knowledge of Electrical Code Rules for receptacle installation	
219. Knowledge of Electrical Code Rules for receptacle replacement	
220. Knowledge of ADA requirements for location of receptacles	
221. Skill in selecting and installing receptacles, cord connectors and attachment plugs based on requirements	

Task: Selects, Sizes and Installs Switchboards, Switchgear, and Panelboards

	Importance Rating
222. Knowledge of selection, size and installation requirements for switchboards, switchgear, and panelboards	
223. Knowledge of product standards for switchboards, panelboards, and switchgear	
224. Skill in installing switchboards, panelboards, and switchgear as per appropriate installation standard	

Task: Selects, Sizes and Installs Industrial Control Panels

	Importance Rating
225. Knowledge of industrial control panel product standards	
226. Skill in selection, size and installation requirements for industrial control panels	

Task: Selects, Locates, Mounts and Wires Luminaries, Lampholders, and Lamps

	Importance Rating
227. Knowledge of installation requirements for luminaries	
228. Skill in determining the selection, location, mounting and wiring of luminaries, lampholders, and lamps	

Task: Selects, Locates, Mounts and Wires Low Voltage Lighting Systems

	Importance Rating
229. Knowledge of installation requirements for low voltage luminaries	
230. Skill in determining the selection, location, mounting and wiring of low voltage lighting systems	

Task: Installs, Constructs, Uses and Protects Appliances

	Importance Rating
231. Knowledge of the use, installation requirements, disconnecting means, protection and construction of appliances	
232. Skill in applying installation requirements to install appliances	

Task: Installs, Constructs, Uses and Protects Fixed Electric Space Heating Equipment

	Importance Rating
233. Knowledge of the use, installation requirements, disconnecting means, protection and construction of fixed electric space heating equipment	
234. Skill in installing fixed electric space heating equipment	

Task: Installs, Constructs, Uses and Protects Electric Deicing and Snow Melting Equipment

	Importance Rating
235. Knowledge of the use, installation requirements, disconnecting means, protection and construction of electric deicing and snow melting equipment	
236.Skill in applying the GFPE (Ground-Fault Protection Equipment) for electric deicing and snow melting equipment	
237. Skill in applying installation requirements to the installation of electric deicing and snow melting equipment	

Task: Installs, Constructs, Uses and Protects Fixed Electric Pipeline and Vessel Heating Equipment

	Importance Rating
238. Knowledge of the use, installation requirements, disconnecting means, protection and construction of fixed electric pipeline and vessel heating equipment	
239. Skill in applying installation requirements to the installation of fixed electric pipeline and vessel heating equipment	

Task: Selects, Sizes, Installs and Protects Feeders, Branch Circuits, Control Circuits, Disconnecting Means, and Controllers for Motors

	Importance Rating
240. Knowledge of the installation requirements of motors and their uses	
241. Knowledge of the various types of motors and their uses	
242. Skill in determining the size of conductors	
243. Skill in determining the size of overcurrent protective devices	
244. Skill in determining the size of disconnecting means	
245. Skill in determining the size of controllers	
246. Skill in determining the locked rotor current	
247. Skill in determining the installation requirements for motors	

Task: Selects, Sizes, Installs and Protects Feeders, Branch Circuits, Control Circuits, Disconnecting Means, and Controllers for Refrigeration and Air-Conditioning Equipment

	Importance Rating
248. Knowledge of the installation requirements of HVACR (Heating, Ventilation, Air Conditioning and Refrigeration) equipment and their uses	
249. Knowledge of the various types of HVACR equipment and their uses	
250. Skill in determining the size of conductors	
251. Skill in determining the size of overcurrent protective devices	
252. Skill in determining the size of disconnecting means	
253. Skill in determining the size of controllers	
254. Skill in determining the locked rotor current	
255. Skill in determining the size of conductors and overcurrent devices used for control circuits	
256. Skill in determining the installation requirements for refrigeration and air-conditioning equipment	

Task: Installs Generators

	Importance Rating
257. Knowledge of installation requirements and protection for generators	
258. Knowledge of automatic or manual transfer switch installations	
259. Knowledge of separately derived and non-separately derived systems	
260. Skill in installing life safety emergency power sources	
261. Skill In installing legally required standby systems	
262. Skill in installing optional standby systems	

Task: Installs Transformers

	Importance Rating
263. Knowledge of selection, rating, protection and installation requirements for transformers	
264. Skill in installing the size and type of transformer	
265. Skill in providing ventilation for transformer installation	

Task: Installs Phase Converters

	Importance Rating
266. Knowledge of rating, grounding, protection and installation requirements for phase converters	

Task: Installs Capacitors

	Importance Rating
267. Knowledge of rating, grounding, protection and installation requirements for capacitors	

Task: Installs Resistors and Reactors

	Importance Rating
268. Knowledge of rating, grounding, protection and installation requirements for resistors and reactors	

Task: Installs Electrical and Electronic Industrial Instrumentation

	Importance Rating
269. Knowledge of grounding, protection and installation requirements for industrial instrumentation	
270. Knowledge of selection and use of basic electrical and electronic testing equipment	
271. Skill in interpreting basic electrical and electronic schematics and diagrams	

Task: Selects and Installs Storage Batteries

	Importance Rating
272. Knowledge of selection, rating, grounding, protection and installation requirements for storage batteries	
273. Knowledge of rectifier and battery chargers circuits and systems	
274. Knowledge of DOD (Depth of Discharge), cycle rates, series, parallel circuits for energy storage systems	
275. Knowledge of charge rate vs. voltage for bulk, absorption and equalization of energy storage systems	
276. Knowledge of hydrometer readings and load tests to determine SOC (State of Charge)	

Task: Selects and Installs Equipment Over 1,000 Volts

	Importance Rating
277. Knowledge of selection, rating, grounding, protection and installation requirements for equipment over 1,000 volts	

Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Domain 8: Special Occupancies, Special Equipment & Special Conditions

Task: Installs Electrical and Electronic Equipment and Wiring For Hazardous (Classified) Locations

	Importance Rating
278. Knowledge of the installation requirements for hazardous (classified) locations	
279. Knowledge of the installation requirements for the divisions and zones within the Class I, Class II, and Class III locations of hazardous (classified) locations	
280. Skill in identifying hazardous (classified) locations within special occupancies	

Task: Installs Electrical Equipment and Wiring In Special Occupancies Other Than Hazardous (Classified) Locations

	Importance Rating
281. Knowledge of installation requirements for special occupancies	
282. Knowledge of ampacity requirements for special occupancies	
283. Knowledge of electrical requirements involving mobile homes, manufactured homes, and mobile home parks	
284. Knowledge of electrical requirements involving marinas and boatyards	
285. Knowledge of electrical requirements involving temporary installations	
286. Skill in determining the size of service for mobile home parks or RV parks	

Task: Installs Electrical Equipment and Wiring For Emergency Systems, Legally Required or Optional Standby Systems, and Critical Operation Power Systems

	Importance Rating
287. Knowledge of the use and installation requirements for emergency systems, legally required or optional standby systems, and critical operation power systems	
288. Knowledge of identification of emergency systems, standby systems, and critical operation power systems, and devices	

Task: Installs Interconnected Electric Power Production Systems

	Importance Rating
289. Knowledge of the use and installation requirements for interconnected electric power production systems	
290. Knowledge of in-phase and out-of-phase energy systems	
291. Knowledge of energy support and energy shaving systems	
292. Knowledge of maximum volt and cycle deviation for different energy systems	
293. Skill in installing interconnected electrical power production systems to utility specifications	
294. Skill in applying installation standards for protection and operation of systems	

Task: Installs Circuits Operating Less Than 50 Volts, and Class 1, Class 2 and Class 3 Remote Control Signaling and Power Limited Circuits

	Importance Rating
295. Knowledge of the use and installation requirements for circuits operating less than 50 volts, and Class 1, Class 2 and Class 3 remote control signaling and power limited circuits	
296. Knowledge of conductor and current limiting devices for 12 vdc systems	
297. Skill in installing selected cable types as per system selected	
298. Skill in applying installation standard to selected systems	

Task: Installs Energy Management Systems

	Importance Rating
299. Knowledge of the use and installation requirements for Energy Management Systems	
300. Knowledge of load shedding	
301. Knowledge of energy “support” systems	
302. Knowledge of parallel and independent energy storage systems	
303. Knowledge of control circuits for energy management systems	
304. Skill in determining energy management system size vs. needs and production	
305. Skill in operating or programming systems in accordance with the energy code requirements	

Task: Installs Optical Fiber Cables and Raceways

	Importance Rating
306. Knowledge of the use and installation requirements for optical fiber cables and raceways	

Task: Installs Instrumentation Tray Cables (ITC)

	Importance Rating
307. Knowledge of the use and installation requirements for instrumentation tray cable	

Task: Installs Fire Resistive Cable Systems

	Importance Rating
308. Knowledge of the use and installation requirements for fire resistive cable systems	
309. Knowledge of the product standard installation requirements	

Task: Installs Security Systems

	Importance Rating
310. Knowledge of the use and installation requirements for security systems	
311. Knowledge of equipment used in security systems	
312. Knowledge of connectors and switches for use with security systems	
313. Skill in using installation methods for security system wiring and foil	

Task: Installs Fire Alarm Systems

	Importance Rating
314. Knowledge of the use and installation requirements for fire alarm systems	
315. Knowledge of primary power supply sources for fire alarm systems	
316. Knowledge of performance of notification and signaling line circuits	
317. Skill in applying fire code requirements to systems	

Task: Installs Electric Signs and Outline Lighting

	Importance Rating
318. Knowledge of the lighting used in electrical signs and outline lighting	
319. Skill in identifying the lighting used in electric signs and outline lighting for fixed, portable and mobile installations	
320. Skill in identifying and installing the wiring methods, conduit and conductor terminations for signs and outline lighting	

Task: Mounts and Installs Electric Cranes and Hoists

	Importance Rating
321. Knowledge of wiring methods approved for electric crane and hoist installations	

Task: Installs Electric Vehicle Charging Stations

	Importance Rating
322. Knowledge of the conductors and equipment required for electric vehicle charging stations including minimum circuits sizes and ventilation requirements	
323. Skill in determining the cable limitations related to size, type and length for connection of electric vehicle charging stations	

Task: Installs Welders

	Importance Rating
324. Knowledge of the requirements for a single welder or a group of welders fed from a single circuit including conductor sizing, overcurrent protection, and disconnecting means	

Task: Installs Electrical Wiring, Equipment and Bonding for Swimming Pools, Fountains, and Similar Installations

	Importance Rating
325. Knowledge of the installation requirements regarding electrical systems for swimming pools, fountains, and similar installations	
326. Skill in determining the specific bonding requirements for swimming pools, fountains and similar equipment	
327. Skill in applying personnel protection circuits in swimming pools, fountains, spas and similar areas	

Task: Installs PV (Photovoltaic) Systems

	Importance Rating
328. Knowledge of the components, conductors, equipment and overcurrent protection requirements used in photovoltaic systems	
329. Knowledge of calculations for volt drop for PV source circuits	
330. Knowledge of the 156% rule for source circuit current limiting devices	
331. Knowledge of DC vs. AC current limiting devices	
332. Knowledge of the number of blades of knife switches per circuit in PV source circuits	
333. Knowledge of series and parallel PV source circuits	
334. Knowledge of combiners and disconnects	

	Importance Rating
335. Knowledge of PV source strings, VOC (open-circuit voltage), Isc (short circuit current), Vmax (voltage at maximum power output) & Imax (current at maximum power output)	
336. Knowledge of inverter MPPT (maximum power point tracking) window and how it affects PV power production	
337. Knowledge of roof sealing and mounting techniques for PV roof mounts	
338. Knowledge of multiple array rows & shading	
339. Knowledge of PV system site orientation in relationship to demand and load requirements	
340. Knowledge of fire rating for BIPV (building-integrated photovoltaics) systems	
341. Knowledge of solar controllers and programming	
342. Knowledge of temperature effect on solar panel voltage	
343. Knowledge of PV Diagrams for permitting requirements	
344.Knowledge of MPPT (Maximum Power Point Tracking) and PWM (Pulse Width Modulation) controllers	
345. Knowledge of grounding techniques for solar system equipment	
346. Knowledge of panelboard buss bar rating for solar system branch circuits	
347. Knowledge of disposal of solar panels	
348. Knowledge of buss bar ratings for solar system equipment or service conductors	
349. Knowledge of tap rules governing solar system installations	
350. Knowledge of source circuits, control circuits, sensing circuits and power circuits for solar, hydro, and wind electrical systems	
351. Knowledge of how to handle shattered solar panels	

Task: Installs Wind Electric Systems

	Importance Rating
352. Knowledge of wind system and tower fall requirements	
353. Knowledge of wind machine noise levels	
354. Knowledge of deterring wind system sight analysis, turbulence, wind speed, M/S, and average wind speed	
355. Knowledge of 3-phase PM alternators/generators	
356. Knowledge of rectifier circuits	
357. Knowledge of over speed control circuits	
358. Knowledge of wind turbine tower designs, installations and vibration issues	
359. Knowledge of wind turbine foundation and guy wires	
360. Knowledge of vibration and noise issues when systems are mounted on roofs or buildings	
361. Knowledge of wind resistance calculations of towers and turbines	
362. Knowledge of Horizontal Axis Wind Turbine (HAWT) and Vertical Axis Wind Turbine (VAWT) and benefits and drawbacks	
363. Knowledge of hydro and wind system OC voltage and load dump or clamping circuits to limit maximum voltage	
364. Skill in identifying the components, conductors, equipment and overcurrent protection requirements used in wind electric systems	

Task: Installs Fuel Cell Systems

	Importance Rating
365. Knowledge of proton exchange membrane (PEM) and solid oxide fuel (SOF) fuel cells	
366. Knowledge of fuel cell stacks	
367. Knowledge of starting and stopping of fuel cells	
368. Knowledge of fuel cell “crash” issues	
369. Knowledge of fuel cell power production and overloads	
370. Skill in identifying the components, conductors, equipment and overcurrent protection requirements used in fuel cell systems	

Task: Commissions Alternative Energy Systems

	Importance Rating
371. Knowledge of polarity	
372. Knowledge of AC/DC	
373. Knowledge of the use of DLC (Direct Load Control) and VLC (Variable Load Control)	
374. Knowledge of test equipment	
375. Knowledge of PV system source circuit ground faults	
376. Knowledge of how to trouble shoot a PV source circuit ground fault	

Task: Installs Feeders, Circuits and Equipment for Elevators

	Importance Rating
377. Knowledge of electrical requirements involving elevators, escalators, etc.	
378. Skill in identifying the feeder and branch circuit size and installation requirements for elevator equipment	

Task: Installs Fire Pumps

	Importance Rating
379. Knowledge of installation standard that governs fire pumps (NFPA 20)	
380. Skill in determining the service, control and installation requirements for fire pumps	

Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Domain 9: Communication Systems

Task: Installs Communication Cable for Specific Locations

	Importance Rating
381. Knowledge of installation requirements for communication cables	
382. Knowledge of hierarchy tables for communication cables	

Task: Installs Grounding for Specific Communication Systems

	Importance Rating
383. Knowledge of grounding requirements for communication systems	
384. Knowledge of tower grounding	
385. Knowledge of terminations	
386. Skill in installing terminations for intersystem grounding	

Task: Installs Communication Cable Inside a Building

	Importance Rating
387. Knowledge of requirements for the installation of cable inside a building	
388. Knowledge of cable types and uses within structures	

Task: Installs Communication Cable Outside a Building

	Importance Rating
389. Knowledge of requirements for the installation of cable outside a building	
390. Knowledge of primary electrical protection	
391. Knowledge of clearances to other systems and grade	
392. Knowledge of lightning protection	

Task: Installs SPDs (Surge Protection Devices)

	Importance Rating
393. Knowledge of surge protection types	
394. Knowledge of surge protection installation	
395. Knowledge of required installation of SPD within specific systems	
396. Skill in installing selected SPD for the application	
397. Skill in locating specific types of SPD in an electrical system	

Task: Installs Communication Cables

	Importance Rating
398. Knowledge of execution of the work	
399. Skill in installing communication cable in neat and workmanlike manner	

Task: Removes or Tags Abandoned Cables

	Importance Rating
400. Knowledge of the various means of detecting abandoned cables	
401. Skill in identifying abandoned cables	

Task: Maintains Required Separation Between Communication Cables and Other Electrical Sources

	Importance Rating
402. Knowledge of separation requirements between communication cables and other electrical sources	

Task: Determines Antenna Mounting Requirements

	Importance Rating
403. Knowledge of types and styles of antennas	
404. Skill in determining configurations and placements for the brackets	

Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Determining the Number of Items that Should be Tested in Each Domain

The next 9 lines reflect the domains (main content areas) that will be covered in the nationally recognized Electrical Contractor examination. Please provide your input as to the approximate number of questions that should be tested in each of these areas. Assume the exam consists of 100 questions. Therefore, the total of your estimate for these 9 domains must equal 100. If your answers do not equal 100 an error message will pop up asking you to adjust.

***Please note, the number of actual examination questions has not yet been determined, the 100 example is simply for an even number to calculate.**

Project Design and Management	
Safety	
Electrical Theory and Principles	
General Code Requirements	
Wiring and Protection	
Wiring Methods and Materials	
Equipment for General Use	
Special Occupancies, Special Equipment and Special Conditions	
Communication Systems	

You have now completed SECTION III of this survey. Thank you so much for your input!

Appendix E

Electrical Contractor Job Analysis Survey Respondent Demographics

Electrical Contractor Job Analysis Survey Respondent Demographics

The tables listed below detail the demographics of the respondents for the NASCLA Electrical Contractor/Master Electrician job analysis survey.

The number of years that the Respondents reported that they spent working in the electrical profession, supervising electricians, estimating, or preparing contracts, each ranged from 3 months to 51 years. Table 6 depicts their estimate of the average cost of contracts their company undertakes, ranging from less than $10,000 per job to over $100,000 per job, as follows:

Table 6
Size of Job Undertaken by Respondent's Companies

Average Size of Job	No. of Respondents
Less than $10K	**49**
$10K to $50K	**56**
$50K to $100K	**27**
Greater than $100K	**74**

Table 7 depicts how many people are employed by their organization:

Table 7
Number of People Employed by their Organization

Employee Range	No. of Respondents
Less than 6 people	**82**
6 – 25 people	**53**
25 -50 people	**16**
More than 50 people	**55**

Not all Respondents answered this question, as a few of them now work for electrical associations or licensing or code authority agencies or other public agencies, and do not perform independent contract work.

Table 8 indicates the states where the Respondents are licensed and have performed work as an Electrical Contractor or equivalent to:

Table 8
States in Which the Respondents are Licensed as an Electrical Contractor

State	No. of Respondents Licensed
Alabama	92
Alaska	10
Arizona	24
Arkansas	59
California	33
Colorado	39
Connecticut	13
Delaware	17
District of Columbia	15
Florida	137
Georgia	69
Hawaii	7
Idaho	40
Illinois	13
Iowa	24
Kansas	14
Kentucky	50
Louisiana	102
Maine	10
Maryland	40
Massachusetts	12
Michigan	17
Minnesota	16
Mississippi	63
Missouri	15
Montana	18

State	No. of Respondents Licensed
Nebraska	29
Nevada	14
New Hampshire	13
New Jersey	39
New Mexico	20
New York	12
North Carolina	81
North Dakota	18
Ohio	67
Oklahoma	36
Oregon	18
Pennsylvania	18
Rhode Island	9
South Carolina	79
South Dakota	20
Tennessee	72
Texas	77
Utah	20
Vermont	12
Virginia	122
Washington	13
West Virginia	47
Wisconsin	21
Wyoming	22

Appendix F

Electrical Contractor Job Analysis Survey Results

Electrical Contractor Survey Results

Task	Mean Task Frequency Rating	Mean Task Importance Rating		KSA	Mean KSA Importance Rating
Domain 1: Project Design and Management					
Develops, Reads, and Interprets Plans and Specifications	2.83	2.84	1	Knowledge of electrical symbols	2.84
			2	Skill in interpreting blueprints and plans	2.87
			3	Skill in interpreting specifications	2.81
			4	Skill in identifying conflicts in specifications, blueprints, plans, etc.	2.78
			5	Skill in applying blueprints/plans to contracts	2.76
Complies with the Requirements of the Authority Having Jurisdiction (AHJ)	2.89	2.91	6	Knowledge of Authority Having Jurisdiction (AHJ)	2.72
			7	Knowledge of the documents to submit for a permit	2.54
			8	Knowledge of basic bonding, liability insurance and other common requirements for state and local permits	2.49
			9	Knowledge of code enforcement (requirements, penalties, fines)	2.52
			10	Skill in preparing one-line diagrams for plan review	2.3
Selects and Procures Materials	2.66	2.5	11	Knowledge of how to order and schedule delivery of materials	2.45
			12	Knowledge of project scheduling and coordination of material lead time	2.45
			13	Knowledge of product substitutions and submittals	2.41
			14	Skill in maintaining material compliance with specifications (Quality Assurance)	2.48
			15	Skill in applying product standards to equivalent materials	2.78
			16	Skill in delivery, handling and storage methods	2.57
Estimates Bids, Proposals, and Contracts	2.67	2.73	17	Knowledge of basic accounting concepts (cash flow, invoicing, collection, etc)	2.38
			18	Knowledge of business law and regulations on contracts	2.37
			19	Skill in estimating time and materials	2.44
			20	Skill in reading and understanding bids and proposals	2.54
Maintains Documentation	2.62	2.61	21	Knowledge of forms or documentation to track job	2.66
			22	Knowledge of terminology used in documentation to track job	2.26
			23	Knowledge of legally–required employee notices (posters, letters, etc)	2.38
			24	Knowledge of document retention requirements	2.57
			25	Knowledge of performance and warranties requirements	2.66
			26	Skill in recordkeeping	1.76
			27	Skill in maintaining document control (current revision, redlines)	2.88
			28	Skill in documenting impacts of scheduling delays	2.7
Coordinates with Other Trades	2.53	2.55	29	Knowledge of sequencing activities	2.5
			30	Knowledge of overall construction scheduling	2.73
			31	Knowledge of scope of work with respect to the electrical work required versus the entire project	2.59
			32	Knowledge of inspection scheduling	2.51
			33	Skill in scheduling using the critical path method	2.71
			34	Skill in labor management	2.33
Conducts Site Analysis	2.43	2.46	35	Knowledge of preconstruction documentation	2.67
			36	Knowledge of requirements for utility locations	2.63
			37	Knowledge of potential unforeseen job conditions to look for	2.63
			38	Knowledge of contractor lay down areas and temporary facilities availability, location and requirements	2.66
			39	Knowledge of inspection requirements	2.71
			40	Knowledge of any special requirements for the job (PPE [personal protective equipment], entry requirements, screening, etc)	2.35
			41	Skill of setting up job trailer on–site	2.6

Domain 2: Safety

Complies with NFPA 70E	2.74	2.82	42	Knowledge of PPE (Personal Protective Equipment)	2.58
			43	Knowledge of electrical lockout/tagout	2.69
			44	Knowledge of incident energy	2.61
			45	Knowledge of risk analysis (shock and arc flash)	2.74
			46	Knowledge of maintenance requirements related to electrical equipment	2.49
			47	Knowledge of preconstruction and construction documentation concerning arc flash hazards	2.48
			48	Knowledge of shock hazard, flash hazard, blast hazard	2.5
			49	Knowledge of limit−of−approach boundaries	2.47
			50	Knowledge of labeling	2.46
			51	Knowledge of other construction hazards that might affect the electrician	2.06
			52	Skill in administering NFPA 70E training	2.31
Complies with OSHA Regulations	2.77	2.79	53	Knowledge of OSHA requirements regarding ladders and scaffolds	2.19
			54	Knowledge of OSHA requirements regarding trenches and excavations	2.47
			55	Knowledge of OSHA requirements regarding confined spaces	2.63
			56	Knowledge of OSHA requirements regarding control of hazardous energy	2.45
			57	Knowledge of OSHA requirements regarding general electrical requirements	2.62
			58	Knowledge of OSHA requirements regarding classification and labeling of chemicals	2.51
			59	Knowledge of OSHA requirements regarding barriers, signs, etc at work site	1.98
			60	Knowledge of OSHA record keeping requirements	1.83
Provides Safety Training Programs	2.31	2.55	61	Knowledge of Injury Illness Prevention Program Requirements	1.93
			62	Knowledge of assured grounding program or use of GFCI (ground fault circuit interrupter) protection	1.97
			63	Knowledge of electrical safety programs	1.91
			64	Knowledge of first aid, CPR, basic life support, etc	2.6
			65	Knowledge of environmental hazard considerations– (sun exposure, heat, cold, lightning, insects, snakes, etc)	2.3
			66	Knowledge of safety requirements for installing and maintaining electrical systems	2.63
			67	Knowledge of fall protection standards	2.2
			68	Knowledge of incident management and reporting procedures	2.24
			69	Skill in developing safety program curriculum	2.43
			70	Skill in conducting job safety analysis	2.35
Uses and Maintains Tools and Trains Employees to do the Same	2.46	2.54	71	Knowledge of use of tools (conduit benders, wire pullers, test equipment, etc)	2.45
			72	Knowledge of how to maintain tools	2.69
			73	Knowledge of selection of correct tool/ piece of equipment to perform task	2.34
			74	Knowledge of training sequences to prepare employees to use and maintain tools	2.59
			75	Skill in creating tool inventory, training, and maintenance program	2.49
Complies with Federal and State Regulations regarding Handling and Disposing of Hazardous and Toxic Materials	1.5	2.07	76	Knowledge of working around potential areas of asbestos and lead contamination	2.46
			77	Knowledge of disposal	2.08
			78	Knowledge of LBP (lead based paint) containment	2.06
			79	Skill in disposal of contaminated materials	2.01
Handles and Disposes of Hazardous and Toxic Materials	1.02	1.95	80	Knowledge of disposal method of batteries, transformers, fluorescent lamps, HID (high intensity discharge) lamps	2.24
			81	Knowledge of disposal of electrical equipment	2.7
			82	Knowledge of cleanup protocol or spill response	2.64
Complies with Manufacturer's Procedures	2.67	2.6	83	nowledge of using the equipment per manufacturer's instructions included in the listing	2.57
			84	Skill in interpreting labels	2.8

Domain 3: Electrical Theory & Principles

Uses Ohm's Law in Calculations for Resistance in Series/Parallel	1.96	2.21	85	Knowledge of units of measurement	2.67
			86	Knowledge of Ohm's Law	2.63
			87	Knowledge of the basic Ohm's law formulas	2.61
			88	Skill in calculating conversions	2.45
			89	Skill in calculating resistance	2.32
			90	Skill in calculating current	2.62
			91	Skill in calculating volts	2.57
			92	Skill in calculating power	2.51
			93	Skill in calculating voltage drop	2.58
Calculates Energy Efficiency and Conservation	1.46	1.67	94	Knowledge of energy codes	2.15
			95	Knowledge of lighting retrofits and lighting controls	2.7
			96	Knowledge of energy storage	2..88
			97	Skill in providing energy conservation techniques with energy saving products	2.74
Uses Kirchhoff's Laws in Calculations	1.31	1.53	98	Knowledge of Kirchhoff's Laws	2.84
			99	Skill in applying Kirchhoff Law calculations to troubleshooting	2.76
Applies Power Factor	1.65	1.82	100	Knowledge of the ratio of true power to apparent power	2.44
Calculates Short Circuit Current	1.68	2.02	101	Knowledge of nameplate information	2.26
			102	Skill in applying series rated systems values for distribution equipment	2.45
Calculates Primary & Secondary Parameters	1.82	2.1	103	Knowledge of wye and delta voltage and current configurations	2.63
			104	Knowledge of sizing and application of autotransformers	2.2
			105	Knowledge of sizing and application of isolation transformers	2.24
			106	Knowledge of sizing and application of step up and step down transformers	2.43
			107	Skill in calculating wye and delta voltage, current and ratios	2.35
			108	Skill in applying sizing for step up/step down transformer to electrical loads	2.45

Domain 4: General Code Requirements

Determines Working Space Requirements	2.32	2.54	109	Knowledge of voltage and amperage of equipment being used	2.69
			110	Knowledge of working space requirements	2.73
			111	Knowledge of the configuration of the equipment	2.76
			112	Knowledge of equipment accessibility requirements other than ADA (Americans with Disabilities Act)	2.82
			113	Skill in applying working clearances around equipment	2.81
			114	Skill in applying space requirements to electrical rooms and egresses	2.77
Selects Enclosure for the Application	2.34	2.42	115	Knowledge of the location of the application	2.51
			116	Knowledge of the environmental conditions	2.44
			117	Knowledge of the NEMA (National Electrical Manufacturers Association) ratings	2.48
			118	Skill in applying NEMA enclosure rating to environment	2.76
			119	Skill in applying NEC (National Electrical Code) rules to application of enclosures	2.7
Selects Equipment with the Interrupting Rating	2.07	2.43	120	Knowledge of interrupting rating of equipment	2.65
			121	Knowledge of interrupting rating of overcurrent protection devices	2.69
			122	Skill in applying available fault current to interrupting rating	2.17
Determines the Conductor Insulation Needed for the Application	2.32	2.49	123	Knowledge of environmental conditions surrounding use of the electrical application and their effect on the choice of insulation	2.28
			124	Knowledge of temperature limitation	2.73
			125	Knowledge of the types of insulation	2.72
			126	Knowledge of characteristics of cable construction	2.72
			127	Skill in applying NEC insulation tables to wire and cable applications	2.6
Executes the Work	2.6	2.62	128	Knowledge of Standard for Good Workmanship in Electrical Construction (NECA 1–2010)	2.51
			129	Skill in closing unused openings	2.2
			130	Skill in neat–and–workmanlike installation of materials	2.65

Protects Integrity of Electrical Equipment and Connections	2.72	2.77	131	Knowledge of contamination prevention for electrical equipment	2.18
			132	Knowledge of bonding and termination techniques	2.35
			133	Knowledge of torque values	2.72
			134	Knowledge of effects of damage related to improper installation of dissimilar metals	2.51
			135	Knowledge of materials and methods for making electrical onnections	2.57
			136	Skill in applying torque values on terminations	2.6
Evaluates Equipment for Suitability based on Listing and Labeling	2.28	2.43	137	Knowledge of equipment selection relative to the product listing	2.25
			138	Knowledge of the impact of the product listing with field modifications to equipment	2.12
			139	Knowledge of the nationally recognized testing laboratory's (NRTL's) Product Safety Standards	1.96
			140	Knowledge of counterfeit parts	2.04
Domain 5: Wiring & Protection					
Installs Grounding Electrode Conductors, and other Conductors	2.82	2.85	141	Knowledge of various types of equipment grounding conductors	2.71
			142	Knowledge of various types of grounding electrode conductors	2.7
			143	Knowledge of where bonding conductors are required	2.87
			144	Knowledge of when equipment is required to be connected to an equipment grounding conductor	2.88
			145	Knowledge of ground loops	2.59
			146	Skill in applying installation rules for grounding electrode conductors,etc	2.74
			147	Skill in applying the sizing of grounding electrode conductors, equipment grounding conductors and bonding conductors	2.82
			148	Skill in applying Article 250 to bonding and grounding installations	2.84
Installs Overcurrent Protection Device	2.78	2.85	149	Knowledge of overcurrent protection device, rating and locations	1.97
			150	Knowledge of system coordination and series rated systems	2.02
			151	Knowledge of response time of overcurrent protection device	2.25
			152	Skill in applying AIC (amperes interrupting current) ratings to overcurrent protection device	2.22
			153	Skill in determining size of overcurrent protective device	2.19
Installs Branch Circuits	2.78	2.81	154	Knowledge of the ampacity and number of branch circuits	2.14
			155	Skill in applying voltage limitations of branch circuits	1.71
			156	Skill in determining size of branch circuit conductors	1.92
Installs GFCI/AFCI Protection	2.67	2.76	157	Knowledge of GFCI	2.75
			158	Knowledge of AFCI	2.64
			159	Knowledge of location requirements for GFCI and AFCI	2.79
			160	Skill in diagnosing and installing GFCI/AFCI circuitry	2.69
Installs Receptacles	2.63	2.58	161	Knowledge of the number, placement and types of receptacles	2.33
			162	Knowledge of the use of the space in which the receptacles are being placed	2.7
			163	Knowledge of environments in which receptacles are being used	2.61
			164	Knowledge of individual branch circuit limitations	2.49
			165	Skill in applying NEC Article 210 for receptacle placement	2.02
Installs Service Equipment & Service Conductors	2.67	2.74	166	Knowledge of the rating and installation requirements for service equipment and service conductors for a specific applicatior	2.67
			167	Knowledge of service clearances	2.63
			168	Skill in determining the size of a service (includes size of conductors, raceway, and overload protection)	2.5
			169	Skill in installation of service equipment	2.24
Installs Feeders and Disconnecting Means	2.69	2.76	170	Knowledge of the rating and installation requirements of feeders and disconnecting means required for a specific applicatior	2.42
			171	Knowledge of the tap rules regarding feeder taps	2.14
			172	Skill in determining the size of a feeder (includes size of conductors, raceway, and overcurrent protection)	2.47

Installs Tap Conductors	2.12	2.41	173	Knowledge of the tap rules regarding tap conductors	2.51
			174	Knowledge of overcurrent protection for transformers using the tap rules	2.39
			175	Skill in determining size of tap conductor	2.33
			176	Skill in determining size of overload protection for transformer secondary conductors	2.54
Installs Grounding Electrodes	2.66	2.74	177	Knowledge of type of and installation requirements for grounding electrode	1.77
			178	Knowledge of interconnection of grounding electrodes to form a grounding electrode system	1.71
			179	Knowledge of connection to the electrode	2.12
			180	Skill in installing and connecting grounding electrode systems	1.88
Installs Grounding and Bonding of Separately Derived Systems	2.31	2.62	181	Knowledge of the method for grounding and bonding separately derived systems	1.62
			182	Skill in calculating the size of grounding and bonding conductors for separately derived systems	1.53
Installs Surge Arresters and Surge Protective Devices	2.02	2.29	183	Knowledge of the selection requirements for surge arresters and surge protective devices	2.53
			184	Knowledge of the installation requirements for surge arresters and surge protective devices	2.5
			185	Skill in applying the correct type of surge protective devices	2.48
Domain 6: Wiring Methods & Materials					
Selects and Installs Cabinets, Boxes, Fittings, and other Enclosures	2.72	2.57	186	Knowledge of the selection requirements for the number of wires for a box size	2.73
			187	Knowledge of location requirements for boxes, fittings and conduit bodies	2.73
			188	Knowledge of selection, sizing and installation requirements for cabinets, boxes, conduit bodies, fittings and other enclosures	2.72
			189	Knowledge of fireproofing requirements and methods at penetrations	2.61
			190	Skill in determining conductor box fill	2.72
Installs Conductors in Raceways, Cables etc.	2.73	2.64	191	Knowledge of grouping and arrangement of conductors in raceways, cables and other wire handling systems	2.53
			192	Knowledge of appropriate methods for protection of conductors, cables and raceways from physical damage	2.6
			193	Skill in calculating the minimum size conduit with respect to the size and number of conductors	2.7
			194	Skill in the various techniques of wire pulling and tooling	2.51
Installs Electrical Material in Underground Installations	2.4	2.54	195	Knowledge of manholes and other electrical enclosures intended for personnel entry	1.94
			196	Knowledge of burial depth, ampacities, spacings, and conductor requirements for underground installations	1.78
			197	Knowledge of the use of equipment (backhoes, trenches, etc) to install underground electrical conduit	1.9
			198	Skill in the techniques of installing underground wiring	1.95
Selects Conductors	2.66	2.73	199	Skill in calculating conductor ampacities based on condition of use	1.6
			200	Skill in identifying conductor ampacity, size, material and insulation type	1.7
Installs Cables	2.65	2.6	201	Knowledge of requirements for use and installation for specific type of cable	1.65
			202	Skill in installing support for cables used for the appropriate application	1.82
Installs Raceways	2.62	2.61	203	Knowledge of the requirements for use and installation for specific type of raceway	1.9
			204	Knowledge of the calculations and tools necessary to make bends in raceways	1.47
			205	Skill in determining size and installation requirements for raceway systems	1.55
Installs Auxiliary Gutters and Wireways	2.18	2.32	206	Knowledge of the requirements for use and installation for specific types of auxiliary gutters and wireways	2.14
			207	Skill in determining auxiliary gutter size and wireways	1.95
Installs Busways	1.72	2.2	208	Knowledge of the requirements for use and installation for specific types of busways	2.07
Installs Open Wiring Systems	1.38	1.83	209	Knowledge of the requirements for use and installation for specific types of open wiring systems	1.8

Domain 7: Equipment for General Use

Installs Fixture Wires, Flexible Cords or Flexible Cables	2.46	2.44	210	Knowledge of source circuits, control circuits, sensing circuits and power circuits for solar, hydro, and wind electrical systems	1.8
			211	Knowledge of seismic and vibration restraints and isolation for electrical equipment	1.94
			212	Skill in selecting and installing the type, size and use of a particular type of fixture wire, flexible cord or flexible cable	1.73
Selects and Installs Switches	2.62	2.48	213	Knowledge of Electrical Code rules governing switches	1.75
			214	Knowledge of ADA (Americans with Disabilities Act) requirements for location of switches	1.85
			215	Skill in selecting and installing switches based on requirements	2.02
Selects & Installs Receptacles, Cord Connectors & Attach Plugs	2.52	2.49	216	Knowledge of Electrical Code Rules for receptacle installation	2.63
			217	Knowledge of Electrical Code Rules for receptacle replacement	2.61
			218	Knowledge of ADA requirements for location of receptacles	2.39
			219	Skill in selecting and installing receptacles, cord connectors and attachment plugs based on requirements	2.51
Selects, Sizes & Installs Switchboards, Switchgear, & Panelboards	2.36	2.52	220	Knowledge of selection, size and installation requirements for switchboards, switchgear, and panelboards	2.64
			221	Knowledge of product standards for switchboards, panelboards, and switchgear	2.45
			222	Skill in installing switchboards, panelboards, and switchgear as per appropriate installation standard	2.61
Selects, Sizes and Installs Industrial Control Panels	1.83	2.2	223	Knowledge of industrial control panel product standards	1.8
			224	Skill in selection, size and installation requirements for industrial control panels	1.61
Selects, Locates, Mounts & Wires Luminaries, etc.	2.45	2.41	225	Knowledge of installation requirements for luminaries	2.42
			226	Skill in determining the selection, location, mounting and wiring of luminaries, lampholders, and lamps	2.42
Selects, Locates, Mounts and Wires Low Voltage Lighting Systems	1.81	1.93	227	Knowledge of installation requirements for low voltage luminaries	1.68
			228	Skill in determining the selection, location, mounting and wiring of low voltage lighting systems	1.67
Installs, Constructs, Uses and Protects Appliances	1.71	1.87	229	Knowledge of the use, installation requirements, disconnecting means, protection and construction of appliances	1.65
			230	Skill in applying installation requirements to install appliances	1.68
Installs, Constructs, Uses & Protects Fixed Electric Space Heating	1.61	1.83	231	Knowledge of the use, installation requirements, disconnecting means, protection and construction of fixed electric space heating equipment	2.19
			232	Skill in installing fixed electric space heating equipment	2.14
Installs, Constructs, Uses & Protects Electric Deicing/Snow Melting	0.97	1.35	233	Knowledge of the use, installation requirements, disconnecting means, protection and construction of electric deicing and snow melting equipment	1.71
			234	Skill in applying the GFPE (Ground–Fault Protection Equipment) for electric deicing and snow melting equipment	1.92
			235	Skill in applying installation requirements to the installation of electric deicing and snow melting equipment	1.78
Installs, Constructs, Uses & Protects Electric Pipeline/Vessel Heating	0.96	1.43	236	Knowledge of the use, installation requirements, disconnecting means, protection and construction of fixed electric pipeline and vessel heating equipment	1.64
			237	Skill in applying installation requirements to the installation of fixed electric pipeline and vessel heating equipment	1.61
Selects, Sizes, Installs & Protects Feeders, etc. for Motors	2.35	2.51	238	Knowledge of the installation requirements of motors and their uses	2.51
			239	Knowledge of the various types of motors and their uses	2.33
			240	Skill in determining the size of conductors	2.69
			241	Skill in determining the size of overcurrent protective devices	2.7
			242	Skill in determining the size of disconnecting means	2.7
			243	Skill in determining the size of controllers	2.61
			244	Skill in determining the locked rotor current	2.35
			245	Skill in determining the installation requirements for motors	2.49

Installs Generators	2.08	2.37	246	Knowledge of installation requirements and protection for generators	1.25
			247	Knowledge of automatic or manual transfer switch installations	1.28
			248	Knowledge of separately derived and non–separately derived systems	1.47
			249	Skill in installing life safety emergency power sources	2.08
			250	Skill In installing legally required standby systems	2.14
			251	Skill in installing optional standby systems	1.75
Installs Transformers	2.21	2.49	252	Knowledge of selection, rating, protection and installation requirements for transformers	1.98
			253	Skill in installing the size and type of transformer	1.78
			254	Skill in providing ventilation for transformer installation	1.81
Installs Phase Converters	1.1	1.65	255	Knowledge of rating, grounding, protection and installation requirements for phase converters	2.17
Installs Capacitors	1.17	1.64	256	Knowledge of rating, grounding, protection and installation requirements for capacitors	2.19
Installs Resistors and Reactors	1.01	1.5	257	Knowledge of rating, grounding, protection and installation requirements for resistors and reactors	2.2
Installs Electrical and Electronic Industrial Instrumentation	1.4	1.76	258	Knowledge of grounding, protection and installation requirements for industrial instrumentation	2.23
			259	Knowledge of selection and use of basic electrical and electronic testing equipment	1.67
			260	Skill in interpreting basic electrical and electronic schematics and diagrams	1.96
Selects and Installs Storage Batteries	1.1	1.61	261	Knowledge of selection, rating, grounding, protection and installation requirements for storage batteries	2.02
			262	Knowledge of rectifier and battery chargers circuits and systems	2.03
			263	Knowledge of DOD (Depth of Discharge), cycle rates, series, parallel circuits for energy storage systems	2.02
			264	Knowledge of charge rate vs voltage for bulk, absorption and equalization of energy storage systems	1.8
			265	Knowledge of hydrometer readings and load tests– to determine SOC (State of Charge)	2.02
Selects and Installs Equipment Over 1,000 Volts	1.04	1.75	266	Knowledge of selection, rating, grounding, protection and installation requirements for equipment over 1,000 volts	2.05
Domain 8: Special Occupancies, Special Equipment & Special Conditions					
Installs Electrical and Electronic Equipment and Wiring For Hazardous (Classified) Locations:	1.74	2.31	267	Knowledge of the installation requirements for hazardous (classified) locations	2.53
			268	Knowledge of the installation requirements for the divisions and zones within the Class I, Class II, and Class III locations of hazardous (classified) locations	2.5
			269	Skill in identifying hazardous (classified) locations within special occupancies	2.48
Installs Electrical Equipment & Wiring In non– Hazardous Locations	1.64	2.17	270	Knowledge of installation requirements for special occupancies	2.2
			271	Knowledge of ampacity requirements for special occupancies	2.2
			272	Knowledge of electrical requirements involving mobile homes, manufactured homes, and mobile home parks	2.08
			273	Knowledge of electrical requirements involving marinas and boatyards	2.02
			274	Knowledge of electrical requirements involving temporary installations	2.28
			275	Skill in determining the size of service for mobile home parks or RV parks	2
Installs Electrical Equipment & Wiring For Emergency Systems, etc	1.71	2.22	276	Knowledge of the use and installation requirements for emergency systems, legally required or optional standby systems, and critical operation power systems	2.27
			277	Knowledge of identification of emergency systems, standby systems, and critical operation power systems, and devices	2.28

Installs Interconnected Electric Power Production Systems	1.04	1.58	278	Knowledge of the use and installation requirements for interconnected electric power production systems	1.77
			279	Knowledge of in−phase and out−of−phase energy systems	1.68
			280	Knowledge of energy support and energy shaving systems	1.54
			281	Knowledge of maximum volt and cycle deviation for different energy systems	1.54
			282	Skill in installing interconnected electrical power production systems to utility specifications	1.68
			283	Skill in applying installation standards for protection and operation of systems	1.76
Installs Circuits Operating Less Than 50 Volts,	1.79	1.84	284	Knowledge of the use and installation requirements for circuits operating less than 50 volts, and Class 1, Class 2 and Class 3 remote control signaling and power limited circuits	1.94
			285	Knowledge of conductor and current limiting devices for 12 vdc systems	1.78
			286	Skill in installing selected cable types as per system selected	1.9
			287	Skill in applying installation standard to selected systems	1.95
Installs Energy Management Systems	1.21	1.55	288	Knowledge of the use and installation requirements for Energy Management Systems	1.73
			289	Knowledge of load shedding	1.7
			290	Knowledge of energy support systems	1.6
			291	Knowledge of parallel and independent energy storage systems	1.67
			292	Knowledge of control circuits for energy management systems	1.7
			293	Skill in determining energy management system size vs needs and production	1.6
			294	Skill in operating or programming systems in accordance with the energy code requirements	1.65
Installs Optical Fiber Cables and Raceways	1.14	1.44	295	Knowledge of the use and installation requirements for optical fiber cables and raceways	1.68
Installs Instrumentation Tray Cables (ITC)	1.29	1.49	296	Knowledge of the use and installation requirements for instrumentation tray cable	1.82
Installs Fire Resistive Cable Systems	1.1	1.56	297	Knowledge of the use and installation requirements for fire resistive cable systems	1.95
			298	Knowledge of the product standard installation requirements	1.9
Installs Security Systems	0.99	1.23	299	Knowledge of the use and installation requirements for security systems	1.56
			300	Knowledge of equipment used in security systems	1.47
			301	Knowledge of connectors and switches for use with security systems	1.49
			302	Skill in using installation methods for security system wiring and foil	1.55
Installs Fire Alarm Systems	1.4	1.79	303	Knowledge of the use and installation requirements for fire alarm systems	2.1
			304	Knowledge of primary power supply sources for fire alarm systems	2.14
			305	Knowledge of performance of notification and signaling line circuits	1.95
			306	Skill in applying fire code requirements to systems	2.07
Installs Electric Signs and Outline Lighting	1.26	1.52	307	Knowledge of the lighting used in electrical signs and outline lighting	1.8
			308	Skill in identifying the lighting used in electric signs and outline lighting for fixed, portable and mobile installations	1.8
			309	Skill in identifying and installing the wiring methods, conduit and conductor terminations for signs and outline lighting	1.94
Mounts and Installs Electric Cranes and Hoists	0.92	1.38	310	Knowledge of wiring methods approved for electric crane and hoist installations	1.73
Installs Electric Vehicle Charging Stations	0.87	1.4	311	Knowledge of the conductors and equipment required for electric vehicle charging stations including minimum circuits sizes and ventilation requirements	1.75
			312	Skill in determining the cable limitations related to size, type and length for connection of electric vehicle charging stations	1.85
Installs Welders	1.33	1.55	313	Knowledge of the requirements for a single welder or a group of welders fed from a single circuit including conductor sizing, overcurrent protection, and disconnecting means	2.02

Installs Electrical Wiring, Equipment & Bonding for Swimming Pools	1.46	2.21	314	Knowledge of the installation requirements regarding electrical systems for swimming pools, fountains, and similar installations	2.42
			315	Skill in determining the specific bonding requirements for swimming pools, fountains and similar equipment	2.51
			316	Skill in applying personnel protection circuits in swimming pools, fountains, spas and similar areas	2.52
Installs PV (Photovoltaic) Systems	0.92	1.61	317	Knowledge of the components, conductors, equipment and overcurrent protection requirements used in photovoltaic systems	1.85
			318	Knowledge of calculations for volt drop for PV source circuits	1.76
			319	Knowledge of the 156 percent rule for source circuit current limiting devices	1.8
			320	Knowledge of DC vs AC current limiting devices	1.81
			321	Knowledge of the number of blades of knife switches per circuit in PV source circuits	1.73
			322	Knowledge of series and parallel PV source circuits	1.76
			323	Knowledge of combiners and disconnects	1.76
			324	Knowledge of PV source strings, VOC, Isc , Vmax & Imax	1.8
			325	Knowledge of inverter MPPT window and how it affects PV power production	1.61
			326	Knowledge of roof sealing and mounting techniques for PV roof mounts	1.64
			327	Knowledge of multiple array rows & shading	1.65
			328	Knowledge of PV system site orientation in relationship to demand and load requirements	1.68
			329	Knowledge of fire rating for BIPV (building–integrated photovoltaics) systems	1.67
			330	Knowledge of solar controllers and programming	1.65
			331	Knowledge of temperature effect on solar panel voltage	1.68
			332	Knowledge of PV Diagrams for permitting requirements	1.74
			333	Knowledge of MPPT (Maximum Power Point Tracking) and PWM (Pulse Width Modulation) controllers	1.54
			334	Knowledge of grounding techniques for solar system equipment	2.01
			335	Knowledge of panelboard buss bar rating for solar system branch circuits	1.86
			336	Knowledge of disposal of solar panels	1.61
			337	Knowledge of buss bar ratings for solar system equipment or service conductors	1.89
			338	Knowledge of tap rules governing solar system installations	1.8
			339	Knowledge of source circuits, control circuits, sensing circuits and power circuits for solar, hydro, and wind electrical systems	1.73
			340	Knowledge of how to handle shattered solar panels	1.61
Installs Wind Electric Systems	0.47	1.21	341	Knowledge of wind system and tower fall requirements	1.42
			342	Knowledge of wind machine noise levels	1.24
			343	Knowledge of deterring wind system sight analysis, turbulence, etc.	1.25
			344	Knowledge of 3–phase PM alternators/generators	1.48
			345	Knowledge of rectifier circuits	1.41
			346	Knowledge of over speed control circuits	1.37
			347	Knowledge of wind turbine tower designs,etc.	1.36
			348	Knowledge of wind turbine foundation and guy wires	1.38
			349	Knowledge of vibration & noise issues when systems are mounted	1.32
			350	Knowledge of wind resistance calculations of towers and turbines	1.27
			351	Knowledge of(HAWT and VAWT and benefits and drawbacks	1.27
			352	Knowledge of hydro and wind system OC voltage	1.32
			353	Skill in identifying the components, conductors, equipment etc.	1.61
Installs Fuel Cell Systems	0.34	1.12	354	Knowledge of proton exchange membrane (PEM) and solid oxide fuel (SOF) fuel cells	1.21
			355	Knowledge of fuel cell stacks	1.21
			356	Knowledge of starting and stopping of fuel cells	1.24
			357	Knowledge of fuel cell crash issues	1.25
			358	Knowledge of fuel cell power production and overloads	1.28
			359	Skill in identifying the components, conductors, equipment and overcurrent protection requirements used in fuel cell systems	1.47

Commissions Alternative Energy Systems	0.51	1.1	360	Knowledge of polarity	2.08
			361	Knowledge of AC/DC	2.14
			362	Knowledge of the use of DLC (Direct Load Control) and VLC (Variable Load Control)	1.75
			363	Knowledge of test equipment	1.98
			364	Knowledge of PV system source circuit ground faults	1.78
			365	Knowledge of how to trouble shoot a PV source circuit ground fault	1.81
Installs Informational Technology Equipment	0.96	1.33			
Installs Fire Pumps	0.98	1.83	366	Knowledge of installation standard that governs fire pumps (NFPA 20)	2.2
			367	Skill in determining the service, control and installation requirements for fire pumps	2.23
Domain 9: Communication Systems					
Installs Communication Cable for Specific Locations	1.66	1.68	368	Knowledge of installation requirements for communication cables	1.83
			369	Knowledge of hierarchy tables for communication cables	1.67
Installs Grounding for Specific Communication Systems	1.73	1.94	370	Knowledge of grounding requirements for communication systems	2.2
			371	Knowledge of tower grounding	1.96
			372	Knowledge of terminations	2.02
			373	Skill in installing terminations for intersystem grounding	2.02
Installs Communication Cable Inside a Building	1.78	1.81	374	Knowledge of requirements for the installation of cable inside a building	2.03
			375	Knowledge of cable types and uses within structures	2.02
Installs Communication Cable Outside a Building	1.2	1.43	376	Knowledge of requirements for the installation of cable outside a building	1.8
			377	Knowledge of primary electrical protection	2.02
			378	Knowledge of clearances to other systems and grade	2.05
			379	Knowledge of lightning protection	2.04
Installs SPDs (Surge Protection Devices)	1.69	1.89	380	Knowledge of surge protection types	2.1
			381	Knowledge of surge protection installation	2.15
			382	Knowledge of required installation of SPD within specific systems	2.07
			383	Skill in installing selected SPD for the application	2.02
			384	Skill in locating specific types of SPD in an electrical system	2.02
Installs Communication Cables	1.72	1.67	385	Knowledge of execution of the work	2.15
			386	Skill in installing communication cable in neat and workmanlike manner	2.2
Removes or Tags Abandoned Cables	1.57	1.71	387	Knowledge of the various means of detecting abandoned cables	1.94
			388	Skill in identifying abandoned cables	1.95
Maintains Separation between Comm Cables & Other Sources	2.2	2.21	389	Knowledge of separation requirements between communication cables and other electrical sources	2.38
Determines Antenna Mounting Requirements	0.59	1.05	390	Knowledge of types and styles of antennas	1.21
			391	Skill in determining configurations and placements for the brackets	1.24
Installs Feeders, Circuits and Equipment for Elevators			392	Knowledge of electrical requirements involving elevators, escalators, etc.	2.17
			393	Skill in identifying the feeder and branch circuit size and installation requirements for elevator equipment	2.19

Appendix G

Electrical Contractor Examination Plan

Domains for Electrical Contractor/Master Electrician	
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Communication Systems	1

Definition of Electrical Contractor

One who conducts business in the installation, maintenance and repair of electrical work conforming to applicable standards and codes.

Domains, Tasks, KSAs for Electrical Contractor/Master Electrician	# of items
A. Project Design & Management	**8**
1. Develops, Reads & Interprets Construction Documents: Skill in interpreting blueprints and plans Skill in interpreting specifications Skill in identifying conflicts in specifications, blueprints, plans, and other construction documentations Skill in applying drawings/plans to contracts Skill in estimating time and materials Skill in reading and understanding bids and proposals and other construction documents	2
2. Complies with applicable requirements for permits and inspections: Knowledge of Authority Having Jurisdiction (AHJ) Knowledge of the documents to submit for a permit Skill in preparing required documents (one-line diagrams) for plan review	1
3. Selects & Procures Materials: Knowledge of how to order and schedule delivery of materials Knowledge of project scheduling and coordination of material lead times Knowledge of product substitutions and submittals Skill in maintaining material compliance with specifications (Quality Assurance) Skill in applying product standards to equivalent materials Skill in delivery, handling and storage methods	2
4. Maintains Essential Documentation: Skill in recordkeeping-(change orders, time cards, materials, material receipts, job logs, conducts preconstruction meetings, as built drawings, RFIs (requests for information), billing, punch lists, closeouts)	1
5. Coordinates with Other Trades: Knowledge of sequencing activities Knowledge of overall construction scheduling Knowledge of scope of work with respect to the electrical work required versus the entire project	1
6. Conducts Site Analysis: Knowledge of requirements for utility locations Knowledge of potential unforeseen job conditions to look for (environmental, archaeological, safety hazards, geotechnical) Knowledge of contractor lay down areas and temporary facilities availability, location and requirements Knowledge of any special requirements for the job (PPE (personal protective equipment), entry requirements, screening)	1

B. Safety	9
7. Complies with NFPA 70E: Knowledge of PPE (Personal Protective Equipment) Knowledge of electrical Lockout/Tagout Knowledge of risk analysis (shock and arc flash) Knowledge of maintenance requirements related to electrical equipment Knowledge of preconstruction and construction documentation concerning arc flash hazards Knowledge of Shock Hazard, Arc Flash Hazard and Blast Hazard Knowledge of limit-of-approach boundaries Knowledge of labeling Knowledge of other construction hazards that might affect the electrician Skill in administering and documenting NFPA 70E training	2
8. Complies with OSHA Regulations: Knowledge of OSHA requirements regarding ladders, scaffolds and lifts Knowledge of OSHA requirements regarding trenches and excavations Knowledge of OSHA requirements regarding confined spaces Knowledge of OSHA requirements regarding control of hazardous energy Knowledge of OSHA requirements regarding general electrical requirements Knowledge of OSHA requirements regarding classification and labeling of chemicals Knowledge of OSHA requirements regarding barriers, signs at work site Knowledge of OSHA record keeping requirements Knowledge of fall protection standards Knowledge of assured grounding program or use of GFCI (ground fault circuit interrupter) protection	2
9. Provides Safety Training Programs: Knowledge of Injury Illness Prevention Program requirements Knowledge of electrical safety programs Knowledge of first aid, CPR, basic life support, etc. Knowledge of environmental hazard considerations (e.g., sun exposure, heat, cold, lightning, insects, snakes,) Knowledge of incident management and reporting procedures Skill in developing safety program curriculum Skill in conducting Job Safety Analysis	2
10. Uses and Maintains Tools and Trains Employees to do same: Knowledge of use of tools (e.g., conduit benders, wire pullers, test equipment) Knowledge of how to maintain tools Knowledge of selection of correct tool/ piece of equipment to perform task Knowledge of training sequences to prepare employees to use and maintain tools Skill in creating tool inventory, training, and maintenance program	2
11. Complies with Federal and State Regulations regarding Handling and Disposing of Hazardous and Toxic Materials: Knowledge of working around potential areas of hazardous materials Knowledge of disposal of hazardous materials and contaminated equipment (batteries, transformers, fluorescent lamps, Solar Panels, Asbestos, Lead, HID (high intensity discharge lamps)) Knowledge of cleanup protocol or spill response	1

C. Electrical Theory & Principles	11
12. Uses Ohm's and Kirchhoff's Laws to Calculate Circuit Values: Knowledge of Ohm's Law Knolwedge of Kirchhoff's Law Skill in calculating voltage drop Skill in calculating circuit values (IERP)	4
13. Calculates Energy Efficiency and Conservation: Knowledge of energy codes Knowledge of lighting retrofits and lighting controls Skill in providing Energy Conservation techniques with energy saving products	2
14. Applies Power Factor: Knowledge of the ratio of true power to apparent power	1
15. Calculates the Primary & Secondary Parameters of Various Transformer Connections: Knowledge of Wye and Delta voltage and current configurations Knowledge of sizing and application of autotransformers Knowledge of sizing and application of isolation transformers Knowledge of sizing and application of step up and step down transformers Skill in calculating Wye and Delta voltage, current and ratios Skill in applying sizing for step up/step down transformer to electrical loads	4

D. General Code Requirements	17
16. Determines Working Space Requirements: Knowledge of voltage and amperage of equipment being used Knowledge of working space requirements Knowledge of the configuration of the equipment Knowledge of equipment accesibility requirements (other than ADA (Americans with Disabiities Act)) Skill in applying working clearances around equipment Skill in applying space requirements to electrical rooms and egresses	2
17. Selects Enclosure for the Application: Knowledge of the environmental conditions Knowledge of the NEMA (National Electrical Manufacturers Association) ratings Skill in applying NEMA enclosure rating to environment Skill in applying NEC (National Electrical Code) rules to application of enclosures	3
18. Selects Equipment with the Proper Interrupting Rating and short circuit current ratings: Knowledge of overcurrent protective device interrupting ratings Knowledge of equipment short circuit current ratings Skill in applying available fault current to interrupting and short circuit current ratings	3
19. Determines the Conductor Insulation Needed for the Application: Knowledge of environmental conditions (wet, damp, dry, temperature) surrounding use of the electrical application and their effect on the choice of insulation Knowledge of the types of insulation Knowledge of characteristics of cable construction Skill in applying NEC insulation tables to wire and cable applications	4
20. Protects Integrity of Electrical Equipment and Connections: Knowledge of contamination prevention for electrical equipment Knowledge of bonding and termination techniques Knowledge of effects of damage related to improper installation of dissimilar metals/materials Knowledge of materials and methods for making electrical connections	3
21. Evaluates Equipment for Suitability based on Listing and Labeling: Knowledge of equipment selection relative to the product listing and labeling Skill in applying equipment based on listing and labeling requirements	2

E. Wiring & Protection	17
22. Installs Grounding Electrode Conductors, Equipment Grounding Conductors and Bonding Conductors: Knowledge of various types of equipment grounding conductors Knowledge of various types of grounding electrode conductors Knowledge of where bonding conductors are required Knowledge of when equipment is required to be connected to an equipment grounding conductor Skill in applying installation rules for grounding electrode conductors, equipment grounding conductors and bonding conductors Skill in applying the sizing of grounding electrode conductors, equipment grounding conductors and bonding conductors Skill in applying Article 250 to bonding and grounding installations	3
23. Installs Overcurrent Protection Device: Knowledge of overcurrent protection device, rating and locations Knowledge of system coordination and series rated systems Knowledge of response time of overcurrent protection device Knowledge of nameplate or equipment label information Skill in applying AIC (amperes interrupting current) ratings to overcurrent protection device Skill in determining size of overcurrent protective device Skill in replacing series rated components Skill in applying series rated systems values for distribution equipment	2
24. Installs Branch Circuits: Knowledge of the ampacity and number of branch circuits Knowledge of individual branch circuit limitations Skill in applying voltage limitations of branch circuits Skill in determiming size of branch circuit conductors	2
25. Installs and Maintains GFCI/AFCI (Ground Fault Circuit Interrupter/Arc Fault Circuit Interrupter) Protection: Knowledge of GFCI Knowledge of AFCI Knowledge of location requirements for GFCI and AFCI Skill in diagnosing and installing GFCI/AFCI circuitry	2
26. Installs Receptacle Outlets: Knowledge of the number, placement and types of receptacle outlets Knowledge of the use of the space in which the receptacle outlets are being placed Knowledge of environments in which receptacle outlets are being used Knowledge of ADA requirements for location of receptacle outlets Skill in receptacle placement	2

27. Installs Service Equipment & Service Conductors: Knowledge of the rating and installation requirements for service equipment and service conductors for a specific application Knowledge of service clearances Skill in determining the size of a service (includes size of conductors, raceway, and overload protection) Skill in installation of service equipment	1
28. Installs Feeder Conductors and Feeder Disconnecting Means: Knowledge of the rating and installation requirements of feeder conductor and feeder disconnecting means required for a specific application Skill in determining the size of a feeder (includes size of conductors, raceway, and overcurrent protection)	1
29. Installs Tap Conductors: Knowledge of the tap rules regarding tap conductors Knowledge of overcurrent protection for transformers using the tap rules Knowledge of the tap rules regarding feeder taps Skill in determining size of tap conductor Skill in determining size of overcurrent protection for transformer secondary conductors	1
30. Installs Grounding Electrodes: Knowledge of type of and installation requirements for grounding electrode Knowledge of interconnection of grounding electrodes to form a grounding electrode systems Knowledge of connection to the electrode Skill in installing and connecting grounding electrode systems	1
31. Installs Grounding and Bonding of Separately Derived Systems: Knowledge of the method for grounding and bonding separately derived systems Skill in calculating the size of grounding and bonding conductors for separately derived systems	1
32. Installs Surge Arrestors and Surge Protective Devices: Knowledge of the selection requirements for surge arrestors and surge protective devices Knowledge of the installation requirements for surge arrestors and surge protective devices Skill in applying the correct type of surge protective devices	1

F. Wiring Methods & Materials	16
33. Selects and Installs Cabinets, Boxes, Fittings, Conduit Bodies and other Enclosures: Knowledge of the selection requirements for the number of wires for a box size Knowledge of location requirements for boxes, fittings and conduit bodies Knowledge of selection, sizing and installation requirements for cabinets, boxes, conduit bodies, fittings and other enclosures Knowledge of fireproofing requirements and methods at penetrations Skill in determining conductor box fill	3
34. Installs Conductors in Raceways, Cables and Cable Trays: Knowledge of grouping and arrangement of conductors in raceways, cables and cable trays Knowledge of appropriate methods for protection of conductors, cables and raceways from physical damage Skill in calculating the minimum size conduit with respect to the size and number of conductors Skill in the various techniques of wire pulling and tooling	3
35. Installs Electrical Material in Underground Installations: Knowledge of manholes and other electrical enclosures intended for personnel entry Knowledge of burial depth, ampacities, spacings, and conductor requirements for underground installations Skill in the techniques of installing underground wiring	1
36. Selects Conductors and Cables: Knowledge of requirements for use and installation for specific type of cable Skill in calculating conductor ampacities based on condition of use Skill in identifying conductor ampacity, size, material and insulation type Skill in installing support for cables used for the appropriate application	4
37. Installs Raceways, Cable Trays and Auxiliary Gutters and Wireways: Knowledge of the requirements for use and installation for specific type of raceway and cable trays Knowledge of the calculations and tools necessary to make bends in raceways Knowledge of the requirements for use and installation for specific types of auxiliary gutters and wireways Skill in determining the size and installation requirements for raceway and cable tray systems Skill in determining auxiliary gutter size and wireways	3
38. Installs busways: Knowledge of the requirements for use and installation for specific types of busways	1
39. Installs Open Wiring Systems: Knowledge of the requirements for use and installation for specific types of open wiring systems	1

G. Equipment for General Use	13
40. Installs Fixture Wires, Flexible Cords or Flexible Cables: Knowledge of source circuits, control circuits, sensing circuits and power circuits for electrical systems Knowledge of seismic and vibration restraints and isolation for electrical equipment Skill in selecting and installing type, size and use of a particular type of fixture wire, flexible cord or flexible cable	1
41. Selects and Installs Switches: Knowledge of NEC rules governing switches Knowledge of ADA (Americans with Disabilities Act) requirements for location of switches Skill in selecting and installing switches based on requirements	1
42. Selects and Installs Receptacles, Cord Connectors and Attachment Plugs: Knowledge of NEC Rules for Receptacle installation Knowledge of NEC Rules for Receptacle replacement Skill in selecting and installing receptacles, cord connectors and attachment plugs based on requirements	1
43. Selects, Sizes and Installs Switchboards, Switchgear, and Panelboards: Knowledge of selection, size and installation requirements for switchboards, switchgear, and panelboards Knowledge of product standards for switchboards, panelboards, and switchgear Skill in selection, size and installation of switchboards, panelboards, and switchgear **44. Selects, Sizes and Installs Industrial Control Panels:** Knowledge of Industrial Control Panel installation requirements Skill in selection, size and installation requirements for industrial control panels	1
45. Selects, Locates, Mounts and Wires Luminaires, Lampholders, and Lamps: Knowledge of installation requirements for luminaires Skill in determining the selection, location, mounting and wiring of luminaires, lampholders, and lamps	2
46. Installs equipment as specified by Building Code: Knowledge of building code requirements for equipment such as emergency lighting, fire alarm systems, smoke and CO alarms	1

47. Selects, Locates, Mounts and Wires Low Voltage Lighting Systems: Knowledge of Installation requirements for low voltage luminaires Skill in determining the selection, location, mounting and wiring of low voltage lighting systems **48. Installs, Uses and Protects Appliances:** Knowledge of the use, installation requirements, disconnecting means, and protection of appliances Skill in applying installation requirements for appliances **49. Installs, Uses and Protects Fixed Electric Space Heating Equipment:** Knowledge of use, installation requirements, disconnecting means, and protection of fixed electric space heating equipment Skill in installing fixed electric space heating equipment **50. Installs, Uses and Protects Electric Deicing and Snow Melting Equipment:** Knowledge of the use, installation requirements, disconnecting means, and protection of electric deicing and snow melting equipment Skill in applying GFPE (Ground-Fault Protection Equipment) for electric deicing and snow melting equipment Skill in applying installation requirements for electric deicing and snow melting equipment **51. Installs, Uses and Protects Fixed Electric Pipeline and Vessel Heating Equipment:** Knowledge of the use, installation requirements, disconnecting means, protection of fixed electric pipeline and vessel heating equipment Skill in applying installation requirements to the installation of fixed electric pipeline and vessel heating equipment	1
52. Selects, Sizes, Installs and Protects Feeders, Branch Circuits, Control Circuits, Disconnecting Means, and Controllers for Motors: Knowledge of the installation requirements of motors and their uses Knowledge of the various types of motors and their uses Skill in determining the size of conductors Skill in determining the size of overload and overcurrent protective device Skill in determining the size of disconnecting means Skill in determining the size of controller Skill in determining the locked rotor current Skill in determining the installation requirements for motors	2
53. Selects, Sizes, Installs and Protects Feeders, Branch Circuits, Control Circuits, Disconnecting Means, and Controllers for Refrigeration and Air-Conditioning Equipment: Knowledge of the installation requirements of HVACR (Heating, Ventilation, Air Conditioning and Refrigeration) equipment and their uses Knowledge of the various types of HVACR equipment and their uses Skill in determining the size of conductors Skill in determining the size of overload and overcurrent protective device Skill in determining the size of disconnecting means Skill in determining the size of controller Skill in determining the locked rotor current Skill in determining the size of conductors and overcurrent devices used for control circuits Skill in determining the installation requirements for refrigeration and air-conditioning equipment	1

54. Installs Generators: Knowledge of installation requirements and protection for generators Knowledge of automatic and manual transfer switch installations and types Knowledge of separately derived and nonseparately derived systems **55. Installs Transformers:** Knowledge of selection, rating, protection and installation requirements for transformers Skill in installing the proper size and type of transformer Skill in providing ventilation for transformer installation	1

56. Installs Phase Converters, Capacitors, Resistors and Reactors: Knowledge of rating, grounding, protection and installation requirements for phase converters Knowledge of rating, grounding, protection and installation requirements for capacitors Knowledge of rating, grounding, protection and installation requirements for resistors and reactors **57. Installs Electrical and Electronic Industrial Instrumentation:** Knowledge of grounding, protection and installation requirements for industrial instrumentation Knowledge of selection and use of basic electrical and electronic testing equipment Skill in interpreting basic electrical and electronic schematics and diagrams **58. Selects and Installs Storage Batteries:** Knowledge of selection, rating, grounding, protection and installation requirements for storage batteries Knowledge of rectifier and battery chargers circuits and systems Knowledge of DOD (Depth of Discharge), cycle rates, series, parallel circuits for energy storage systems Knowledge of charge rate vs. voltage for bulk, absorption and equalize of energy storage systems Knowledge of hydrometer readings and load tests to determine SOC (State of Charge) **59. Selects and Installs Equipment Over 1,000 Volts:** Knowledge of selection, rating, grounding, protection and installation requirements for equipment over 1,000 volts	1

H. Special Occupancies, Special Equipment & Special Conditions	8
60. Installs Electrical and Electronic Equipment and Wiring For Hazardous (Classified) Locations: Knowledge of the installation requirements for Hazardous (Classified) Locations Knowledge of the installation requirements for the Divisions and Zones within the Class I, Class II, and Class III Locations of Hazardous (Classified) Locations Skill in identifying Hazardous (Classified) Locations within special occupancies **61. Installs Electrical Equipment and Wiring In Special Occupancies Other Than Hazardous (Classified) Locations:** Knowledge of installation requirements for health care facilities Knowledge of installation requirements for assembly occupancies Knowledge of ampacity requirements for special occupancies Knowledge of electrical requirements involving mobile homes, manufactured homes, and mobile home parks Knowledge of electrical requirements involving marinas and boatyards Knowledge of electrical requirements involving temporary installations Skill in determining size of service for Mobile Home park or RV park **62. Installs Electrical Equipment and Wiring For Emergency Systems, Legally Required or Optional Standby Systems, and Critical Operation Power Systems:** Knowledge of the use and installation requirements for emergency systems, legally required or optional standby systems, and critical operation power systems Knowledge of identification of emergency systems, standby systems, and critical operation power systems, and devices Skill in installing life safety emergency power sources Skill In installing legally required standby systems Skill in installing optional standby systems	1

63. Installs Circuits Operating Less Than 50 Volts, and Class 1, Class 2 and Class 3 Remote Control Signaling and Power Limited Circuits: Knowledge of the use and installation requirements for circuits operating less than 50 volts, and Class 1, Class 2 and Class 3 Remote Control Signaling and Power Limited Circuits Knowledge of conductor and current limiting devices for 12 vdc systems Skill in installing selected Cable types as per system selected Skill in applying installation standard to selected systems **64. Installs Energy Management Systems:** Knowledge of the use and installation requirements for Energy Management Systems Knowledge of load shaving Knowledge of energy "support" systems Knowledge of parallel and independent energy storage systems Knowledge of control circuits for energy management systems Skill in determining energy management system size vs. needs and production Skill in operating or programming systems in accordance with the Energy Code requirements **65. Installs Fire Alarm Systems:** Knowledge of the use and installation requirements for fire alarm systems Knowledge of primary power supply sources for fire alarm systems Knowledge of performance of Notification and Signaling Line Circuits Skill in applying Fire Code requirements to Systems	1
66. Installs Electric Vehicle Charging Stations: Knowledge of the conductors and equipment required for electric vehicle charging stations including minimum circuits sizes and ventilation requirements Skill in determining the cable limitations related to size, type and length for connection of electric vehicle charging stations **67. Installs Welders:** Knowledge of the requirements for a single welder or a group of welders fed from a single circuit including conductor sizing, overcurrent protection, and disconnecting means	1
68. Installs Electrical Wiring, Equipment and Bonding for Swimming Pools, Fountains, and Similar Installations: Knowledge of the installation requirements regarding electrical systems for swimming pools, fountains, and similar installations Skill in determining the specific bonding requirements for swimming pools, fountains and similar equipment Skill in applying personnel protection circuits in swimming pools, fountains, spas and similar areas	1

69. Install interconnected Electric Power Production Systems: Knowledge of the use and installation requirements for interconnected electric power production systems Knowledge of in-phase and out-of-phase energy systems Knowledge of energy support and energy shaving systems Knowledge of maximum volt and cycle deviation for different energy systems Skill in installing interconnected electrical power production systems to utility specifications Skill in applying installation standards for protection and operation of systems	1
70. Installs PV (Photovoltaic) Systems: Knowledge of the components, conductors, equipment and overcurrent protection requirements used in photovoltaic systems Knowledge of series and parallel PV source circuits Knowledge of combiners and disconnects Knowledge of PV source strings, VOC (open-circuit voltage), Isc (short circuit current), Vmax (voltage at maximum power output) & Imax (current at maximum power output) Knowledge of temperature effect on solar panel voltage Knowledge of grounding techniques for-solar system equipment Knowledge of source circuits, control circuits, sensing circuits and power circuits for solar, hydro, and wind electrical systems	1
71. Installs Wind Electric Systems and Fuel Cell Systems: Skill in identifying the components, conductors, equipment and overcurrent protection requirements used in wind electric systems Skill in identifying the components, conductors, equipment and overcurrent protection requirements used in fuel cell systems	1
72. Installs Feeders, Circuits and Equipment for Elevators: Knowledge of Electrical Requirements involving elevators, escalators, etc. Skill in identifying the feeder and branch circuit size and installation requirements for elevator equipment **73. Installs Electrical Supplies for Fire Pumps:** Knowledge of the electrical installation standard that governs fire pumps (NFPA 20) Skill in determining the electrical service, control and installation requirements for fire pumps	1

I. Communication Systems	1
74. Installs Communication Systems: Knowledge of installation requirements for communication cables Knowledge of hierarchy tables for communication cables Knowledge of grounding requirements for communication systems Knowledge of tower grounding Knowledge of terminations Skill in installing terminations for intersystem grounding Knowledge of requirements for the installation of cable inside a building Knowledge of cable types and uses within structures Knowledge of requirements for the installation of cable outside a building Knowledge of primary electrical protection Knowledge of clearances to other systems and grade Knowledge of lightning protection **75. Maintains Required Separation Between Communication Cables and Other Electrical Sources:** Knowledge of separation requirements between communication cables and other electrical sources	1

Additional Psychometric Criteria
Open book
Last two revisions of Code
4-choice Multiple Choice (items can also be in the format of 4-choice "hot spot")
No more than 5% negatively worded items
Cut score based on standard setting workshop
Number of scored items on exam: 100
Number of pre-test items: 15
The % of non-code items must be at least equal to 100% minus the % cutscore plus 1%.
Number of items relating to visual aids: 15%
No “none of the above” or “all of the above” items
Items must be referenced
All skill statements from the KSAs should be written at the application and analysis level
No true/false or essay items
Generally avoid absolute items with words such as “always” “all” or “never” - may use “shall” or “shall not”
No weighted items
Clones should be created when feasible although they must be designated as such so that clones do not appear on the same version of an examination.
Other "Enemies" should be marked and set so that they do not appear on the same version of an examination.

Appendix H

Journeyman Electrician Job Analysis Meeting SME Demographics

The tables listed below detail the demographics of the SMEs who participated in the panel meetings for the NASCLA Journeyman Electrician job analysis.

Table 9 depicts their estimate of the average price of contracts their company undertakes, ranging from less than $10,000 per job to over $100,000 per job, as follows:

Table 9
Size of Job Undertaken by SMEs' Companies

Average Size of Job	No. of SMEs
Less than $10K	**1**
$10K to $50K	**2**
$50K to $100K	**0**
Greater than $100K	**7**

The SMEs were also asked the number of jobs of each type of work below that they have performed during their career. Table 10 depicts the diversity and breadth among the SMEs throughout the electrical field.

Table 10
Types of Electrical Work Experience of Journeyman SMEs

Type of Electrical Work	Zero Jobs	1-5 jobs	6-10 jobs	11-25 jobs	More than 25 jobs
General Residential Wiring		2	1	3	8
General Commercial Wiring			4	2	12
General Industrial Wiring	1	5	1	2	7
Instrumentation/Calibration	7	4			5
Fire alarms/Fire Pumps	1	2	7	1	5
Security alarms/CCTV	2	7	2	1	3
Door/Gate Access Systems	2	7	2	2	2
Telecommunications	1	5	2	2	5
Temporary Installations		3	3	3	8
Equipment/Machinery/Engine/ Generator Installation/Repair/ Maintenance		2	4	3	5
Tower Construction	9	2		1	2
Underground Conduit			4	3	10
Fiber Optic Cable	2	6	1	2	2
Electrical Signs/Displays/ Scoreboards	1	7	2	2	3
Traffic Signals/Intelligent Transportation Systems	5	8	1		
Electrical Transmission/ Distribution Line Work	8	4	2		1
Electrical Substations	8	5			1
Transformers		2	4	2	8
Electrical Inspections	2	3	2	1	7
Fuel cell systems	11	2	1		
Photovoltaic systems	2	5	2	3	2
Wind energy systems	11	3			
Battery systems	4	3	2	3	3
Electrical Systems and Bonding for Swimming Pools	2	4	4	2	2

Tables 11 and 12 indicate where the SMEs reside and the locations in which the SMEs have worked as an electrical contractor.

Table 11
State of Residence of the Journeyman SMEs

State of Current Residence	No. of SMEs
Alaska	**1**
Arizona	**1**
California	**2**
Colorado	**1**
Florida	**3**
Idaho	**1**
Louisiana	**2**
Maryland	**2**

State of Current Residence	No. of SMEs
Nevada	**2**
New Hampshire	**1**
Oregon	**1**
Texas	**1**
Utah	**1**
Washington	**1**

Table 12
States in Which the SMEs Have Practiced as a Journeyman Electrical

State	No. of SMEs Who Have Worked There
Alabama	**1**
Alaska	**1**
Arizona	**1**
Arkansas	**1**
California	**4**
Colorado	**1**
Florida	**2**
Idaho	**2**
Louisiana	**2**
Maine	**1**
Nevada	**3**
New Hampshire	**1**

State	No. of SMEs Who Have Worked There
New York	**1**
North Carolina	**1**
Oregon	**1**
Pennsylvania	**1**
South Carolina	**1**
Texas	**2**
Utah	**1**
Vermont	**1**
Washington	**1**
Wisconsin	**1**
Wyoming	**1**
Canada	**1**

Appendix I

List of Journeyman Electrician SME Participants

First Journeyman Electrician Meeting

June 9 – 12, 2015, Dallas, Texas
Location: International Association of Electrical Inspectors

Madison Burnett
Training Director, Electrical JATC of Southern Nevada
Las Vegas, NV

Ronnie Gulino
Director of Field Services, ISC Contractors, LLC
Baton Rouge, LA

Palmer Hickman
Director of Code & Safety Training Curriculum Development
Electrical Training ALLIANCE
Upper Marlboro, MD

Jesse Jameson
Construction Compliance Supervisor, Washington Department of Labor & Industries
Tumwater, WA

Keith Lofland
Director of Education, International Association of Electrical Inspectors (IAEI),
Richardson, TX

Craig Monin
President, Lon's Electrical Service, Inc.
San Bernardino, CA

Nathan Philips
Owner, Integrated Electronic Systems
Eugene, OR

Roy Pollack
Director of Training and Compliance, Comcast Xfinity Home
Wellington, FL

Mike Querry
Construction Inspector Supervisor, Trinity River Authority
Arlington, TX

Alvin Leo Riley
Owner, Alvin Leo Riley
New Orleans, LA

Brad Stevens
Executive Director, Independent Electrical Contractors (IEC) of Utah
Midvale, UT

Joseph Wages Jr.
Technical Advisor, Education, Codes and Standards, International Association of Electrical Inspectors (IAEI)
Richardson, TX

Wesley Lamar Wheeler
National Director of Safety, National Electrical Contractors Association (NECA)
Bethesda, MD

Mick Williams
Electrical Program Manager, Idaho Division of Building Safety
Meridian, ID

Second Journeyman Electrician Meeting

September 1, 2015, San Diego, California
Location: Omni San Diego Hotel

Ryan Andrew
Wireman Instructor, Alaska Joint Electrical Apprenticeship and Training Trust
Anchorage, AK

Daniel Bierly
Senior Education Advisor, Western Electrical Contractors Association (WECA)
Flower Mound, TX

Jay Cannava
President, P.I. Electric, Inc.
Lake Park, FL

Palmer Hickman
Director of Code & Safety Training Curriculum Development
Electrical Training ALLIANCE
Upper Marlboro, MD

Jesse Jameson
Construction Compliance Supervisor, Washington Department of Labor & Industries
Tumwater, WA

Paul Lingo
Training Director, Independent Electrical Contractors (IEC) Rocky Mountain
Denver, CO

Matt Kuiper
Service Manager, K2 Electric
Phoenix, AZ

Craig Monin
President, Lon's Electrical Service, Inc.
San Bernardino, CA

Al Nyman
Director of Licensing Compliance & Regulatory Affairs, Sears Home Improvement Products, Inc.
Longwood, FL

Jack Lyons
Northeast Field Representative, National Electrical Manufacturers Association (NEMA)
West Chesterfield, MA

Jeffrey Sargent
Regional Electrical Code Specialist, National Fire Protection Association (NFPA)
Hampton Falls, NH

Wesley Lamar Wheeler
National Director of Safety, National Electrical Contractors Association (NECA)
Bethesda, MD

Mick Williams
Electrical Program Manager, Idaho Division of Building Safety
Meridian, ID

Doug Ziegenhogen
Instructor/Journeyman Wireman
Electrical JATC of Southern Nevada/IBEW LO 357
Las Vegas, NV

Appendix J

NASCLA Journeyman Electrician Job Analysis Survey

Journeyman Electricians Job Analysis (Domains & Tasks) Survey

Survey Instructions

The National Association of State Contractors Licensing Agencies (NASCLA) is asking for your help!

NASCLA is currently developing a nationally recognized **Journeyman Electrician** licensing trade examination. This exam would allow an electrical journeyman who passes this exam to use the exam grade for all participating states without a further exam, and would save the electrical journeyman the time and expense normally needed to take another exam. The electrician would still need to apply for the license in each state he or she goes to, and meet their requirements, but it would make it a more streamlined process.

We need your participation in this survey to help us make sure that the examination will reflect the work actually performed in the field and that it is representative of the work done in every area of the country, including your area. Your contributions will help ensure that new contractors are qualified to be licensed, and that the exam will be fair. When we have compiled the results from all of the surveys, we will send a copy of the results to everyone who participated. Thank you in advance for your assistance.

Definition of a Journeyman Electrician: *An Electrical Journeyman (Journeyperson) is an individual who has demonstrated competency in the knowledge and skills needed to properly perform the installation, maintenance and repair of electrical work conforming to applicable standards and codes.*

***Please note** that you can come back later to edit your responses or finish the survey if you choose to do so. Once you begin the survey, you will have to click “Next” and then click “Exit” at the top to leave the survey in order for your results to be saved. *If you do not click "Next",* your responses to that page will not be saved. After you have saved and exited the survey, you can go back in to the original survey to edit your responses or to finish, by copying and pasting the survey URL (that was sent to you in the original email) into your web browser from the same computer that was used to begin the survey. From there, you will be taken to the exact page that you last left.

Please also note that once you click ***“Done”*** at the end of the survey, you will **not** be able to reenter to change your answers.

This survey is to rank the importance and frequency of the Domains and Tasks needed as an entry level Journeyman Electrician.

Journeyman Electricians Job Analysis (Domains & Tasks) Survey

Survey Description

This survey will ask you to rate tasks common to entry level Journeyman Electricians, and the knowledge and skills needed to perform these tasks. The committee that developed these tasks determined 10 domains (major areas of work) associated with a journeyman electrician's profession. These are:

1. Interpreting Plans and Specifications
2. Basic Electrical Safety
3. Electrical Theory and Principles
4. Testing and Troubleshooting
5. General Code Requirements
6. Wiring and Protection
7. Wiring Methods and Materials
8. Equipment for General Use
9. Special Occupancies and Special Equipment
10. Special Conditions and Communication Systems

Each of these major areas have specific tasks associated with them that will be rated in this survey. Another survey will have the specific knowledge and skills viewed as necessary for performing each task.

Journeyman Electricians Job Analysis (Domains & Tasks) Survey

Demograhics

The information you provide here is voluntary and confidential and will be used only for the purpose of providing a description of survey participants.

If you have not worked in the Electrical Trade for at least five (5) years, including at least one (1) year at the Journeyman Electrician Level, please do not respond to this survey.

Are you currently or have you ever been licensed as a Journeyman Electrician (or equivalent)?

- ◯ Yes
- ◯ No

If YES, how many years have you been licensed as such?

Are you currently or have you ever been licensed as an Electrical Contractor (Master Electrician/Unlimited Electrician/Electrical Administrator)?

- ◯ Yes
- ◯ No

If YES, how many years have you been licensed as such?

Do you belong to an association for your electrical trade? If yes, please list the association name(s) below:

Journeyman Electricians Job Analysis (Domains & Tasks) Survey

In what state do you currently reside in?

- ◯ Alabama
- ◯ Alaska
- ◯ Arizona
- ◯ Arkansas
- ◯ California
- ◯ Colorado
- ◯ Connecticut
- ◯ Delaware
- ◯ District of Columbia
- ◯ Florida
- ◯ Georgia
- ◯ Hawaii
- ◯ Idaho
- ◯ Illinois
- ◯ Indiana
- ◯ Iowa
- ◯ Kansas
- ◯ Kentucky
- ◯ Louisiana
- ◯ Maine
- ◯ Maryland
- ◯ Massachusetts
- ◯ Michigan
- ◯ Minnesota
- ◯ Mississippi
- ◯ Missouri
- ◯ Montana
- ◯ Nebraska
- ◯ Nevada
- ◯ New Hampshire
- ◯ New Jersey
- ◯ New Mexico
- ◯ New York
- ◯ North Carolina
- ◯ North Dakota
- ◯ Ohio
- ◯ Oklahoma
- ◯ Oregon
- ◯ Pennsylvania
- ◯ Rhode Island
- ◯ South Carolina
- ◯ South Dakota
- ◯ Tennessee
- ◯ Texas
- ◯ Utah
- ◯ Vermont
- ◯ Virginia
- ◯ Washington
- ◯ West Virginia
- ◯ Wisconsin
- ◯ Wyoming

Other (please specify)

In what state(s) do you have experience as a journeyman electrician (or equivalent to)?

- [ ] Alabama
- [ ] Alaska
- [ ] Arizona
- [ ] Arkansas
- [ ] California
- [ ] Colorado
- [ ] Connecticut
- [ ] Delaware
- [ ] District of Columbia
- [ ] Florida
- [ ] Georgia
- [ ] Hawaii
- [ ] Idaho
- [ ] Illinois
- [ ] Indiana
- [ ] Iowa
- [ ] Kansas
- [ ] Kentucky
- [ ] Louisiana
- [ ] Maine
- [ ] Maryland
- [ ] Massachusetts
- [ ] Michigan
- [ ] Minnesota
- [ ] Mississippi
- [ ] Missouri
- [ ] Montana
- [ ] Nebraska
- [ ] Nevada
- [ ] New Hampshire
- [ ] New Jersey
- [ ] New Mexico
- [ ] New York
- [ ] North Carolina
- [ ] North Dakota
- [ ] Ohio
- [ ] Oklahoma
- [ ] Oregon
- [ ] Pennsylvania
- [ ] Rhode Island
- [ ] South Carolina
- [ ] South Dakota
- [ ] Tennessee
- [ ] Texas
- [ ] Utah
- [ ] Vermont
- [ ] Virginia
- [ ] Washington
- [ ] West Virginia
- [ ] Wisconsin
- [ ] Wyoming

Other (please specify)

As of October 2015, approximately how many years have you worked in the electrical profession for at least 30 hours per week (include any apprenticeship training)?

Have you had any years' experience supervising electricians?

- ◯ Yes
- ◯ No

If yes, how many years?

How many people are employed in your organization?

- ◯ Less than 6 people
- ◯ 6 - 25 people
- ◯ 25 - 50 people
- ◯ More than 50 people

Which of the following options best represents the average cost ofeach electrical project that your firm undertakes?

- ◯ Less than $10,000
- ◯ Between $10,000 and $50,000
- ◯ Between $50,000 and $100,000
- ◯ Over $100,000

What is your gender?

- ◯ Male
- ◯ Female

What is your national origin, if other than the U.S.?

What is the race/ethnicity that you most closely identify yourself as?

- ☐ AfricanAmerican (nonHispanic)
- ☐ Asian
- ☐ Native Hawaiian or Pacific Islander
- ☐ Caucasian (non-Hispanic)
- ☐ Hispanic
- ☐ Native American or Alaskan Native
- ☐ Middle Eastern
- ☐ Other

What is your age (check one)?

- ◯ 20 - 25 years
- ◯ 26 - 35 years
- ◯ 36 - 45 years
- ◯ 46 - 55 years
- ◯ 56 - 65 years
- ◯ Over 66 years

You have now completed the SECTION I of this survey.

Journeyman Electricians Job Analysis (Domains & Tasks) Survey

Rating Scale for the TASKS Performed as a Journeyman Electrician

Rating TASK Frequency and Importance Instructions

Journeyman Electricians licensed in 15 states identified the tasks as well as the knowledge and skills that you will be asked to rate. The following section includes different tasks performed by journeyman electricians. You will be asked to rate each task in terms of:

(1) the **frequency** with which **you OR the employees you supervise** perform each task

AND

(2) the **importance** of a **newly licensed journeyman electrician** being able to perform the task **competently**

Rating scale for FREQUENCY of performing the task

In my work and/or the work of my employees:

0 - This task is NOT performed
1 - This task is RARELY performed
2 - This task is SOMETIMES performed
3 - This task is FREQUENTLY performed

Rating scale for IMPORTANCE of performing the task

For a newly licensed journeyman electrician:

0 - This task is NOT important
1 - This task is MINIMALLY important
2 - This task is MODERATELY important
3 - This task is VERY important

Journeyman Electricians Job Analysis (Domains & Tasks) Survey

Domain 1. Interpreting Plans and Specifications

Domain 1. Interpreting Plans and Specifications

	Frequency	Importance
1. Identifies Locations for and Types of Outlets and Devices		
2. Identifies the Symbols		
3. Selects Quantity and Types of Equipment		
4. Identifies Equipment Locations		
5. Identifies Installation Details		
6. Identifies Working Clearances		
7. Identifies Conflicts with Other Installations		
8. Interprets Specifications		
9. Identifies Relationship Between Drawings and Physical Location		

Journeyman Electricians Job Analysis (Domains & Tasks) Survey

Domain 2: Basic Electrical Safety

Domain 2: Basic Electrical Safety

	Frequency	Importance
10. Utilizes the Electrical PPE (Personal Protective Equipment)		
11. Uses Tools Properly		
12. Applies Lockout/Tagout		

Domain 3: Electrical Theory and Principles

	Frequency	Importance
13. Uses Ohm's Law in Calculations		
14. Calculates the Primary and Secondary Parameters of Various Transformers		

Domain 4: Testing and Troubleshooting

	Frequency	Importance
15. Measures Amperage, Voltage, Resistance, Insulation Resistance		
16. Verifies Meter Operation(s)		

Domain 5: General Code Requirements

	Frequency	Importance
17. Applies Article 90 to the Job		
18. Determines Working Space Requirements		
19. Selects Enclosure for the Proper Application		
20. Selects Equipment with the Proper Interrupting Rating		
21. Determines the Proper Conductors Needed for the Application		
22. Protects Integrity of Electrical Equipment and Connections		
23. Evaluates Equipment for Suitability based on Listing and Labeling		
24. Identifies Equipment Warning Labels (motor disconnects, arc flash hazards, motor nameplates, etc.):		

Domain 6: Wiring and Protection

	Frequency	Importance
25. Installs Grounding Electrode Conductors, Equipment Grounding Conductors and Bonding Conductors		
26. Installs Proper Overcurrent Protective Device		
27. Installs Branch Circuits		
28. Installs Feeders and Disconnecting Means		
29. Installs GFCI/AFCI Protection		
30. Installs Receptacles		
31. Installs Service Equipment & Service Conductors		
32. Installs Tap Conductors		
33. Installs Grounding Electrodes		
34. Installs Grounding and Bonding of Separately Derived Systems		
35. Installs Grounded Conductors		

Domain 7: Wiring Methods and Materials

	Frequency	Importance
36. Selects and Installs Cabinets, Boxes, Fittings, Conduit Bodies and other Enclosures		
37. Installs Electrical Equipment and Systems		
38. Selects and Installs Conductors		
39. Selects and Installs Cables (Types AC, MC, NM, etc.)		
40. Selects and Installs Raceways		
41. Installs Auxiliary Gutters, Cable Trays and Wireways		
42. Installs Busways		

Domain 8: Equipment for General Use

	Frequency	Importance
43. Installs Appliances, Fixed Electric Space Heating Equipment, Electric Deicing and Snow Melting Equipment, and Fixed Electric Pipeline and Vessel Heating Equipment		
44. Selects, Sizes, Installs and Protects Feeders, Branch Circuits, Control Circuits, Disconnecting Means, and Controllers for Motors and Air Conditioners and Refrigeration Equipment (Article 430 and 440)		
45. Installs Generators		
46. Installs Transformers		

Domain 9: Special Occupancies and Special Equipment

	Frequency	Importance
47. Installs Electrical and Electronic Equipment and Wiring For Hazardous (Classified) Locations		
48. Installs Electrical Equipment and Wiring In Special Occupancies Other Than Hazardous (Classified) Locations		
49. Installs Special Equipment		

Journeyman Electricians Job Analysis (Domains & Tasks) Survey

Domain 10: Special Conditions and Communications Systems

Domain 10: Special Conditions and Communication Systems

	Frequency	Importance
50. Installs Circuits Operating Less Than 50 Volts, and Class 1, Class 2 and Class 3 Remote Control Signaling and Power Limited Circuits, Fire Resistive Cables and Fire Alarm Systems		
51. Installs Communication Systems		

Are there any additional Tasks statements that you believe were forgotten? If so, please list your ideas below:

You have now completed the SECTION II of this survey.

Journeyman Electricians Job Analysis (Domains & Tasks) Survey

Determining the Number of Items that Should be Tested in Each Domain

The next 10 lines reflect the domains (main content areas) that will be covered in the nationally recognized Journeyman Electrician examination. Please provide your input as to the approximate number of questions that should be tested in each of these areas.

For example, assume the exam consists of 100 questions. Therefore, the total of your estimate for these 10 domains must equal 100. If your answers do not equal 100 an error message will pop up asking you to adjust.

***Please note, the number of actual examination questions has not yet been determined, the 100 example is simply for an even number to calculate.**

1. Interpreting Plans and Specifications
2. Basic Electrical Safety
3. Electrical Theory and Principles
4. Testing and Troubleshooting
5. General Code Requirements
6. Wiring and Protection
7. Wiring Methods and Materials
8. Equipment for General Use
9. Special Occupancies and Special Equipment
10. Special Conditions and Communication Systems

Journeyman Electricians Job Analysis (Knowledge & Skills) Survey

Survey Instructions

The National Association of State Contractors Licensing Agencies (NASCLA) is asking for your help!

NASCLA is currently developing a nationally recognized **Journeyman Electrician** licensing trade examination. This exam would allow an electrical journeyman who passes this exam to use the exam grade for all participating states without a further exam, and would save the electrical journeyman the time and expense normally needed to take another exam. The electrician would still need to apply for the license in each state he or she goes to, and meet their requirements, but it would make it a more streamlined process.

We need your participation in this survey to help us make sure that the examination will reflect the work actually performed in the field and that it is representative of the work done in every area of the country, including your area. Your contributions will help ensure that new contractors are qualified to be licensed, and that the exam will be fair. When we have compiled the results from all of the surveys, we will send a copy of the results to everyone who participated. Thank you in advance for your assistance.

Definition of a Journeyman Electrician: *An Electrical Journeyman (Journeyperson) is an individual who has demonstrated competency in the knowledge and skills needed to properly perform the installation, maintenance and repair of electrical work conforming to applicable standards and codes.*

***Please note** that you can come back later to edit your responses or finish the survey if you choose to do so. Once you begin the survey, you will have to click “Next” and then click “Exit” at the top to leave the survey in order for your results to be saved. *If you do not click "Next",* your responses to that page will not be saved. After you have saved and exited the survey, you can go back in to the original survey to edit your responses or to finish, by copying and pasting the survey URL (that was sent to you in the original email) into your web browser from the same computer that was used to begin the survey. From there, you will be taken to the exact page that you last left.

Please also note that once you click ***“Done”*** at the end of the survey, you will **not** be able to reenter to change your answers.

This survey is to rank the importance of the Knowledge and Skills related to the Tasks needed as a entry level Journeyman Electrician.

Journeyman Electricians Job Analysis (Knowledge & Skills) Survey

Survey Description

This survey will ask you to rate the knowledges and skills common to entry level Journeyman Electricians.

The committee that determined these knowledges and skills identified 10 domains (major categories of work) into which all of the main tasks associated with a journeyman's work would fall. These are:

1. Interpreting Plans and Specifications
2. Basic Electrical Safety
3. Electrical Theory and Principles
4. Testing and Troubleshooting
5. General Code Requirements
6. Wiring and Protection
7. Wiring Methods and Materials
8. Equipment for General Use
9. Special Occupancies and Special Equipment
10. Special Conditions and Communication Systems

Each of these major areas have specific tasks associated with them and the tasks then have specific knowledge and skills viewed as necessary for performing the tasks.

Journeyman Electricians Job Analysis (Knowledge & Skills) Survey

Demographics

The information you provide here is voluntary and confidential and will be used only for the purpose of providing a description of survey participants.

If you have not worked in the Electrical Trade for at least five (5) years, including at least one (1) year at the Journeyman Electrician level, please do not respond to this survey.

Are you currently or have you ever been licensed as a Journeyman Electrician (or equivalent)?

- ◯ Yes
- ◯ No

If YES, how many years have you been licensed as such?

Are you currently or have you ever been licensed as an Electrical Contractor (Master Electrician/Unlimited Electrician/Electrical Administrator)?

- ◯ Yes
- ◯ No

If YES, how many years have you been licensed as such?

Do you belong to an association for your electrical trade? If yes, please list the association name(s) below:

Journeyman Electricians Job Analysis (Knowledge & Skills) Survey

In what state do you currently reside in?

- ◯ Alabama
- ◯ Alaska
- ◯ Arizona
- ◯ Arkansas
- ◯ California
- ◯ Colorado
- ◯ Connecticut
- ◯ Delaware
- ◯ District of Columbia
- ◯ Florida
- ◯ Georgia
- ◯ Hawaii
- ◯ Idaho
- ◯ Illinois
- ◯ Indiana
- ◯ Iowa
- ◯ Kansas
- ◯ Kentucky
- ◯ Louisiana
- ◯ Maine
- ◯ Maryland
- ◯ Massachusetts
- ◯ Michigan
- ◯ Minnesota
- ◯ Mississippi
- ◯ Missouri
- ◯ Montana
- ◯ Nebraska
- ◯ Nevada
- ◯ New Hampshire
- ◯ New Jersey
- ◯ New Mexico
- ◯ New York
- ◯ North Carolina
- ◯ North Dakota
- ◯ Ohio
- ◯ Oklahoma
- ◯ Oregon
- ◯ Pennsylvania
- ◯ Rhode Island
- ◯ South Carolina
- ◯ South Dakota
- ◯ Tennessee
- ◯ Texas
- ◯ Utah
- ◯ Vermont
- ◯ Virginia
- ◯ Washington
- ◯ West Virginia
- ◯ Wisconsin
- ◯ Wyoming

Other (please specify)

In what state(s) have you performed work as an electrician?

- [ ] Alabama
- [ ] Alaska
- [ ] Arizona
- [ ] Arkansas
- [ ] California
- [ ] Colorado
- [ ] Connecticut
- [ ] Delaware
- [ ] District of Columbia
- [ ] Florida
- [ ] Georgia
- [ ] Hawaii
- [ ] Idaho
- [ ] Illinois
- [ ] Indiana
- [ ] Iowa
- [ ] Kansas
- [ ] Kentucky
- [ ] Louisiana
- [ ] Maine
- [ ] Maryland
- [ ] Massachusetts
- [ ] Michigan
- [ ] Minnesota
- [ ] Mississippi
- [ ] Missouri
- [ ] Montana
- [ ] Nebraska
- [ ] Nevada
- [ ] New Hampshire
- [ ] New Jersey
- [ ] New Mexico
- [ ] New York
- [ ] North Carolina
- [ ] North Dakota
- [ ] Ohio
- [ ] Oklahoma
- [ ] Oregon
- [ ] Pennsylvania
- [ ] Rhode Island
- [ ] South Carolina
- [ ] South Dakota
- [ ] Tennessee
- [ ] Texas
- [ ] Utah
- [ ] Vermont
- [ ] Virginia
- [ ] Washington
- [ ] West Virginia
- [ ] Wisconsin
- [ ] Wyoming

Other (please specify)

As of October 2015, approximately how many years have you worked in the electrical profession for at least 30 hours per week (include any apprenticeship training)?

Have you had any years' experience supervising electricians?

- ◯ Yes
- ◯ No

If yes, how many years?

How many people are employed in your organization?

- ◯ Less than 6 people
- ◯ 6 - 25 people
- ◯ 25 - 50 people
- ◯ More than 50 people

Which of the following options best represents the average cost ofeach electrical project that your firm undertakes?

- ◯ Less than $10,000
- ◯ Between $10,000 and $50,000
- ◯ Between $50,000 and $100,000
- ◯ Over $100,000

What is your gender?

- ◯ Male
- ◯ Female

What is your national origin, if other than the U.S.?

What is the race/ethnicity that you most closely identify yourself as?

- ☐ AfricanAmerican (nonHispanic)
- ☐ Asian
- ☐ Native Hawaiian or Pacific Islander
- ☐ Caucasian (non-Hispanic)
- ☐ Hispanic
- ☐ Native American or Alaskan Native
- ☐ Middle Eastern
- ☐ Other

What is your age (check one)?

- ◯ 20 - 25 years
- ◯ 26 - 35 years
- ◯ 36 - 45 years
- ◯ 46 - 55 years
- ◯ 56 - 65 years
- ◯ Over 66 years

You have now completed the SECTION I of this survey.

Journeyman Electricians Job Analysis (Knowledge & Skills) Survey

Rating Scale for the KNOWLEDGE and SKILLS Required of a Journeyman Electrician

Rating KNOWLEDGE and SKILLS Importance Instructions

Journeyman Electricians licensed in 15 states identified the tasks as well as the knowledge and skills that you will be asked to rate.

In order for a newly licensed Journeyman Electrician to perform the task **competently**, how important is the following knowledge or skill?:

Rating scale for IMPORTANCE of performing the task

0 - NOT important
1 - Of MINOR importance
2 - MODERATELY important
3 - VERY important

Journeyman Electricians Job Analysis (Knowledge & Skills) Survey

Domain 1: Interpreting Plans and Specifications

Task: Identifies Locations for and Types of Outlets and Devices

	Importance Rating
1. Knowledge of the appropriate type of devices and outlets	
2. Skill in determining the height and location of required outlets and devices	
3. Skill in using scale drawings for dimensions and layout	

Task: Identifies the Symbols

	Importance Rating
4. Knowledge of the electrical symbols (receptacle, switch, motor, range, telephone, door contact)	
5. Knowledge of basic wiring diagrams and schematics (controls schematics, 3 way switches)	
6. Knowledge of symbols used on drawings	
7. Skill in interpreting symbols on drawings	

Task: Selects Quantity and Types of Equipment

	Importance Rating
8. Knowledge of listing and labeling of equipment	
9. Knowledge of materials for conditions	
10. Knowledge of the definition of "equipment"	
11. Skill in selecting the material for the project including type and listing	

Task: Identifies Equipment Locations

	Importance Rating
12. Knowledge of working space requirements including width, depth, and height	
13. Knowledge of mounting height of service equipment	
14. Knowledge of definitions pertaining to accessible, readily accessible and not readily accessible	
15. Skill in determining the working space requirements including width, depth, and height	
16. Skill in determining the mounting height of service equipment"	

Task: Identifies Installation Details

	Importance Rating
17. Knowledge of detail drawings for installation guidelines	
18. Knowledge of manufacturers installation instructions	
19. Skill in determining the installation requirements for equipment	
20. Skill in installing support systems for wiring methods and equipment	

Task: Identifies Working Clearances

	Importance Rating
21. Knowledge of working clearances based on voltage levels and condition	
22. Skill in determining working clearances based on the voltage levels and conditions	
23. Skill in determining guarding requirements for live parts	

Task: Identifies Conflicts with Other Installations

	Importance Rating
24. Knowledge of the dedicated electrical space	
25. Knowledge of symbols and drawings for other trades	
26. Skill in assessing the drawings of other trades	
27. Skill in determining the dedicated working space	

Task: Interprets Specifications

	Importance Rating
28. Knowledge of specifications and drawings	
29. Skill in selecting the appropriate material per the specifications	

Task: Identifies Relationship Between Drawings and Physical Location

	Importance Rating
30. Knowledge of elevation, architectural and detail drawings	
31. Skill in matching drawing sheets and matching lines of drawings	

Journeyman Electricians Job Analysis (Knowledge & Skills) Survey

Domain 2: Basic Electrical Safety

Task: Utilizes the Electrical PPE (Personal Protective Equipment)

	Importance Rating
32. Knowledge of the use of hand protection	
33. Knowledge of the use of eye protection	
34. Knowledge of the use of hearing protection	
35. Knowledge of footwear	
36. Knowledge of hardhats	
37. Knowledge of protective coating	
38. Knowledge of confined space safety	
39. Knowledge of confined space hazards	
40. Knowledge of confined space controls,	
41. Knowledge of confined space protection,	
42. Knowledge of confined space PPE	

Task: Uses Tools Properly

	Importance Rating
43. Knowledge of the proper maintenance of a particular tool	
44. Knowledge of evaluating the tool for use as to if it is safe or needs repair	
45. Knowledge of trade hand tools	
46. Knowledge of trade power tools	
47. Skill in identifying and selecting proper tool for task	
48. Skill in maintaining tools (cleaning, sharpening, lubricating)	
49. Skill in proper use of tools	

Task: Uses Ladders

	Importance Rating
50. Knowledge of ladder rating and capacity	
51. Knowledge of ladder material types	
52. Knowledge of extension ladder setup	
53. Knowledge of ladder working heights	
54. Knowledge of requirements regarding ladders	

Task: Applies Lockout/Tagout

	Importance Rating
55. Knowledge of lockout/tagout requirements	
56. Knowledge of lockout/tagout procedures	
57. Knowledge of lockout/tagout documentation requirements	
58. Skill in documenting lockout/tagout	

Journeyman Electricians Job Analysis (Knowledge & Skills) Survey

Domain 3: Electrical Theory and Principles

Task: Uses Ohm's Law in Calculations

	Importance Rating
59. Knowledge of units of measurement	
60. Knowledge of Ohm's Law	
61. Knowledge of the basic Ohm's law formulas	
62. Knowledge of power factor	
63. Skill in calculating resistance	
64. Skill in calculating current	
65. Skill in calculating voltage	
66. Skill in calculating power	
67. Skill in calculating voltage drop formulas	
68. Skill in calculating three phase circuit values	

Task: Calculates the Primary & Secondary Parameters of Various Transformers

	Importance Rating
69. Knowledge of transformer connections	
70. Knowledge of application of autotransformers (buck boost)	
71. Knowledge of application of isolation transformers	
72. Knowledge of application of step up and step down transformers	
73. Skill in calculating transformer full load currents	
74. Skill in calculating transformer current based on winding ratios and transformer configuration	

Journeyman Electricians Job Analysis (Knowledge & Skills) Survey

Domain 4: Testing and Troubleshooting

Task: Measures Amperage, Voltage, Resistance, Insulation Resistance

	Importance Rating
75. Knowledge of current measuring equipment	
76. Knowledge of voltage measuring equipment	
77. Knowledge of resistance measurement equipment	
78. Knowledge of insulation measuring equipment	
79. Knowledge of troubleshooting GFCI/AFCI circuits	

Task: Verifies Meter Operation(s)

	Importance Rating
80. Knowledge of meter functions	
81. Knowledge of meter settings	
82. Knowledge of meter ratings (voltage rating and category rating)	
83. Knowledge of testing procedures for verification of de-energized circuits	

Journeyman Electricians Job Analysis (Knowledge & Skills) Survey

Domain 5: General Code Requirements

Task: Applies Article 90 to the Job

	Importance Rating
84. Knowledge of what is covered by the code	
85. Knowledge of special permission or local jurisdiction	
86. Knowledge of the code arrangement and its enforcement (90.3, 90.4)	

Task: Determines Working Space Requirements

	Importance Rating
87. Knowledge of voltage and amperage of equipment being used	
88. Knowledge of working space requirements	
89. Knowledge of the configuration of the equipment	
90. Knowledge of equipment accessibility requirements (other than ADA [Americans with Disabilities Act])	
91. Skill in determining working clearances around equipment	
92. Skill in determining entrance to and egress from working spaces	

Task: Selects Enclosure for the Proper Application

	Importance Rating
93. Knowledge of the installation location	
94. Knowledge of the environmental conditions	
95. Knowledge of the NEMA (National Electrical Manufacturers Association) ratings	
96. Skill in determining the NEMA enclosure rating for the environmental conditions of the installation	
97. Skill in applying NEC (National Electrical Code) rules to application of enclosures	

Task: Selects Equipment with the Proper Interrupting Rating

	Importance Rating
98. Knowledge of fault current rating of equipment	
99. Knowledge of interrupting rating of overcurrent devices	
100. Skill in selecting the overcurrent device with the correct interrupting rating	

Task: Determines the Proper Conductors Needed for the Application

	Importance Rating
101. Knowledge of environmental conditions (wet, damp, dry, ambient temperature) surrounding use of the electrical application and their effect on the choice of insulation	
102. Knowledge of temperature limitation of conductors	
103. Knowledge of the types of insulation	
104. Knowledge of characteristics of cable construction	
105. Knowledge of the ampacity rating of the conductor	
106. Skill in applying NEC ampacity tables for wire and cable selection	
107. Skill in determining the conductor ampacity based on the ambient temperature and/or number of current carrying conductors	

Task: Protects Integrity of Electrical Equipment and Connections:

	Importance Rating
108. Knowledge of method to prevent contamination of electrical equipment	
109. Knowledge of torque values	
110. Knowledge of effects of damage related to improper installation of dissimilar metals	
111. Knowledge of materials and methods for making electrical connections	
112. Skill in performing torque function on terminations	
113. Skill in closing unused openings	
114. Skill in neat-and-workmanlike installation of materials	

Task: Evaluates Equipment for Suitability based on Listing and Labeling

	Importance Rating
115. Knowledge of the impact of the product listing with field modifications to equipment	
116. Knowledge of a nationally recognized testing laboratory's (NRTL's) Product Safety Standards	
117. Knowledge of environment and impact on listing and labeling	

Task: Identifies equipment warning labels (motor disconnects, arc flash hazards, motor nameplates, etc.)

	Importance Rating
118. Knowledge of label content and its meaning	
119. Knowledge of when to apply labels	

Journeyman Electricians Job Analysis (Knowledge & Skills) Survey

Domain 6: Wiring and Protection

Task: Installs Grounding Electrode Conductors, Equipment Grounding Conductors and Bonding Conductors

	Importance Rating
120. Knowledge of various types of equipment grounding conductors	
121. Knowledge of various types of grounding electrode conductors	
122. Knowledge of where bonding conductors are required	
123. Knowledge of when equipment is required to be connected to an equipment grounding conductor	
124. Knowledge of ground loops in instrumentation circuits	
125. Knowledge of Ground Rings	
126. Knowledge of bonding and termination techniques	
127. Skill in applying installation rules for grounding electrode conductors, equipment grounding conductors and bonding conductors	
128. Skill in applying the sizing of grounding electrode conductors, equipment grounding conductors and bonding conductors	
129. Skill in applying Article 250 to grounding and bonding	

Task: Installs Proper Overcurrent Protective Device

	Importance Rating
130. Knowledge of overcurrent protective device, rating and locations	
131. Skill in applying AIC (amperes interrupting current) ratings to overcurrent protective device	
132. Skill in determining proper size of overcurrent protective device	

Task: Installs Branch Circuits

	Importance Rating
133. Knowledge of sizing and voltage limitations of branch circuits	
134. Knowledge of overcurrent protection/disconnecting means of multi wire branch circuits	
135. Skill in determining voltage limitations of branch circuits	
136. Skill in determining size of branch circuit conductors	
137. Skill in determining the ampacity and number of branch circuits needed for various applications	

Task: Installs Feeders and Disconnecting Means

	Importance Rating
138. Knowledge of the rating and installation requirements of feeders and disconnecting means required for a specific application	
139. Skill in determining the size of a feeder (includes size of conductors, raceway, and overcurrent protection)	

Task: Installs GFCI/AFCI Protection

	Importance Rating
140. Knowledge of GFCI	
141. Knowledge of AFCI	
142. Knowledge of locations requirements for GFCI and AFCI	
143. Skill in installing GFCI/AFCI protection	

Task: Installs Receptacles

	Importance Rating
144. Knowledge of the number, placement and types of receptacles	
145. Knowledge of the use of the space in which the receptacles are being placed	
146. Knowledge of environments in which receptacles are being used	
147. Knowledge of branch circuit types, identification and limitations	

Task: Installs Service Equipment & Service Conductors

	Importance Rating
148. Knowledge of the proper rating and installation requirements for service equipment and service conductors for an application	
149. Knowledge of service clearances	
150. Knowledge of the identification of a grounded or grounding conductor	
151. Skill in determining the size of a service (includes size of conductors, raceway, and overload protection)	
152. Skill in installation of service equipment	
153. Skill in determining the size of the feeder or neutral load and conductor size needed	

Task: Installs Tap Conductors

	Importance Rating
154. Knowledge of the tap rules regarding tap conductors	
155. Knowledge of overcurrent protection for transformers using the tap rules	
156. Skill in determining size of a tap conductor	
157. Skill in determining the size of transformer overcurrent protection and conductor sizing based on the NEC tap rules	

Task: Installs Grounding Electrodes

	Importance Rating
158. Knowledge of type of and installation requirements for grounding electrode	
159. Knowledge of interconnection of grounding electrodes to form a grounding electrode system	
160. Knowledge of the connection to the electrode system	
161. Skill in installing and connecting to the grounding electrode system	

Task: Installs Grounding and Bonding of Separately Derived Systems

	Importance Rating
162. Knowledge of the method for grounding and bonding separately derived systems	
163. Skill in calculating the size of grounding and bonding conductors for separately derived systems	

Task: Installs Grounded Conductors

	Importance Rating
164. Knowledge of connections of grounded conductors	
165. Knowledge of identification requirements for grounded conductors and their terminations	

NASCLA
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Journeyman Electricians Job Analysis (Knowledge & Skills) Survey

Domain 7: Wiring Methods and Materials

Task: Selects and Installs Cabinets, Boxes, Fittings, Conduit Bodies and other Enclosures

	Importance Rating
165. Knowledge of selection requirements for the number of wires for a box size	
166. Knowledge of location requirements for boxes, fittings and conduit bodies	
167. Knowledge of selection, sizing and installation requirements for cabinets, boxes, conduit bodies, fittings and other enclosures	
168. Knowledge of fireproofing requirements and methods at penetrations	
169. Skill in determining conductor box fill	
170. Skill in determing the size of a box for conductors 4 AWG or larger	

Task: Installs Electrical Equipment and Systems

	Importance Rating
171. Knowledge of effects of corrosion, deterioration, and effects of temperature on electrical equipment	
172. Knowledge of burial depth, branch circuit overcurrent protection ratings, spacings, and conductor installation requirements for underground installations	
173. Skill in protecting electrical equipment from corrosion, mechanical damage, deterioration and effects of temperature	

Task: Selects and Installs Conductors

	Importance Rating
174. Knowledge of conduit fill requirements	
175. Skill in calculating conductor ampacities based on condition of use	
176. Skill in identifying conductor ampacity, size, material and insulation type	

Task: Selects and Installs Cables (Types AC, MC, NM, etc.)

	Importance Rating
177. Knowledge of the requirements for the use of and installation of cables	
178. Skill in installing support for cables used for the appropriate application	

Task: Selects and Installs Raceways

	Importance Rating
179. Knowledge of the requirements for the use of and installation of raceways	
180. Knowledge of the calculations and tools necessary to make bends in raceways	
181. Skill in determining size and installation requirements for raceway systems	

Task: Installs Auxiliary Gutters, Cable Trays and Wireways:

	Importance Rating
182. Knowledge of the requirements for the use of and installation of auxiliary gutters, cable trays and wireways	
183. Skill in determining auxiliary gutter, cable tray and wireway size	

Task: Installs Busways

	Importance Rating
184. Knowledge of the requirements for the use of and installation of busways	

Journeyman Electricians Job Analysis (Knowledge & Skills) Survey

Domain 8: Equipment for General Use

Task: Installs Appliances, Fixed Electric Space Heating Equipment, Electric Deicing and Snow Melting Equipment, and Fixed Electric Pipeline and Vessel Heating Equipment

	Importance Rating
185. Knowledge of requirements for appliances, fixed electric space heating equipment, electric deicing and snow melting equipment, and fixed electric pipeline and vessel heating equipment	

Task: Selects, Sizes, Installs and Protects Feeders, Branch Circuits, Control Circuits, Disconnecting Means, and Controllers for Motors and Air Conditioners and Refrigeration Equipment (Article 430 and 440)

	Importance Rating
186. Knowledge of the installation requirements of motors and their uses	
187. Knowledge of the various types of motors and their uses	
188. Knowledge of the installation requirements of HVACR (Heating, Ventilation, Air Conditioning and Refrigeration) equipment and their uses	
189. Skill in determining the proper size overcurrent protective device	
190. Skill in determining the proper size disconnecting means	
191. Skill in determining the size controller	
192. Skill in determining the size of conductors and overcurrent devices used for control circuits	
193. Skill in determining motor overload protection sizing	

Task: Installs Generators

	Importance Rating
194. Knowledge of installation requirements and protection for generators	
195. Knowledge of automatic or manual transfer switch installations	
196. Knowledge of separately derived and non-separately derived systems	
197. Knowledge of installing life safety emergency power sources	
198. Knowledge of installing legally required standby systems	
199. Skill in installing optional standby systems	

Task: Installs Transformers

	Importance Rating
200. Knowledge of selection, rating, protection and installation requirements for transformers	
201. Skill in selecting and installing the size and type of transformer	

Journeyman Electricians Job Analysis (Knowledge & Skills) Survey

Domain 9: Special Occupancies and Special Equipment

Task: Installs Electrical and Electronic Equipment and Wiring For Hazardous (Classified) Locations

	Importance Rating
202. Knowledge of the installation requirements for hazardous (classified) locations	
203. Knowledge of the installation requirements for the divisions and zones within the Class I, Class II, and Class III locations of hazardous (classified) locations	
204. Skill in identifying hazardous (classified) locations within special occupancies	
205. Skill in identifying fittings for hazardous (classified) locations	

Task: Installs Electrical Equipment and Wiring In Special Occupancies Other Than Hazardous (Classified) Locations

	Importance Rating
206. Knowledge of installation requirements for special occupancies	
207. Knowledge of electrical requirements involving mobile homes, manufactured homes, and mobile home parks	
208. Knowledge of electrical requirements involving marinas and boatyards	
209. Knowledge of electrical requirements involving temporary installations	
210. Skill in determining the outlets required for a manufactured home	
211. Skill in determining the disconnecting means for a manufactured home	
212. Skill in determining the feeder conductors for a manufactured home	
213. Skill in determining services and feeders for mobile home parks	

Task: Installs Special Equipment

	Importance Rating
214. Knowledge of energy management systems	
215. Knowledge of instrumentation tray cables (ITC)	
216. Knowledge of electric signs and outline lighting	
217. Knowledge of electric components for cranes and hoists	
218. Knowledge of electric vehicle charging stations	
219. Knowledge of installation of welders	
220. Knowledge of electrical wiring, equipment and bonding for swimming pools, fountains, and similar installations	
221. Knowledge of PV (Photovoltaic) systems:	
222. Knowledge of wind electric systems	
223. Knowledge of fuel cell systems	
224. Knowledge of feeders, circuits and equipment for elevators	
225. Knowledge of informational technology equipment and modular data centers	
226. Knowledge of electrical components fire pumps	

Journeyman Electricians Job Analysis (Knowledge & Skills) Survey

Domain 10: Special Conditions and Communications Systems

Task: Installs Circuits Operating Less Than 50 Volts, and Class 1, Class 2 and Class 3 Remote Control Signaling and Power Limited Circuits, Fire Resistive Cables and Fire Alarm Systems

	Importance Rating
227. Knowledge of the use and installation requirements for circuits and equipment for systems operating less than 50 volts, and Class 1, Class 2 and Class 3 remote control signaling and power limited circuits, fire resistive cables and fire alarm systems	
228. Knowledge of the use and installation requirements for fire alarm systems	
229. Knowledge of primary power supply sources for fire alarm systems	
230. Skill in selecting cable types for Class 1, Class 2 and Class 3 remote control signaling and power limited circuits, fire resistive cables and fire alarm systems	

Task: Installs Communication Systems

	Importance Rating
231. Knowledge of communication cable inside and outside a building	
232. Knowledge of installation and/or removal of communication cables	
233. Knowledge of required separation between communication cables and other electrical sources	
234. Skill in grounding for specific communication systems	

You have now completed SECTION II of the survey.

Journeyman Electricians Job Analysis (Knowledge & Skills) Survey

Determining the Number of Items that Should be Tested in Each Domain

The next 10 lines reflect the domains (main content areas) that will be covered in the nationally recognized Journeyman Electrician examination. Please provide your input as to the approximate number of questions that should be tested in each of these areas.

For example, assume the exam consists of 100 questions. Therefore, the total of your estimate for these 10 domains must equal 100. If your answers do not equal 100 an error message will pop up asking you to adjust.

***Please note, the number of actual examination questions has not yet been determined, the 100 example is simply for an even number to calculate.**

1. Interpreting Plans and Specifications	
2. Basic Electrical Safety	
3. Electrical Theory and Principles	
4. Testing and Troubleshooting	
5. General Code Requirements	
6. Wiring and Protection	
7. Wiring Methods and Materials	
8. Equipment for General Use	
9. Special Occupancies and Special Equipment	
10. Special Conditions and Communication Systems	

Appendix K

Journeyman Electrician Job Analysis Survey Respondent Demographics

Journeyman Electrician Job Analysis Survey Respondent Demographics

The tables listed below detail the demographics of the respondents for the NASCLA Journeyman Electrician job analysis survey.

The number of years that the Respondents reported that they spent working in the electrical profession, supervising electricians, estimating, or preparing contracts, each ranged from 1 year to 43 years. Table 13 depicts their estimate of the average cost of contracts their company undertakes, ranging from less than $10,000 per job to over $100,000 per job, as follows:

Table 13
Size of Job Undertaken by Respondent's Companies

Average Size of Job	No. of Respondents
Less than $10K	28
$10K to $50K	40
$50K to $100K	42
Greater than $100K	105

Table 14 depicts how many people are employed by their organization:

Table 14
Number of People Employed by their Organization

Employee Range	No. of Respondents
Less than 6 people	40
6 – 25 people	59
25 -50 people	17
More than 50 people	100

Not all Respondents answered this question, as a few of them now work for electrical associations or licensing or code authority agencies or other public agencies, and do not perform independent contract work.

Table 15 indicates the states where the Respondents have performed work as a Journeyman Electrician or equivalent to:

Table 15
States in Which the Respondents have Performed Work as a Journeyman Electrician

State	No. of Respondents Licensed
Alabama	38
Alaska	4
Arizona	5
Arkansas	37
California	19
Colorado	7
Connecticut	4
Delaware	3
District of Columbia	11
Florida	19
Georgia	14
Hawaii	0
Idaho	41
Illinois	11
Iowa	14
Kansas	8
Kentucky	7
Louisiana	20
Maine	4
Maryland	18
Massachusetts	4
Michigan	5
Minnesota	5
Mississippi	12
Missouri	7
Montana	6

State	No. of Respondents Licensed
Nevada	7
New Hampshire	3
New Jersey	6
New Mexico	4
New York	6
North Carolina	25
North Dakota	6
Ohio	14
Oklahoma	11
Oregon	12
Pennsylvania	13
Rhode Island	0
South Carolina	11
South Dakota	4
Tennessee	19
Texas	21
Utah	12
Vermont	2
Virginia	51
Washington	15
West Virginia	14
Wisconsin	3
Wyoming	14

Appendix L

Journeyman Electrician Job Analysis Survey Results

Journeyman Electrician Survey Results

Task	Mean Task Frequency Rating	Mean Task Importance Rating		KSA	Mean KSA Importance Rating
Domain 1: Interpreting Plans and Specifications					
Identifies Locations for and Types of Outlets and Devices	2.81	2.76	1	Knowledge of the appropriate type of devices and outlets	2.62
			2	Skill in determining the height and location of required outlets and devices	2.58
			3	Skill in using scale drawings for dimensions and layout	2.67
Identifies the Symbols	2.63	2.73	4	Knowledge of the electrical symbols (receptacle, – switch, motor, range, telephone, door contact)	2.67
			5	Knowledge of basic wiring diagrams and schematics (controls schematics, 3 way switches)	2.67
			6	Knowledge of symbols used on drawings	2.65
			7	Skill in interpreting symbols on drawings	2.67
Selects Quantity and Types of Equipment	2.22	2.38	8	Knowledge of listing and labeling of equipment	2.25
			9	Knowledge of proper materials for conditions	2.6
			10	Knowledge of the definition of "equipment"	2.23
			11	Skill in selecting the proper material for the project including type and listing	2.5
Identifies Equipment Locations	2.56	2.7	12	Knowledge of working space requirements including width, depth, and height	2.55
			13	Knowledge of mounting height of service equipment	2.65
			14	Knowledge of definitions pertaining to accessible, readily accessible and not readily accessible	2.55
			15	Skill in determining the working space requirements including width, depth, and height	2.6
			16	Skill in determining the mounting height of service equipment	2.65
Identifies Installation Details	2.61	2.54	17	Knowledge of detail drawings for installation guidelines	2.5
			18	Knowledge of manufacturers installation instructions	2.42
			19	Skill in determining the installation requirements for equipment	2.6
			20	Skill in installing support systems for wiring methods and equipment	2.75
Identifies Working Clearances	2.26	2.58	21	Knowledge of working clearances based on voltage levels and condition	2.62
			22	Skill in determining working clearances based on the voltage levels and conditions	2.67
			23	Skill in determining guarding requirements for live parts	2.62
Identifies Working Clearances	2.26	2.58	24	Knowledge of working clearances based on voltage levels and condition	2.62
			25	Skill in determining working clearances based on the voltage levels and conditions	2.67
			26	Skill in determining guarding requirements for live parts	2.62
Identifies Conflicts with Other Installations	2.28	2.54	27	Knowledge of the dedicated electrical space	2.54
			28	Knowledge of symbols and drawings for other trades	2.1
			29	Skill in assessing the drawings of other trades	2
			30	Skill in determining the dedicated working space	2.49
Interprets Specifications	2.37	2.6	30	Knowledge of specifications and drawings	2.56
			31	Skill in selecting the appropriate material per the specifications	2.53
Identifies Relationship Between Drawings and Physical Location	2.65	2.67	32	Knowledge of elevation, architectural and detail drawings	2.45
			33	Skill in matching drawing sheets and matching lines of drawings	2.45

Domain 2: Basic Electrical Safety					
Utilizes the Electrical PPE (Personal Protective Equipment)	2.56	2.86	34	Knowledge of the use of hand protection	2.69
			35	Knowledge of the use of eye protection	2.82
			36	Knowledge of the use of hearing protection	2.79
			37	Knowledge of footwear	2.59
			38	Knowledge of hardhats	2.69
			39	Knowledge of protective coating	2.18
			40	Knowledge of confined space safety	2.64
			41	Knowledge of confined space hazards	2.69
			42	Knowledge of confined space controls	2.54
			43	Knowledge of confined space protection	2.62
			44	Knowledge of confined space PPE	2.67
Uses Tools Properly	2.87	2.9	45	Knowledge of the proper maintenance of a particular tool	2.31
			46	Knowledge of evaluating the tool for use as to if it is safe or needs repair	2.56
			47	Knowledge of trade hand tools	2.51
			48	Knowledge of trade power tools	2.59
			49	Skill in identifying and selecting proper tool for task	2.74
			50	Skill in maintaining tools (cleaning, sharpening, lubricating)	2.28
			51	Skill in proper use of tools	2.69
Applies Lockout/Tagout	2.48	2.86	52	Knowledge of lockout/tagout requirements	2.72
			53	Knowledge of lockout/tagout procedures	2.72
			54	Knowledge of lockout/tagout documentation requirements	2.49
			55	Skill in documenting lockout/tagout	2.44
Domain 3: Electrical Theory & Principles					
Uses Ohm's Law in Calculations	1.92	2.34	56	Knowledge of units of measurement	2.41
			57	Knowledge of Ohm's Law	2.49
			58	Knowledge of the basic Ohm's law formulas	2.56
			59	Knowledge of power factor	1.87
			60	Skill in calculating resistance	1.97
			61	Skill in calculating current	2.54
			62	Skill in calculating voltage	2.38
			63	Skill in calculating power	2.33
			64	Skill in calculating voltage drop formulas	2.23
			65	Skill in calculating three phase circuit values	2.15
Calculates the Primary & Secondary Parameters	1.6	2.12	66	Knowledge of transformer connections	2.67
			67	Knowledge of application of autotransformers (buck boost)	2.05
			68	Knowledge of application of isolation transformers	1.92
			69	Knowledge of application of step up and step down transformers	2.38
			70	Skill in calculating transformer full load currents	2.26
			71	Skill in calculating transformer current based on winding ratios and transformer configuration	1.64
Domain 4: Testing and Troubleshooting					
Measures Amperage, Voltage, Resistance, Insulation Resistance	2.62	2.78	72	Knowledge of current measuring equipment	2.69
			73	Knowledge of voltage measuring equipment	2.79
			74	Knowledge of resistance measurement equipment	2.38
			75	Knowledge of insulation measuring equipment	2.18
			76	Knowledge of troubleshooting GFCI/AFCI circuits	2.46
Verifies Meter Operation(s)	2.23	2.42	77	Knowledge of meter functions	2.51
			78	Knowledge of meter settings	2.46
			79	Knowledge of meter ratings (voltage rating and category rating)	2.56
			80	Knowledge of testing procedures for verification of de−energized circuits	2.87

Domain 5: General Code Requirements

Applies Article 90 to the Job	1.85	2.26	81	Knowledge of what is covered by the code	2.7
			82	Knowledge of special permission or local jurisdiction	2.22
			83	Knowledge of the code arrangement	2.24
Determines Working Space Requirements	2.26	2.63	84	Knowledge of voltage and amperage of equipment being used	2.76
			85	Knowledge of working space requirements	2.62
			86	Knowledge of the configuration of the equipment	2.36
			87	Knowledge of equipment accessibility requirements (other than ADA [Americans with Disabilities Act])	2.27
			88	Skill in determining working clearances around equipment	2.54
			89	Skill in determining entrance to and egress from working spaces	2.46
Selects Enclosure for the Proper Application	2.13	2.51	90	Knowledge of the installation location	2.46
			91	Knowledge of the environmental conditions	2.38
			92	Knowledge of the NEMA (National Electrical Manufacturers Association) ratings	2.27
			93	Skill in determining the NEMA enclosure rating for the environmental conditions of the installation	2.32
			94	Skill in applying NEC (National Electrical Code) rules to application of enclosures	2.49
Selects Equipment with the Proper Interrupting Rating	1.98	2.67	95	Knowledge of fault current rating of equipment	2.38
			96	Knowledge of interrupting rating of overcurrent devices	2.49
			97	Skill in selecting the overcurrent device with the correct interrupting rating	2.57
Determines the Proper Conductors Needed for the Application	2.57	2.75	98	Knowledge of environmental conditions surrounding use of the electrical application & their effect on insulation choice	2.49
			99	Knowledge of temperature limitation of conductors	2.51
			100	Knowledge of the types of insulation	2.49
			101	Knowledge of characteristics of cable construction	2.16
			102	Knowledge of the ampacity rating of the conductor	2.81
			103	Skill in applying NEC ampacity tables for wire and cable selection	2.89
			104	Skill in determining the conductor ampacity based on the ambient temperature and/or number of current carrying conductors	2.7
Protects Integrity of Electrical Equipment and Connections	2.64	2.75	105	Knowledge of method to prevent contamination of electrical equipment	2.22
			106	Knowledge of torque values	2.38
			107	Knowledge of effects of damage related to improper installation of dissimilar metals	2.51
			108	Knowledge of materials and methods for making electrical connections	2.62
			109	Skill in performing torque function on terminations	2.38
			110	Skill in closing unused openings	2.24
			111	Skill in neat−and−workmanlike installation of materials	2.7

Evaluates Equipment for Suitability based on Listing and Labeling	1.85	2.39	112	Knowledge of the impact of the product listing with field modifications to equipment	2.16
			113	Knowledge of a nationally recognized testing laboratory's (NRTL's) Product Safety Standards	1.89
			114	Knowledge of environment and impact on listing and labeling	2.14
Identifies Equipment Warning Labels	2.35	2.57	115	Knowledge of label content and its meaning	2.31
			116	Knowledge of when to apply labels	2.28
Domain 6: Wiring & Protection					
Installs Grounding Electrode Conductors, Equipment Grounding Conductors and Bonding Conductors	2.73	2.86	117	Knowledge of various types of equipment grounding conductors	2.58
			118	Knowledge of various types of grounding electrode conductors	2.64
			119	Knowledge of where bonding conductors are required	2.75
			120	Knowledge of when equipment is required to be connected to an equipment grounding conductor	2.75
			121	Knowledge of ground loops in instrumentation circuits	2.06
			122	Knowledge of Ground Rings	2.17
			123	Knowledge of bonding and termination techniques	2.58
			124	Skill in applying installation rules for grounding electrode, equip grounding & bonding conductors	2.69
			125	Skill in applying the sizing of grounding electrode conductors, equipment grounding conductors and bonding conductors	2.69
			126	Skill in applying Article 250 to grounding and bonding	2.86
Installs Proper Overcurrent Protective Device	2.8	2.88	127	Knowledge of overcurrent protective device, rating and locations	2.69
			128	Skill in applying AIC (amperes interrupting current) ratings to overcurrent protective device	2.39
			129	Skill in determining proper size of overcurrent protective device	2.72
Installs Branch Circuits	2.8	2.8	130	Knowledge of sizing and voltage limitations of branch circuits	2.72
			131	Knowledge of overcurrent protection/disconnecting means of multi wire branch circuits	2.72
			132	Skill in determining voltage limitations of branch circuits	2.66
			133	Skill in determining size of branch circuit conductors	2.78
			134	Skill in determining the ampacity and number of branch circuits needed for various applications	2.69
Installs Feeders and Disconnecting Means	2.73	2.83	135	Knowledge of the rating and installation requirements of feeders and disconnecting means required for a specific application	2.67
			136	Skill in determining the size of a feeder (includes size of conductors, raceway, and overcurrent protection	2.69
Installs GFCI/AFCI Protection	2.62	2.76	137	Knowledge of GFCI	2.64
			138	Knowledge of AFCI	2.56
			139	Knowledge of locations requirements for GFCI and AFCI	2.72
			140	Skill in installing GFCI/AFCI protection	2.58
Installs Receptacles	2.76	2.57	141	Knowledge of the number, placement and types of receptacles	2.5
			142	Knowledge of the use of the space in which the receptacles are being placed	2.44
			143	Knowledge of environments in which receptacles are being used	2.56
			144	Knowledge of branch circuit types, identification and limitations	2.58
Installs Service Equipment & Service Conductors	2.64	2.8	145	Knowledge of the proper rating & installation requirements for service equipment & service conductors	2.61
			146	Knowledge of service clearances	2.53
			147	Knowledge of the identification of a grounded or grounding conductor	2.72
			148	Skill in determining the size of a service (includes size of conductors, raceway, and overload protection)	2.61
			149	Skill in installation of service equipment	2.72
			150	Skill in determining the size of the feeder or neutral load and conductor size needed	2.67
Installs Tap Conductors	1.82	2.24	151	Knowledge of the tap rules regarding tap conductors	2.14
			152	Knowledge of overcurrent protection for transformers using the tap rules	2.19
			153	Skill in determining size of a tap conductor	2.19
			154	Skill in determining the size of transformer overcurrent protection and conductor sizing based on the NEC tap rules	2.31

Installs Grounding Electrodes	2.51	2.79	155	Knowledge of type of and installation requirements for grounding electrode	2.61
			156	Knowledge of interconnection of grounding electrodes to form a grounding electrode system	2.66
			157	Knowledge of the connection to the electrode system	2.61
			158	Skill in installing and connecting to the grounding electrode system	2.67
Installs Grounding and Bonding of Separately Derived Systems	2.31	2.71	159	Knowledge of the method for grounding and bonding separately derived systems	2.56
			160	Skill in calculating the size of grounding and bonding conductors for separately derived systems	2.61
Installs Grounded Conductors	2.71	2.83	161	Knowledge of connections of grounded conductors	2.67
			162	Knowledge of identification requirements for grounded conductors and their terminations	2.75
Domain 7: Wiring Methods & Materials					
Selects and Installs Cabinets, Boxes, Fittings, Conduit Bodies and other Enclosures	2.53	2.49	163	Knowledge of selection requirements for the number of wires for a box size	2.6
			164	Knowledge of location requirements for boxes, fittings and conduit bodies	2.54
			165	Knowledge of selection, sizing & installation requirements for cabinets,etc	2.66
			166	Knowledge of fireproofing requirements and methods at penetrations	2.46
			167	Skill in determining conductor box fill	2.51
			168	Skill in determing the size of a box for conductors 4 AWG or larger	2.54
Installs Electrical Equipment and Systems	2.74	2.77	169	Knowledge of effects of corrosion, deterioration, and effects of temperature on electrical equipment	2.4
			170	Knowledge of burial depth, branch circuit overcurrent protection ratings, spacings, and conductor installation requirements for underground installations	2.69
			171	Skill in protecting electrical equipment from corrosion, mechanical damage, deterioration and effects of temperature	2.49
Selects and Installs Conductors	2.72	2.85	172	Knowledge of conduit fill requirements	2.77
			173	Skill in calculating conductor ampacities based on condition of use	2.66
			174	Skill in identifying conductor ampacity, size, material and insulation type	2.83
Selects and Installs Cables	2.35	2.49	175	Knowledge of the requirements for the use of and installation of cables	2.49
			176	Skill in installing support for cables used for the appropriate application	2.46
Selects and Installs Raceways	2.53	2.59	177	Knowledge of the requirements for the use of and installation of raceways	2.66
			178	Knowledge of the calculations and tools necessary to make bends in raceways	2.57
			179	Skill in determining size and installation requirements for raceway systems	2.65
Installs Auxiliary Gutters, Cable Trays and Wireways	2.14	2.44	180	Knowledge of the requirements for the use of and installation of auxiliary gutters, cable trays and wireways	2.14
			181	Skill in determining auxiliary gutter, cable tray and wireway size	2.2
Installs Busways	1.58	2.13	182	Knowledge of the requirements for the use of and installation of busways	2.09
Domain 8: Equipment for General Use					
Installs Appliances, Fixed Electric Space Heating Equipment, Electric Deicing and Snow Melting Equipment, and Fixed Electric Pipeline and Vessel Heating Equipment	1.35	1.92	183	Knowledge of requirements for appliances, fixed electric space heating equipment, electric deicing and snow melting equipment, and fixed electric pipeline and vessel heating equipment	1.79

Selects, Sizes, Installs and Protects Feeders, etc for Motors, AC & Ref	2.19	2.59	184	Knowledge of the installation requirements of motors and their uses	2.59
			185	Knowledge of the various types of motors and their uses	2.09
			186	Knowledge of the installation requirements of HVACR equipment and their uses	2.12
			187	Skill in determining the proper size overcurrent protective device	2.79
			188	Skill in determining the proper size disconnecting means	2.76
			189	Skill in determining the size controller	2.56
			190	Skill in determining the size of conductors and overcurrent devices used for control circuits	2.56
			191	Skill in determining motor overload protection sizing	2.74
Installs Generators	1.7	2.18	192	Knowledge of installation requirements and protection for generators	2.29
			193	Knowledge of automatic or manual transfer switch installations	2.38
			194	Knowledge of separately derived and non−separately derived systems	2.38
			195	Knowledge of installing life safety emergency power sources	2.38
			196	Knowledge of installing legally required standby systems	2.32
			197	Skill in installing optional standby systems	2.29
Installs Transformers	2.26	2.65	198	Knowledge of selection, rating, protection and installation requirements for transformers	2.65
			199	Skill in selecting and installing the size and type of transformer	2.44
Domain 9: Special Occupancies and Special Equipment					
Installs Electrical and Electronic Equipment and Wiring For Hazardous (Classified) Locations	1.55	2.3	200	Knowledge of the installation requirements for hazardous (classified) locations	2.42
			201	Knowledge of the installation requirements for the divisions/zones within the Class I, Class II, and Class III hazardous locations	2.41
			202	Skill in identifying hazardous (classified) locations within special occupancies	2.3
			203	Skill in identifying fittings for hazardous (classified) locations	2.48
Installs Electrical Equip & Wiring In Special Occup for non−Hazardous	1.6	2.12	204	Knowledge of installation requirements for special occupancies	2.24
			205	Knowledge of electrical requirements involving mobile homes, manufactured homes, and mobile home parks	1.91
			206	Knowledge of electrical requirements involving marinas and boatyards	1.94
			207	Knowledge of electrical requirements involving temporary installations	2.42
			208	Skill in determining the outlets required for a manufactured home	1.7
			209	Skill in determining the disconnecting means for a manufactured home	1.79
			210	Skill in determining the feeder conductors for a manufactured home	1.94
			211	Skill in determining services and feeders for mobile home parks	1.94
Installs Special Equipment	1.7	2.12	212	Knowledge of energy management systems	1.75
			213	Knowledge of instrumentation tray cables (ITC)	1.7
			214	Knowledge of electric signs and outline lighting	1.85
			215	Knowledge of electric components for cranes and hoists	1.76
			216	Knowledge of electric vehicle charging stations	1.94
			217	Knowledge of installation of welders	1.88
			218	Knowledge of electrical wiring, equipment and bonding for swimming pools, fountains, and similar installations	2.58
			219	Knowledge of PV (Photovoltaic) systems	2.15
			220	Knowledge of wind electric systems	1.91
			221	Knowledge of fuel cell systems	1.61
			222	Knowledge of feeders, circuits and equipment for elevators	2.25
			223	Knowledge of informational technology equipment and modular data centers	2.03
			224	Knowledge of electrical components fire pumps	2.15

Domain 10: Special Conditions and Communication Systems				
Installs Circuits Operating Less Than 50 Volts	1.98	2.15	225 Knowledge of the use and installation requirements for circuits	2.15
			226 Knowledge of the use and installation requirements for fire alarm systems	2.09
			227 Knowledge of primary power supply sources for fire alarm systems	2.03
			228 Skill in selecting cable types for remote control signaling and circuits	2.12
Installs Communication Systems	1.49	1.55	229 Knowledge of communication cable inside and outside a building	1.58
			230 Knowledge of installation and/or removal of communication cables	1.79
			231 Knowledge of required separation between communication cables and other electrical sources	2.15
			232 Skill in grounding for specific communication systems	2.09
Uses Ladders			233 Knowledge of ladder rating and capacity	2.64
			234 Knowledge of ladder material types	2.38
			235 Knowledge of extension ladder setup	2.69
			236 Knowledge of ladder working heights	2.74
			237 Knowledge of requirments regarding ladders	2.67

Appendix M

Journeyman Electrician Examination Plan

Domains	# of items
1. Interpreting Plans and Specifications	
2. Basic Electrical Safety	
3. Electrical Theory & Principles	
4. Testing and Troubleshooting	
5. General Code Requirements	
6. Wiring & Protection	
7. Wiring Methods & Materials	
8. Equipment for General Use	
9. Special Occupancies and Special Equipment	
10. Special Conditions and Communication Systems	

Definition of An Electrical Journeyman (Journeyperson)
An individual who has demonstrated competency in the knowledge and skills needed to properly perform the installation, maintenance and repair of electrical work conforming to applicable standards and codes.

Journeyman Electrician Domains, Tasks, KSAs

	Number of Items (i.e., Questions)
A. Interpreting Plans and Specifications	**6**
1. Identifies Locations for and Types of Outlets and Devices: Knowledge of the appropriate type of devices, outlets and other equipment Skill in determining the height and location of required outlets and devices Skill in using scale drawings for dimensions and layout	1
2. Identifies the Symbols: Knowledge of the electrical symbols (receptacle, switch, motor, range, telephone, door contact) Knowledge of basic wiring diagrams and schematics (controls schematics, 3 way switches) -- NOTE to item writers, controls schematics may be a difficult knowledge so items written on this topic should be basic Knowledge of symbols used on drawings Skill in interpreting symbols on drawings	1
3. Selects Quantity and Types of Equipment: Knowledge of listing and labeling of equipment Knowledge of proper materials for conditions Skill in selecting the proper material for the project including type and listing	1
4. Identifies Installation Details: Knowledge of detail drawings for installation guidelines Knowledge of manufacturers installation instructions Skill in determining the installation requirements for equipment Skill in determining the adequate structural support of electrical equipment	1
5. Interprets Specifications: Knowledge of specifications and drawings Skill in selecting the appropriate material per the specifications	1
6. Identifies Conflicts with Other Installations: Knowledge of the dedicated electrical space Knowledge of-symbols and drawings for other trades Skill in assessing the drawings of other trades Skill in determining the dedicated working space **7. Identifies Relationship Between Drawings and Physical Location:** Knowledge of elevation, architectural and detail drawings Skill in matching drawing sheets and match lines of drawings	1

B. Basic Electrical Safety	8

8. Utilizes the Electrical PPE (Personal Protective Equipment):	
Knowledge of the use of hand protection Knowledge of the use of eye protection Knowledge of the use of hearing protection Knowledge of footwear Knowledge of hardhats Knowledge of protective clothing Knowledge of confined space safety	2

9. Uses Tools Properly	
Knowledge of evaluating the tool for use as to if it is safe or needs repair Knowledge of trade hand tools Knowledge of trade power tools Skill in identifying and selecting proper tool for task Skill in maintaining tools (cleaning, sharpening, lubricating) Skill in proper use of tools	2

10. Uses Ladders, Scaffolds and Lifts:	
Knowledge of rating and capacity for ladders, scaffolds and lifts Knowledge of ladder material types Knowledge of extension ladder setup Knowledge of working heights of ladders, scaffolds, and lifts	1

11 Applies Lockout/Tagout:	
Knowledge of lockout/tagout requirements Knowledge of lockout/tagout procedures Skill in applying lockout/tagout procedures	3

C. Electrical Theory & Principles	10
12. Uses Ohm's Law in Calculations Knowledge of the basic Ohm's law formulas Skill in calculating voltage drop formulas Skill in calculating three phase power Skill in calculating and applying Ohm's law formulas	7
13. Applies basic transformer theory: Knowledge of transformer connections Knowledge of application of step up and step down transformers Skill in calculating transformer full load currents	3

D. Testing and Troubleshooting	7
14. Measures Amperage, Voltage, Resistance, Insulation Resistance: Knowledge of meter functions Knowledge of meter settings Knowledge of meter ratings (voltage rating and category rating) Skill in current measuring Skill in voltage measuring Skill in resistance measuring Skill in insulation resistance measuring Skill in basic troubleshooting	7

E. General Code Requirements	15
15. Applies Article 90 and 100 to the Job: Knowledge of what is covered by the code Knowledge of special permission or local jurisdiction Knowledge of the code arrangement and its enforcement (90.3, 90.4) Knowledge of definitions	2
16. Determines Working Space Requirements: Knowledge of voltage and amperage of equipment being used Knowledge of the configuration of the equipment Knowledge of working space requirements including width, depth, and height Knowledge of mounting height of equipment Knowledge of definitions pertaining to accessible and readily accessible Knowledge of working clearances based on voltage levels and condition Skill in determining the working space requirements including width, depth, and height Skill in determining the mounting height of equipment Skill in determining working clearances based on the voltage levels and conditions Skill in determining guarding requirements for live parts Skill in determining entrance to and egress from working spaces	3
17. Selects Enclosure for the Proper Application: Knowledge of the installation location Knowledge of the environmental conditions Knowledge of the NEMA (National Electrical Manufacturers Association) ratings Skill in determining the NEMA enclosure rating for the environmental conditions of the installation Skill in applying NEC (National Electrical Code) rules to application of enclosures	2
18. Selects Equipment with the Proper Interrupting Rating: Knowledge of fault current rating of equipment Knowledge of interrupting rating of overcurrent devices Skill in selecting the overcurrent device with the correct interrupting rating Skill in selecting equipment with the correct short circuit current rating	2
19. Determines the Proper Conductors Needed for the Application: Knowledge of environmental conditions (wet, damp, dry, ambient temperature) surrounding use of the electrical application and their effect on the choice of insulation Knowledge of temperature limitation of conductors Knowledge of the types of insulation Knowledge of characteristics of cable construction Knowledge of the ampacity rating of the conductor Skill in applying NEC ampacity tables for wire and cable selection Skill in determining the conductor ampacity based on the ambient temperature and/or number of current carrying conductors	2
20. Protects Integrity of Electrical Equipment and Connections: Knowledge of method to prevent contamination of electrical equipment Knowledge of effects of damage related to improper installation of dissimilar metals Knowledge of materials and methods for making electrical connections, including termination temperature ratings Skill in closing unused openings Skill in neat-and-workmanlike installation of materials	2
21. Identifies equipment warning labels (motor disconnects, arc flash hazards, motor nameplates, etc.): Knowledge of label content and its meaning Knowledge of when to apply labels	2

F. Wiring & Protection	18
22. Installs Grounding Electrode Conductors, Equipment Grounding Conductors and Bonding Conductors: Knowledge of various types of equipment grounding conductors Knowledge of various types of grounding electrode conductors Knowledge of where bonding conductors are required Knowledge of when equipment is required to be connected to an equipment grounding conductor Knowledge of ground loops in instrumentation circuits Knowledge of Ground Rings Knowledge of bonding and termination techniques Skill in applying installation rules for grounding electrode conductors, equipment grounding conductors and bonding conductors Skill in applying the sizing rules for grounding electrode conductors, equipment grounding conductors and bonding conductors	2
23. Installs Proper Overcurrent Protective Devices: Knowledge of overcurrent protective devices, ratings and locations Skill in applying AIC (amperes interrupting current) ratings to overcurrent protective devices Skill in determining proper size of overcurrent protective devices	2
24. Installs Branch Circuits: Knowledge of sizing and voltage limitations of branch circuits Knowledge of overcurrent protection/disconnecting means of multi wire branch circuits Skill in determining voltage limitations of branch circuits Skill in determining size of branch circuit conductors Skill in determining the ampacity and number of branch circuits needed for various applications	2
25. Installs Feeders and Disconnecting Means: Knowledge of the rating and installation requirements of feeders and disconnecting means required for a specific application Skill in determining the size of a feeder (includes size of conductors, raceway, and overcurrent protection)	1
26. Installs and Maintains GFCI/AFCI Protection: Knowledge of GFCI Knowledge of AFCI Knowledge of locations requirements for GFCI and AFCI Knowledge of troubleshooting GFCI/AFCI circuits Skill in installing GFCI/AFCI protection	2
27. Installs Receptacles and Receptacle Outlets: Knowledge of the number, placement and types of receptacle outlets Knowledge of the use of the space in which the receptacles and receptacle outlets are being placed Knowledge of environments in which receptacles and receptacle outlets are being used Knowledge of branch circuit types, identification and limitations	2

28. Installs Service Equipment & Service Conductors: Knowledge of the proper rating and installation requirements for service equipment and service conductors for an application Knowledge of service clearances Knowledge of the identification of a grounded or grounding conductor Knowledge of the neutral conductor sizing Skill in determining the size of a service (includes size of conductors, raceway, and overload protection) Skill in installation of service equipment	2
29. Installs Tap and Transformer Secondary Conductors: Knowledge of the tap rules regarding tap conductors Knowledge of overcurrent protection for transformers using the tap rules Skill in determining size of a tap conductor Skill in determining the size of transformer overcurrent protection and conductor sizing	1
30. Installs Grounding Electrodes: Knowledge of type of and installation requirements for grounding electrode Knowledge of interconnection of grounding electrodes to form a grounding electrode system Knowledge of the connection to the electrode system Skill in installing and connecting to the grounding electrode system	2
31. Installs Grounding and Bonding of Separately Derived Systems: Knowledge of the method for grounding and bonding separately derived systems Skill in calculating the size of grounding and bonding conductors for separately derived systems	1
32. Installs Grounded Conductors: Knowledge of connections of grounded conductors Knowledge of identification requirements for grounded conductors and their terminations	1

G. Wiring Methods & Materials	16
33. Selects and Installs Cabinets, Boxes, Fittings, Conduit Bodies and other Enclosures: Knowledge of requirements for the number of wires for a box size Knowledge of location requirements for boxes, fittings and conduit bodies Knowledge of selection, sizing and installation requirements for cabinets, boxes, conduit bodies, fittings and other enclosures Knowledge of fireproofing requirements and methods at penetrations Skill in determining conductor box fill Skill in determining the size of a box for conductors 4 AWG or larger	4
34. Installs Electrical Equipment and Systems: Knowledge of effects of corrosion, deterioration, and effects of temperature on electrical equipment Knowledge of burial depth requirements for underground installations Skill in protecting electrical equipment from corrosion, mechanical damage, deterioration and effects of temperature	3
35. Selects and Installs Cables (Types AC, MC, NM, etc.): Knowledge of the requirements for the use of and installation of cables Skill in installing various cable types	3
36. Selects and Installs Raceways: Knowledge of the requirements for the use of and installation of raceways Knowledge of the calculations and tools necessary to make bends in raceways Knowledge of raceway fill requirements Skill in determining size and installation requirements for raceway systems	3
37. Installs auxiliary gutters, cable trays, wireways and busways: Knowledge of the requirements for the use of and installation of auxiliary gutters, cable trays, wireways and busways Skill in determining auxiliary gutter, cable tray, wireway and busway size	3

H. Equipment for General Use	10
38. Installs Appliances, Fixed Electric Space Heating Equipment, Electric Deicing and Snow Melting Equipment, and Fixed Electric Pipeline and Vessel Heating Equipment: Knowledge of requirements for appliances Knowledge of requirements for fixed electric space heating equipment, electric deicing and snow melting equipment, and fixed electric pipeline and vessel heating equipment	1
39. Installs circuits for Motors, Air Conditioning and Refrigerating equipment: Knowledge of the installation requirements of motors and their uses Knowledge of the various types of motors and their uses Knowledge of the installation requirements of HVACR (Heating, Ventilation, Air Conditioning and Refrigeration) equipment Skill in determining the proper size overcurrent protective device Skill in determining the proper size disconnecting means Skill in determining the size of controller Skill in determining the size of conductors and overcurrent devices used for control circuits Skill in determining motor overload protection sizing	2
40. Installs Generators: Knowledge of installation requirements and protection for generators Knowledge of automatic and manual transfer switch installations Knowledge of separately derived and nonseparately derived systems Knowledge of installing life safety emergency power sources Knowledge of installing legally required standby systems Skill in installing optional standby systems	2
41. Installs Transformers: Knowledge of selection, rating, protection and installation requirements for transformers Skill in selecting and installing the size and type of transformer	2
42. Installs Luminaires and Lighting Outlets: Knowledge of the number, placement and types of luminaires and lighting outlets Knowledge of the use of the space in which the luminairess and lighting outlets are being placed Knowledge of environments in which luminaires and lighting outlets are being used Knowledge of branch circuit types, identification and limitations	3

I. Special Occupancies and Special Equipment	8
43. Installs Electrical and Electronic Equipment and Wiring For Hazardous (Classified) Locations: Knowledge of the installation requirements for hazardous (classified) locations Knowledge of the installation requirements for the divisions and zones within the Class I, Class II, and Class III locations of hazardous (classified) locations Skill in identifying hazardous (classified) locations Skill in identifying fittings for hazardous (classified) locations	2
44. Installs Electrical Equipment and Wiring In Special Occupancies Other Than Hazardous (Classified) Locations: Knowledge of installation requirements for health care facilities Knowledge of installation requirements for assembly occupancies Knowledge of electrical requirements involving mobile and manufactured home parks Knowledge of electrical requirements involving marinas and boatyards Knowledge of electrical requirements involving temporary installations	3
45. Installs Special Equipment: Knowledge of energy management systems Knowledge of instrumentation tray cables (ITC) Knowledge of electric signs and outline lighting Knowledge of electric components for cranes and hoists Knowledge of electric vehicle supply equipment (EVSE) Knowledge of installation of welders Knowledge of electrical wiring, equipment and bonding for swimming pools, fountains, and similar installations Knowledge of PV (Photovoltaic) systems Knowledge of fuel cell systems Knowledge of feeders, circuits and equipment for elevators Knowledge of informational technology equipment and modular data centers Knowledge of electrical components for fire pumps	3

J. Special Conditions and Communication Systems:	2
46. Installs Circuits Operating Less Than 50 Volts, and Class 1, Class 2 and Class 3 Remote Control Signaling and Power Limited Circuits, Fire Resistive Cables and Fire Alarm Systems: Knowledge of installation requirements for circuits and equipment for systems operating less than 50 volts, and Class 1, Class 2 and Class 3 remote control signaling and power limited circuits, fire resistive cables and fire alarm systems Knowledge of installation requirements for fire alarm systems Knowledge of primary power supply sources for fire alarm systems Skill in selecting cable types for Class 1, Class 2 and Class 3 remote control signaling and power limited circuits, fire resistive cables and fire alarm systems	1
47. Installs Communication Systems: Knowledge of communication cable inside and outside a building Knowledge of installation and/or removal of communication cables Knowledge of required separation between communication cables and other electrical sources Skill in grounding for specific communication systems	1

PSYCHOMETRIC CRITERIA FOR JOURNEYMAN ELECTRICIAN EXAM

Open book

Last two revisions of Code

4-choice Multiple Choice (items can also be in the format of 4-choice "hot spot")

No more than 5% negatively worded items

Cut score based on standard setting workshop

Number of scored items on exam: 100

Number of non-scored pre-test items: 15

The % of non-code items must be at least equal to 100% minus the % cutscore plus 1%.

Number of items relating to visual aids: 20%

No “none of the above” or “all of the above” items

Items must be referenced

All skill KSAs should be written at the application and analysis level

No true/false or essay items

Generally avoid absolute items with words such as “always” “all” or “never” - use “shall” or “shall not”

No weighted items

Clones should be created when feasible although they must be designated as such so that clones do not appear on the same version of an examination.

Other "Enemies" should be marked and set so that they do not appear on the same version of an examination.

Appendix N

Residential Electrical Contractor Job Analysis Meeting SME Demographics

The tables listed below detail the demographics of the SMEs who participated in the panel meetings for the NASCLA Electrical Contractor/Master Electrician job analysis.

Table 16 depicts their estimate of the average price of contracts their company undertakes, ranging from less than $10,000 per job to over $100,000 per job, as follows:

Table 16
Size of Job Undertaken by Residential Electrician SMEs' Companies

Average Size of Job	No. of SMEs
Less than $10K	**7**
$10K to $50K	**3**
$50K to $100K	**2**
Greater than $100K	**7**

The SMEs were also asked the number of jobs of each type of work below that they have performed during their career. Table 17 depicts the diversity and breadth among the SMEs throughout the electrical field.

Table 17
Types of Electrical Work Experience of Residential Electrician SMEs

Type of Electrical Work	Zero Jobs	1-5 jobs	6-10 jobs	11-25 jobs	More than 25 jobs
General Residential Wiring				5	10
General Commercial Wiring		1		4	10
General Industrial Wiring	3	2	2		5
Instrumentation/Calibration	7	2	1		3
Fire alarms/Fire Pumps	1	1	6	1	7
Security alarms/CCTV	2	3	2	1	7
Door/Gate Access Systems		7	3	2	4
Telecommunications		4	1	2	7
Temporary Installations		2	3	1	7
Equipment/Machinery/Engine/ Generator Installation/Repair/ Maintenance		3	2	2	6
Tower Construction	6	5		1	
Underground Conduit		1	1	5	8
Fiber Optic Cable	4	3	2	2	1
Electrical Signs/Displays/ Scoreboards	1	5	2	3	3
Traffic Signals/Intelligent Transportation Systems	9	3	1		
Electrical Transmission/ Distribution Line Work	9	3	1		
Electrical Substations	9	3	1		
Transformers	3	2	1	3	5
Electrical Inspections	2	1	1	3	6
Fuel cell systems	9	2	1	1	
Photovoltaic systems	4	4	2	2	1
Wind energy systems	9	3	1		
Battery systems	4	4	2	3	
Electrical Systems and Bonding for Swimming Pools	1	3	2	2	3

Tables 18 and 19 indicate where the SMEs reside and the locations in which the SMEs have worked as an electrical contractor.

Table 18
State of Residence of the Residential Electrician SMEs

State of Current Residence	No. of SMEs
Arizona	1
California	2
Colorado	1
Florida	5
Hawaii	1
Iowa	1
Louisiana	2

State of Current Residence	No. of SMEs
Massachusetts	1
Maryland	1
New York	1
Texas	1
Washington	1

Table 19
States in Which the SMEs Have Practiced as a Residential Electrician

State	No. of SMEs Who Have Worked There
Alabama	2
Arizona	2
Arkansas	1
California	4
Colorado	2
Florida	7
Hawaii	1
Idaho	1
Iowa	1
Louisiana	3

State	No. of SMEs Who Have Worked There
Nebraska	1
New York	1
Oklahoma	1
South Carolina	1
Tennessee	1
Texas	2
Washington	1
Wyoming	2
Canada	1

Appendix O

List of Residential Electrical Contractors SME Participants

First Residential Electrical Contractors Meeting

October 28 – 29, 2015, Phoenix, Arizona
Location: Sheraton Mesa Hotel at Wrigleyville West

Pierre Bellemare
President, Bellemare, Inc. DBA FELLAS
Ellenton, FL

Rocco Deluca, Jr.
Electrical Plans Examiner II, City of Phoenix, Arizona
Gilbert, AZ

Paul Lingo
Training Director, Independent Electrical Contractors (IEC) Rocky Mountain
Denver, CO

Phillip J. Lucero
Owner, Preferred Electricians
Ewa Beach, HI

Bob Ludecke
Owner, Bob Ludecke Electrical Service
Big Bear City, CA

Gary Luke
Electrical Inspector, City of Jacksonville, Florida
Jacksonville, FL

Jeff Masterson
Services License/Compliance Manager, The Home Depot
Rock Hill, SC

Al Nyman
Director of Licensing Compliance & Regulatory Affairs, Sears Home Improvement Products, Inc.
Longwood, FL

Brian Price
President, B P Price Electric, Inc.
San Jose, CA

Jeffrey Sargent
NFPA Regional Electrical Code Specialist, National Fire Protection Association (NFPA)
Hampton Falls, NH

Clarence Tibbs
President, STE Electrical Systems, Inc.
Apopka, FL

Richard Tousey
Regional Compliance Manager, The Home Depot
Old Bethpage, NY

Joseph Wages Jr.
Technical Advisor, Education, Codes and Standards, International Association of Electrical Inspectors (IAEI)
Richardson, TX

Wesley Lamar Wheeler
National Director of Safety, National Electrical Contractors Association (NECA)
Bethesda, MD

Bo Wilkinson, Jr.
President, BW Electric of Louisiana Inc.
Shreveport, LA

Second Residential Electrical Contractors Meeting

February 17 – 18, 2016, Phoenix, Arizona
Location: Sheraton Mesa Hotel at Wrigleyville West

Pierre Bellemare
President, Bellemare, Inc. DBA FELLAS
Ellenton, FL

Jay Cannava
President, P.I. Electric, Inc.
Lake Park, FL

Rocco Deluca, Jr.
Electrical Plans Examiner II, City of Phoenix, Arizona
Gilbert, AZ

Julie Gauthreaux
CEO, Pelican Electrical Services, LLC
Theriot, LA

Joseph Hertel
Owner, Joseph A. Hertel Consulting
Madison, WI

Jesse Jameson
Construction Compliance Supervisor, Washington Department of Labor & Industries
Tumwater, WA

Paul Lingo
Training Director, Independent Electrical Contractors (IEC) Rocky Mountain
Denver, CO

Phillip J. Lucero
Owner, Preferred Electricians
Ewa Beach, HI

Bob Ludecke
Owner, Bob Ludecke Electrical Service
Big Bear City, CA

David Mims
President, Georgia-Florida Alarm Company
Tallahassee, FL

Daniel Morphew
Electrical Inspector, Electrical Bureau State Fire Marshal Division – Iowa Department of Public Safety
Des Moines, IA

Al Nyman
Director of Licensing Compliance & Regulatory Affairs, Sears Home Improvement Products, Inc.
Longwood, FL

Jeffrey Sargent
NFPA Regional Electrical Code Specialist, National Fire Protection Association (NFPA)
Hampton Falls, NH

Clarence Tibbs
President, STE Electrical Systems, Inc.
Apopka, FL

Joseph Wages Jr.
Technical Advisor, Education, Codes and Standards, International Association of Electrical Inspectors (IAEI)
Richardson, TX

Wesley Lamar Wheeler
National Director of Safety, National Electrical Contractors Association (NECA)
Bethesda, MD

Bo Wilkinson, Jr.
President, BW Electric of Louisiana Inc.
Shreveport, L

Appendix P

NASCLA Residential Electrical Contractor Job Analysis Survey

Residential Electrician/Residential Electrical Contractor Job Analysis (Domains & Tasks) Survey

Survey Instructions

The National Association of State Contractors Licensing Agencies (NASCLA) is asking for your help!

NASCLA is currently developing a nationally recognized **Residential Electrician/Residential Electrical Contractor** licensing trade examination. This exam would allow a residential electrician who passes this exam to use the exam grade for all participating states without a further exam, and would save the residential electrician the time and expense normally needed to take another exam. The electrician would still need to apply for the license in each state he or she goes to, and meet their requirements, but it would make it a more streamlined process.

We need your participation in this survey to help us make sure that the examination will reflect the work actually performed in the field and that it is representative of the work done in every area of the country, including your area. Your contributions will help ensure that new contractors are qualified to be licensed, and that the exam will be fair. When we have compiled the results from all of the surveys, we will send a copy of the results to everyone who participated. Thank you in advance for your assistance.

Definition of a Residential Electrician/Residential Electrical Contractor: *A Residential Electrician/Residential Electrical Contractor is one who demonstrates competency in performing electrical installations, service, repair and maintenance typically encountered in a permanent dwelling unit.*

***Please note** that you can come back later to edit your responses or finish the survey if you choose to do so. Once you begin the survey, you will have to click “Next” and then click “Exit” at the top to leave the survey in order for your results to be saved. *If you do not click "Next",* your responses to that page will not be saved. After you have saved and exited the survey, you can go back in to the original survey to edit your responses or to finish, by copying and pasting the survey URL (that was sent to you in the original email) into your web browser from the same computer that was used to begin the survey. From there, you will be taken to the exact page that you last left.

Please also note that once you click ***“Done”*** at the end of the survey, you will **not** be able to reenter to change your answers.

This survey is to rank the importance and frequency of the Domains and Tasks needed to be an entry level Residential Electrician/Residential Electrical Contractor.

Residential Electrician/Residential Electrical Contractor Job Analysis (Domains & Tasks) Survey

Survey Description

This survey will ask you to rate tasks common to entry level Residential Electrician/Residential Electrical Contractors. ***Entry level*** means the level at which a Residential Electrician/Residential Electrical Contractor would work when receiving his/her license.

The committee that determined these tasks identified 10 domains (major categories of work) into which all of the main tasks associated with an electrical contractor's profession would fall. These are:

1. Theory
2. Personal/Jobsite Safety (OSHA, NFPA 70E)
3. Project Design, Estimating and Management
4. Grounding and Bonding
5. Special System and Special Equipment Installations
6. Tools and Test Equipment
7. Circuit Design, Protection and Installation
8. Wiring Methods and Practices
9. Equipment for General Use
10. Energy Efficiency/Management

Each of these major areas have specific tasks associated with them that will be rated in this survey. Another survey will have the specific knowledge and skills viewed as necessary for performing each task.

Residential Electrician/Residential Electrical Contractor Job Analysis (Domains & Tasks) Survey

Demographics

The information you provide here is voluntary and confidential and will be used only for the purpose of providing a description of survey participants.

If you <u>have not</u> worked as a Residential Electrician for at least five (5) years, including at least one (1) year above the Apprentice level, please <u>do not</u> respond to this survey.

Are you currently or have you ever been licensed as a Residential Electrician/Residential Electrical Contractor (or equivalent)?

- ◯ Yes
- ◯ No

If YES, how many years have you been licensed as such?

Do you belong to an association for your electrical trade? If yes, please list the association name(s) below:

Residential Electrician/Residential Electrical Contractor Job Analysis (Domains & Tasks) Survey

In what state do you currently reside in?

- Alabama
- Alaska
- Arizona
- Arkansas
- California
- Colorado
- Connecticut
- Delaware
- District of Columbia
- Florida
- Georgia
- Hawaii
- Idaho
- Illinois
- Indiana
- Iowa
- Kansas
- Kentucky
- Louisiana
- Maine
- Maryland
- Massachusetts
- Michigan
- Minnesota
- Mississippi
- Missouri
- Montana
- Nebraska
- Nevada
- New Hampshire
- New Jersey
- New Mexico
- New York
- North Carolina
- North Dakota
- Ohio
- Oklahoma
- Oregon
- Pennsylvania
- Rhode Island
- South Carolina
- South Dakota
- Tennessee
- Texas
- Utah
- Vermont
- Virginia
- Washington
- West Virginia
- Wisconsin
- Wyoming

Other (please specify)

In what state(s) do you have experience as a Residential Electrician/Residential Electrical Contractor (or equivalent to)?

- [ ] Alabama
- [ ] Alaska
- [ ] Arizona
- [ ] Arkansas
- [ ] California
- [ ] Colorado
- [ ] Connecticut
- [ ] Delaware
- [ ] District of Columbia
- [ ] Florida
- [ ] Georgia
- [ ] Hawaii
- [ ] Idaho
- [ ] Illinois
- [ ] Indiana
- [ ] Iowa
- [ ] Kansas
- [ ] Kentucky
- [ ] Louisiana
- [ ] Maine
- [ ] Maryland
- [ ] Massachusetts
- [ ] Michigan
- [ ] Minnesota
- [ ] Mississippi
- [ ] Missouri
- [ ] Montana
- [ ] Nebraska
- [ ] Nevada
- [ ] New Hampshire
- [ ] New Jersey
- [ ] New Mexico
- [ ] New York
- [ ] North Carolina
- [ ] North Dakota
- [ ] Ohio
- [ ] Oklahoma
- [ ] Oregon
- [ ] Pennsylvania
- [ ] Rhode Island
- [ ] South Carolina
- [ ] South Dakota
- [ ] Tennessee
- [ ] Texas
- [ ] Utah
- [ ] Vermont
- [ ] Virginia
- [ ] Washington
- [ ] West Virginia
- [ ] Wisconsin
- [ ] Wyoming

Other (please specify)

As of October 2015, approximately how many years have you worked in the electrical profession for at least 30 hours per week (include any apprenticeship training)?

Have you had any years' experience supervising electricians?

- ( ) Yes
- ( ) No

If yes, how many years?

How many people are employed in your organization?

- ◯ Less than 6 people
- ◯ 6 - 25 people
- ◯ 25 - 50 people
- ◯ More than 50 people

Which of the following options best represents the average cost ofeach electrical project that your firm undertakes?

- ◯ Less than $10,000
- ◯ Between $10,000 and $50,000
- ◯ Between $50,000 and $100,000
- ◯ Over $100,000

What is your gender?

- ◯ Male
- ◯ Female

What is your national origin, if other than the U.S.?

What is the race/ethnicity that you most closely identify yourself as?

- ☐ AfricanAmerican (nonHispanic)
- ☐ Asian
- ☐ Native Hawaiian or Pacific Islander
- ☐ Caucasian (non-Hispanic)
- ☐ Hispanic
- ☐ Native American or Alaskan Native
- ☐ Middle Eastern
- ☐ Other

What is your age (check one)?

- ◯ 20 - 25 years
- ◯ 26 - 35 years
- ◯ 36 - 45 years
- ◯ 46 - 55 years
- ◯ 56 - 65 years
- ◯ Over 66 years

You have now completed the SECTION I of this survey.

Residential Electrician/Residential Electrical Contractor Job Analysis (Domains & Tasks) Survey

Rating Scale for the TASKS Performed as a Residential Electrician/Residential Electrical Contractor

Rating TASK Frequency and Importance Instructions

Residential Electricians/Residential Electrical Contractors licensed in 15 states identified the tasks as well as the knowledge and skills that you will be asked to rate. The following section includes different tasks performed by entry level residential electricians/residential electrical contractors. You will be asked to rate each task in terms of:

(1) the **frequency** with which **you OR the employees you supervise** perform each task

AND

(2) the **importance** of a **newly licensed residential electrician/residential electrical contractor** being able to perform the task **competently**

Rating scale for FREQUENCY of performing the task

In my work and/or the work of my employees:

0 - This task is NOT performed
1 - This task is RARELY performed
2 - This task is SOMETIMES performed
3 - This task is FREQUENTLY performed

Rating scale for IMPORTANCE of performing the task

For a newly licensed residential electrician/residential electrical contractor:

0 - This task is NOT important
1 - This task is MINIMALLY important
2 - This task is MODERATELY important
3 - This task is VERY important

Residential Electrician/Residential Electrical Contractor Job Analysis (Domains & Tasks) Survey

Domain 1. Theory

Domain 1. Theory

	Frequency	Importance
1. Calculate Voltage Drop		
2. Determine Voltage, Current, Resistance and Power for Circuits		
3. Calculate Load Requirements based on Volts and Amperage		
4. Determine Short Circuit Current and Overcurrent Protection Rating		
5. Determine Watthour Usage		
6. Determine the Conductive Properties of Materials		
7. Calculate Series and Parallel Circuits		

Residential Electrician/Residential Electrical Contractor Job Analysis (Domains & Tasks) Survey

Domain 2: Personal/Jobsite Safety (OSHA, NFPA 70E)

Domain 2: Personal/Jobsite Safety (OSHA, NFPA 70E)

	Frequency	Importance
8. Mitigate Hazards or Select PPE (Personal Protective Equipment)		
9. Determine Temporary Wiring/Lighting Requirements		
10. Select and Use Ladders/Scaffolding/Lifts based on Application		
11. Implement Trench Fall/Collapse Protection		
12. Implement Lockout/Tagout Procedures		
13. Provide a Clean and Safe Work Environment (Temperature/Weather Conditions, SDS, Air Quality)		
14. Establish Public Safety Around the Jobsite		

Residential Electrician/Residential Electrical Contractor Job Analysis (Domains & Tasks) Survey

Domain 3: Project Design, Estimating and Management

Domain 3: Project Design, Estimating and Management

	Frequency	Importance
15. Create a Design Based on Project Requirements		
16. Estimate Material, Tools, Overhead and Labor Costs		

Residential Electrician/Residential Electrical Contractor Job Analysis (Domains & Tasks) Survey

Domain 4: Grounding and Bonding

Domain 4: Grounding and Bonding

	Frequency	Importance
17. Create Grounding Electrode System		
18. Install Water Pipe, Gas and Metal Structure Bonding Conductors		
19. Install Grounding and Bonding for Special Systems		
20. Install Equipment Grounding/Bonding Conductors		
21. Install Surge Protection Device/Systems		
22. Install Main and Supply Side Bonding Jumpers		

Residential Electrician/Residential Electrical Contractor Job Analysis (Domains & Tasks) Survey

Domain 5: Special System and Special Equipment Installations

Domain 5: Special System and Special Equipment Installations

	Frequency	Importance
23. Install Photovoltaic Electric Systems		
24. Install Electrical Wiring and Components for Swimming Pools, Spas, Hot Tubs, Hydromassage Bath Tubs and Fountains		
25. Install Smoke/CO Detection/Alarm Devices		
26. Install Electric Vehicle Supply Equipment (EVSE)		
27. Install Data/Communications/Audio Visual (AV)		
28. Install Wiring for Chair Lifts, Elevators, Dumbwaiters and Light Lifts		

Residential Electrician/Residential Electrical Contractor Job Analysis (Domains & Tasks) Survey

Domain 6: Tools and Test Equipment

Domain 6: Tools and Test Equipment

	Frequency	Importance
29. Use Test Equipment to Test/Measure Voltage, Current, Resistance and Other Circuit Characteristics		
30. Selects Hand or Power Tools		

Residential Electrician/Residential Electrical Contractor Job Analysis (Domains & Tasks) Survey

Domain 7: Circuit Design, Protection and Installation

Domain 7: Circuit Design, Protection and Installation

	Frequency	Importance
31. Select Conductor Size and Type for Feeders and Branch Circuits		
32. Install Required Branch Circuits		
33. Install Overcurrent Protective Devices		

Residential Electrician/Residential Electrical Contractor Job Analysis (Domains & Tasks) Survey

Domain 8: Wiring Methods and Practices

Domain 8: Wiring Methods and Practices

	Frequency	Importance
34. Select Wiring Method for Services, Feeders and Branch Circuits		
35. Determines Routing and Physical Protection Requirements based on the Construction Type		
36. Terminates Electrical Conductors		
37. Install Equipment based on Product Certification and Manufacturers Requirements		
38. Select Wiring Methods and Equipment based on Environmental Conditions (Wet, Damp, Dry, Exposed, Sunlight, Concealed, Temperature)		
39. Determine Box and Raceway Conductor Fill		
40. Determine Working/Dedicated Space Requirements for Electrical Equipment		

Domain 9: Equipment for General Use

Domain 9: Equipment for General Use

	Frequency	Importance
41. Install Luminaires/Lampholders		
42. Install Switches		
43. Install Metering Enclosures, Panel Boards and Disconnects		
44. Install Receptacles		
45. Install Wiring for HVAC Equipment		
46. Install Wiring for Appliances		
47. Install Optional Standby System		
48. Install Flexible Cords and Cables		

Residential Electrician/Residential Electrical Contractor Job Analysis (Domains & Tasks) Survey

Domain 10: Energy Efficiency/Management

Domain 10: Energy Efficiency/Management

	Frequency	Importance
49. Install Energy Efficient Equipment		

Are there any additional Tasks statements that you believe were forgotten? If so, please list your ideas below:

You have now completed the SECTION II of this survey.

Residential Electrician/Residential Electrical Contractor Job Analysis (Domains & Tasks) Survey

Determining the Number of Items that Should be Tested in Each Domain

The next 10 lines reflect the domains (main content areas) that will be covered in the nationally recognized Residential Electrician/Residential Electrical Contractor examination. Please provide your input as to the approximate number of questions that should be tested in each of these areas.

For example, assume the exam consists of 100 questions. Therefore, the total of your estimate for these 10 domains must equal 100. If your answers do not equal 100 an error message will pop up asking you to adjust.

***Please note, the number of actual examination questions has not yet been determined, the 100 example is simply for an even number to calculate.**

1. Theory	
2. Personal/Jobsite Safety (OSHA, NFPA 70E)	
3. Project Design, Estimating and Management	
4. Grounding and Bonding	
5. Special System and Special Equipment Installations	
6. Tools and Test Equipment	
7. Circuit Design, Protection and Installation	
8. Wiring Methods and Practices	
9. Equipment for General Use	
10. Energy Efficiency/Management	

You have now completed SECTION III of this survey. Thank you so much for your input!

Residential Electrician/Residential Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Survey Instructions

The National Association of State Contractors Licensing Agencies (NASCLA) is asking for your help!

NASCLA is currently developing a nationally recognized **Residential Electrician/Residential Electrical Contractor** licensing trade examination. This exam would allow a residential electrician who passes this exam to use the exam grade for all participating states without a further exam, and would save the residential electrician the time and expense normally needed to take another exam. The electrician would still need to apply for the license in each state he or she goes to, and meet their requirements, but it would make it a more streamlined process.

We need your participation in this survey to help us make sure that the examination will reflect the work actually performed in the field and that it is representative of the work done in every area of the country, including your area. Your contributions will help ensure that new contractors are qualified to be licensed, and that the exam will be fair. When we have compiled the results from all of the surveys, we will send a copy of the results to everyone who participated. Thank you in advance for your assistance.

Definition of a Residential Electrician/Residential Electrical Contractor: *A Residential Electrician/Residential Electrical Contractor is one who demonstrates competency in performing electrical installations, service, repair and maintenance typically encountered in a permanent dwelling unit.*

***Please note** that you can come back later to edit your responses or finish the survey if you choose to do so. Once you begin the survey, you will have to click “Next” and then click “Exit” at the top to leave the survey in order for your results to be saved. *If you do not click "Next",* your responses to that page will not be saved. After you have saved and exited the survey, you can go back in to the original survey to edit your responses or to finish, by copying and pasting the survey URL (that was sent to you in the original email) into your web browser from the same computer that was used to begin the survey. From there, you will be taken to the exact page that you last left.

Please also note that once you click ***“Done”*** at the end of the survey, you will **not** be able to reenter to change your answers.

This survey is to rank the importance of the Knowledge and Skills related to the Tasks needed as an entry level Residential Electrician/Residential Electrical Contractor.

Residential Electrician/Residential Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Survey Description

This survey will ask you to rate knowledges and skills common to entry level Residential Electrician/Residential Electrical Contractors. ***Entry level*** means the level at which a Residential Electrician/Residential Electrical Contractor would work when receiving his/her license.

The committee that determined these knowledges and skills identified 10 domains (major categories of work) into which all of the main tasks associated with an electrical contractor's profession would fall. These are:

1. Theory
2. Personal/Jobsite Safety (OSHA, NFPA 70E)
3. Project Design, Estimating and Management
4. Grounding and Bonding
5. Special System and Special Equipment Installations
6. Tools and Test Equipment
7. Circuit Design, Protection and Installation
8. Wiring Methods and Practices
9. Equipment for General Use
10. Energy Efficiency/Management

Each of these major areas have specific tasks associated with them and the tasks then have specific knowledge and skills viewed as necessary for performing the tasks.

Residential Electrician/Residential Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Demographics

The information you provide here is voluntary and confidential and will be used only for the purpose of providing a description of survey participants.

If you <u>have not</u> worked as a Residential Electrician for at least five (5) years, including at least one (1) year above the Apprentice level, please <u>do not</u> respond to this survey.

Are you currently or have you ever been licensed as a Residential Electrician/Residential Electrical Contractor (or equivalent)?

- ◯ Yes
- ◯ No

If YES, how many years have you been licensed as such?

Do you belong to an association for your electrical trade? If yes, please list the association name(s) below:

Residential Electrician/Residential Electrical Contractors Job Analysis (Knowledge & Skills) Survey

In what state do you currently reside in?

- ◯ Alabama
- ◯ Alaska
- ◯ Arizona
- ◯ Arkansas
- ◯ California
- ◯ Colorado
- ◯ Connecticut
- ◯ Delaware
- ◯ District of Columbia
- ◯ Florida
- ◯ Georgia
- ◯ Hawaii
- ◯ Idaho
- ◯ Illinois
- ◯ Indiana
- ◯ Iowa
- ◯ Kansas
- ◯ Kentucky
- ◯ Louisiana
- ◯ Maine
- ◯ Maryland
- ◯ Massachusetts
- ◯ Michigan
- ◯ Minnesota
- ◯ Mississippi
- ◯ Missouri
- ◯ Montana
- ◯ Nebraska
- ◯ Nevada
- ◯ New Hampshire
- ◯ New Jersey
- ◯ New Mexico
- ◯ New York
- ◯ North Carolina
- ◯ North Dakota
- ◯ Ohio
- ◯ Oklahoma
- ◯ Oregon
- ◯ Pennsylvania
- ◯ Rhode Island
- ◯ South Carolina
- ◯ South Dakota
- ◯ Tennessee
- ◯ Texas
- ◯ Utah
- ◯ Vermont
- ◯ Virginia
- ◯ Washington
- ◯ West Virginia
- ◯ Wisconsin
- ◯ Wyoming

Other (please specify)

In what state(s) have you performed work as an electrician?

- [ ] Alabama
- [ ] Alaska
- [ ] Arizona
- [ ] Arkansas
- [ ] California
- [ ] Colorado
- [ ] Connecticut
- [ ] Delaware
- [ ] District of Columbia
- [ ] Florida
- [ ] Georgia
- [ ] Hawaii
- [ ] Idaho
- [ ] Illinois
- [ ] Indiana
- [ ] Iowa
- [ ] Kansas
- [ ] Kentucky
- [ ] Louisiana
- [ ] Maine
- [ ] Maryland
- [ ] Massachusetts
- [ ] Michigan
- [ ] Minnesota
- [ ] Mississippi
- [ ] Missouri
- [ ] Montana
- [ ] Nebraska
- [ ] Nevada
- [ ] New Hampshire
- [ ] New Jersey
- [ ] New Mexico
- [ ] New York
- [ ] North Carolina
- [ ] North Dakota
- [ ] Ohio
- [ ] Oklahoma
- [ ] Oregon
- [ ] Pennsylvania
- [ ] Rhode Island
- [ ] South Carolina
- [ ] South Dakota
- [ ] Tennessee
- [ ] Texas
- [ ] Utah
- [ ] Vermont
- [ ] Virginia
- [ ] Washington
- [ ] West Virginia
- [ ] Wisconsin
- [ ] Wyoming

Other (please specify)

As of October 2015, approximately how many years have you worked in the electrical profession for at least 30 hours per week (include any apprenticeship training)?

Have you had any years' experience supervising electricians?

- ◯ Yes
- ◯ No

If yes, how many years?

How many people are employed in your organization?

- ◯ Less than 6 people
- ◯ 6 - 25 people
- ◯ 25 - 50 people
- ◯ More than 50 people

Which of the following options best represents the average cost ofeach electrical project that your firm undertakes?

- ◯ Less than $10,000
- ◯ Between $10,000 and $50,000
- ◯ Between $50,000 and $100,000
- ◯ Over $100,000

What is your gender?

- ◯ Male
- ◯ Female

What is your national origin, if other than the U.S.?

What is the race/ethnicity that you most closely identify yourself as?

- ☐ African-American (non-Hispanic)
- ☐ Native Hawaiian or Pacific Islander
- ☐ Caucasian (non-Hispanic)
- ☐ Hispanic
- ☐ Native American or Alaskan Native
- ☐ Middle Eastern
- ☐ Other

What is your age (check one)?

- ◯ 20 - 25 years
- ◯ 26 - 35 years
- ◯ 36 - 45 years
- ◯ 46 - 55 years
- ◯ 56 - 65 years
- ◯ Over 66 years

You have now completed the SECTION I of this survey.

Residential Electrician/Residential Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Rating Scale for the KNOWLEDGE and SKILLS Required of a Residential Electrician

Rating KNOWLEDGE and SKILLS Importance Instructions

Residential Electrician/Residential Electrical Contractors licensed in 15 states identified the tasks as well as the knowledge and skills that you will be asked to rate.

In order for a newly licensed Residential Electrician/Residential Electrical Contractor to perform the task **competently**, how important is the following knowledge or skill?:

Rating scale for IMPORTANCE of performing the task

0 - NOT important
1 - Of MINOR importance
2 - MODERATELY important
3 - VERY important

Residential Electrician/Residential Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Domain 1: Theory

Task: Calculate Voltage Drop

	Importance Rating
1. Knowledge of Ohm's Law elements	
2. Skill in using formulas for calculating voltage drop	

Task: Determine Voltage, Current, Resistance and Power for Circuits

	Importance Rating
3. Knowledge of direct and inverse relationship between the elements	
4. Knowledge of single and three phase systems and voltages	
5. Skill in using formulas for calculating voltage, current, resistance and power for circuits	

Task: Calculate Load Requirements based on Volts and Amperage

	Importance Rating
6. Knowledge of code requirements for determining loads	
7. Knowledge of the relationship between voltage, current and power	
8. Skill in applying the code load calculation rules/tables	

Task: Determine Short Circuit Current and Overcurrent Protection Rating

	Importance Rating
9. Knowledge of types/sizes of overcurrent protection	
10. Knowledge of selecting equipment based on the available short circuit rating	
11. Knowledge of requirements for selecting overcurrent protective devices	
12. Skill in using short circuit calculation formulas	
13. Skill in selecting overcurrent protective devices	

Task: Determine Watthour Usage

	Importance Rating
14. Knowledge of formulas for calculating watthours	
15. Skill in calculating watthours	

Task: Determine the Conductive Properties of Materials

	Importance Rating
16. Knowledge of electron theory	
17. Knowledge of conductors and insulating materials	
18. Skill in selecting conductor materials (aluminum or copper)	

Task: Calculate Series and Parallel Circuits

	Importance Rating
19. Knowledge of series and parallel circuit calculations	
20. Knowledge of differences between series and parallel circuit calculations	
21. Skill in calculating circuit values for series circuits	
22. Skill in calculating circuit values for parallel circuits	

Residential Electrician/Residential Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Domain 2: Personal/Jobsite Safety (OSHA, NFPA 70E)

Task: Mitigate Hazards or Select PPE (Personal Protective Equipment)

	Importance Rating
23. Knowledge of the various types of PPE	
24. Knowledge of OSHA and other standards	
25. Knowledge of identifying and mitigating jobsite hazards	
26. Knowledge of demarcation point for primary and secondary conductor installation	
27. Knowledge of requirements for pre-trenching notification and inspection (public/private)	
28. Knowledge of utility color coding standards	
29. Skill in applying the hierarchy of controls	
30. Skill in identifying and mitigating jobsite hazards (overhead clearances, fall hazards, shock hazards)	
31. Skill in selecting PPE for the specific task	
32. Skill in shock and arc flash hazards implementation protection	
33. Skill in locating underground utilities/systems	

Task: Determine Temporary Wiring/Lighting Requirements

	Importance Rating
34. Knowledge of the proper rating of extension cords	
35. Knowledge of requirements for temporary wiring/lighting	
36. Knowledge of GFCI requirements and assured grounding programs	
37. Knowledge of temporary service equipment, grounding	

Task: Select and Use Ladders/Scaffolding/Lifts based on Application

	Importance Rating
38. Knowledge of safe ladder/scaffolding/lift use practices	
39. Knowledge of types of ladders/scaffolding/lifts	
40. Knowledge of ratings of ladders/scaffolding/lifts	
41. Knowledge of setting up a scaffold	

Task: Implement Trench Fall/Collapse Protection

	Importance Rating
42. Knowledge of types of shoring protection	
43. Knowledge of types of fall/collapse protection	
44. Knowledge of when to use shoring and fall protection	
45. Skill in identifying and mitigating unsafe conditions	

Task: Implement Lockout/Tagout Procedures

	Importance Rating
46. Knowledge of lockout/tagout requirements	
47. Skill in implementing lockout/tagout procedures	

Task: Provide a Clean and Safe Work Environment (Temperature/Weather Conditions, SDS, Air Quality)

	Importance Rating
48. Knowledge of hazard communication requirements	
49. Knowledge of safe work practices in extreme weather and environmental conditions	
50. Skill in working with chemicals	
51. Skill in identifying unsafe work conditions	

Task: Establish Public Safety Around the Jobsite

	Importance Rating
52. Knowledge of barriers/signs	
53. Skill in performing jobsite housekeeping	

Residential Electrician/Residential Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Domain 3: Project Design, Estimating and Management

Task: Create a Design Based on Project Requirements

	Importance Rating
54. Knowledge of branch circuit requirements	
55. Knowledge of reading and interpreting plans and specifications	
56. Knowledge of the requirements of special systems	
57. Knowledge of lighting and receptacle layout/type	
58. Skill in reading and interpreting plans and specifications	
59. Skill in determining the number and size of branch circuits	
60. Skill in calculating service and feeder sizes	
61. Skill in determining cable/raceway routing and supports	

Task: Estimate Material, Tools, Overhead and Labor Costs

	Importance Rating
62. Knowledge of how to procure materials	
63. Knowledge of different types of materials	
64. Skill in determining the use of different types of materials	
65. Skill in estimating labor units	
66. Skill in estimating overhead costs	
67. Skill in identifying differences between job costs and overhead costs	
68. Skill in creating project timeline	

Residential Electrician/Residential Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Domain 4: Grounding and Bonding

Task: Create Grounding Electrode System

	Importance Rating
69. Knowledge of types of grounding electrodes	
70. Knowledge of intersystem bonding requirements	
71. Skill in installing grounding electrode systems and conductors	
72. Skill in determining types/size of grounding electrodes and conductors	

Task: Install Water Pipe, Gas and Metal Structure Bonding Conductors

	Importance Rating
73. Knowledge of bonding requirements	
74. Knowledge of bonding the electrical system components	
75. Skill in determining types/size of bonding conductors	

Task: Install Grounding and Bonding for Special Systems

	Importance Rating
76. Knowledge of the requirements for bonding and grounding for pools	
77. Knowledge of grounding and bonding requirements for separately derived systems or non-separately derived systems (standby power systems)	
78. Knowledge of grounding and bonding requirements for photovoltaic systems	

Task: Install Equipment Grounding/Bonding Conductors

	Importance Rating
79. Knowledge of requirements for grounding equipment (wells, pumps, motors, appliances, etc.)	
80. Knowledge of bonding requirements	
81. Knowledge of types of equipment grounding/bonding conductors	
82. Skill in determining size of equipment grounding/bonding conductor	
83. Skill in applying requirements for identification and installation of equipment grounding/bonding conductors	

Task: Install Surge Protection Device/Systems

	Importance Rating
84. Knowledge of differences between lightning and surge protection device/systems	
85. Skill in installing surge protection device/systems	

Task: Install Main and Supply Side Bonding Jumpers

	Importance Rating
86. Knowledge of requirements for the installation of main and supply side bonding jumpers	
87. Skill in determining the size and type of main and supply side bonding jumpers	
88. Skill in installing main and supply side bonding jumpers	

Residential Electrician/Residential Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Domain 5: Special System and Special Equipment Installations

Task: Install Photovoltaic Electric Systems

	Importance Rating
89. Knowledge of principles of operation of photovoltaic electric systems	
90. Knowledge of the different types of photovoltaic electric systems	
91. Knowledge of the installation requirements for photovoltaic electric systems	
92. Knowledge of energy storage systems	
93. Knowledge of building and fire code requirements	
94. Knowledge of the requirements for interconnected power production sources	
95. Skill in installing different types and sizes of photovoltaic electric systems	
96. Skill in identifying power sources	
97. Skill in installing interconnected power production sources	

Task: Install Electrical Wiring and Components for Swimming Pools, Spas, Hot Tubs, Hydromassage Bath Tubs and Fountains

	Importance Rating
98. Knowledge of overhead conductor clearances for swimming pools, spas, hot tubs, hydromassage bath tubs and fountains	
99. Knowledge of wiring methods for swimming pools, spas, hot tubs, hydromassage bath tubs and fountains	
100. Knowledge of requirements for pool related electrically supplied equipment (pumps, lighting, filters, outlets etc.)	
101. Knowledge of equipotential bonding requirements for electrically supplied and non-electrical equipment	
102. Knowledge of special protection requirements (ground fault, low voltage contact limit)	
103. Knowledge of the difference in requirements for permanent and storable swimming pools, spas, hot tubs, hydromassage bath tubs and fountains	
104. Knowledge of specialized systems (audio, pool heating/cooling)	
105. Skill in installing wiring and equipment associated with swimming pools, spas, hot tubs, hydromassage bath tubs and fountains	
106.Skill in installing the equipotential bonding system/conductors	

Task: Install Smoke/CO Detection/Alarm Devices

	Importance Rating
107. Knowledge of location/spacing and clearance requirements	
108. Knowledge of connection requirements for smoke/CO alarms and associated components	
109. Knowledge of the difference between a fire alarm system and single/multiple station smoke/CO alarms	
110. Knowledge of power and non-power limiting systems	
111. Skill in installing smoke/CO alarms	

Task: Install Electric Vehicle Supply Equipment (EVSE)

	Importance Rating
112. Knowledge of overcurrent protection requirements	
113. Knowledge of requirements necessary to install EVSE	
114. Knowledge of disconnecting means	
115. Knowledg eof protection from physical damage	
116. Knowledge of impact of installing EVSE on existing load	
117. Knowledge of different types of EVSE	
118. Skill in sizing conductors for EVSE	
119. Skill in determining the location of EVSE (ventilated and non-ventilated)	

Task: Install Data/Communications/Audio Visual (AV)

	Importance Rating
120. Knowledge of the types of cabling (performance)	
121. Knowledge of installation requirements for limited energy systems	
122. Knowledge of specialized tools and test equipment for cable installation	
123. Skill in installing cabling and equipment	

Task: Install Wiring for Chair Lifts, Elevators, Dumbwaiters and Light Lifts

	Importance Rating
124. Knowledge of specific wiring methods for chair lifts, elevators, dumbwaiters and light lifts	
125. Knowledge of overcurrent protection and shunt trip equipment	
126. Knowledge of the safety equipment that is required for elevators	
127. Knowledge of working clearance	
128. Skill in installing wiring for chair lifts, elevators, dumbwaiters and light lifts	

Residential Electrician/Residential Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Domain 6: Tools and Test Equipment

Task: Use Test Equipment to Test/Measure Voltage, Current, Resistance and Other Circuit Characteristics

	Importance Rating
129. Knowledge of the various categories of electrical test equipment	
130. Skill in test equipment selection	
131. Skill in use of the various types of electrical test equipment	

Task: Selects Hand or Power Tools

	Importance Rating
132. Knowledge of how to use the appropriate hand tools for working on energized circuits and equipment	
133. Knowledge of the difference between grounded and double insulated power tools	

Residential Electrician/Residential Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Domain 7: Circuit Design, Protection and Installation

Task: Select Conductor Size and Type for Feeders and Branch Circuits

	Importance Rating
134. Knowledge of the temperature rating of terminations	
135. Knowledge of ampacity adjustment	
136. Knowledge of ampacity temperature correction	
137. Knowledge of the ampacity of the conductors	
138. Knowledge of conductor properties	
139. Skill in determining conductor ampacity	
140. Skill in calculating branch circuit loads	

Task: Install Required Branch Circuits

	Importance Rating
141. Knowledge of the required branch circuits/outlets	
142. Knowledge of voltage limitations for residential branch circuits/outlets	
143. Knowledge of device ratings and types	
144. Knowledge of AFCI and GFCI protection requirements	
145. Knowledge of the disconnecting means requirement for multiwire branch circuits	
146. Skill in installing branch circuit wiring and outlets	
147. Skill in installing AFCI and GFCI devices	
148. Skill in identifying circuit conductors	
149. Skill in installing multiwire branch circuits	
150. Skill in installing split wired receptacles and switches	

Task: Install Overcurrent Protective Devices

	Importance Rating
151. Knowledge of sizing of overcurrent protective devices	
152. Knowledge of the physical location of overcurrent protective devices	
153. Knowledge of branch circuit tap rules	

Residential Electrician/Residential Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Domain 8: Wiring Methods and Practices

Task: Select Wiring Method for Services, Feeders and Branch Circuits

	Importance Rating
154. Knowledge of the various types of wiring methods	
155. Skill in selecting the appropriate cable/raceway types	

Task: Determines Routing and Physical Protection Requirements based on the Construction Type

	Importance Rating
156. Knowledge of protection against corrosion and deterioration	
157. Knowledge of clearances related to openings and windows	
158. Knowledge of protection from physical damage	
159. Knowledge of the impact of notching and boring on structural elements	
160. Knowledge of fireproofing requirements and methods at penetrations	
161. Skill in notching, boring and installing protective/steel plates	

Task: Terminates Electrical Conductors

	Importance Rating
162. Knowledge of conductor termination requirements	
163. Knowledge of dissimilar metals	
164. Skill in terminating electrical conductors	
165. Skill in selecting electrical equipment based on conductor type	

Task: Install Equipment based on Product Certification and Manufacturers' Requirements

	Importance Rating
166. Knowledge of the effect that certification/listing and manufacturers' requirements have on the installation	

Task: Select Wiring Methods and Equipment based on Environmental Conditions (Wet, Damp, Dry, Exposed, Sunlight, Concealed, Temperature)

	Importance Rating
167. Knowledge of the uses permitted, uses not permitted and other installation requirements for the respective wiring methods	
168. Knowledge of the environmental markings on electrical equipment and electrical equipment enclosures	
169. Skill in selecting wiring methods and equipment based on conditions of use	

Task: Determine Box and Raceway Conductor Fill

	Importance Rating
170. Knowledge of free conductor length	
171. Knowledge of requirements for calculating conductor fill	
172. Knowledge of requirements of pull boxes, junction boxes and conduit bodies	
173. Knowledge of requirements for cable entry into a box	
174. Skill in selecting the size of boxes and raceways	

Task: Determine Working/Dedicated Space Requirements for Electrical Equipment

	Importance Rating
175. Knowledge of working space requirements	
176. Knowledge of dedicated equipment space requirements	
177. Skill in arranging equipment to meet working/dedicated space requirements	

Residential Electrician/Residential Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Domain 9: Equipment for General Use

Task: Install Luminaires/Lampholders

	Importance Rating
178. Knowledge of installation requirements for luminaires/lampholders	
179. Skill in installing luminaires/lampholders	

Task: Install Switches

	Importance Rating
180. Knowledge of installation requirements for switches	
181. Skill in installing switches	

Task: Install Metering Enclosures, Panel Boards and Disconnects

	Importance Rating
182. Knowledge of installation requirements for metering enclosures, panel boards and disconnects	
183. Skill in installing metering enclosures, panel boards and disconnects	

Task: Install Receptacles

	Importance Rating
184. Knowledge of installation requirements for receptacles	
185. Skill in installing receptacles	

Task: Install Wiring for HVAC Equipment

	Importance Rating
186. Knowledge of installation requirements for HVAC equipment	
187. Skill in installing HVAC equipment	

Task: Install Wiring for Appliances

	Importance Rating
188. Knowledge of installation requirements for appliances	
189. Skill in installing appliances	

Task: Install Optional Standby System

	Importance Rating
190. Knowledge of installation requirements for generators and optional standby systems	
191. Skill in installing generators and optional standby systems	

Task: Install Flexible Cords and Cables

	Importance Rating
192. Knowledge of installation requirements for flexible cords and cables	
193. Skill in installing flexible cords and cables	

Residential Electrician/Residential Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Domain 10: Energy Efficiency/Management

Task: Install Energy Efficient Equipment

	Importance Rating
194. Knowledge of the impact of energy codes on electrical installations	
195. Knowledge of energy saving devices	

You have now completed SECTION II of the survey.

Residential Electrician/Residential Electrical Contractors Job Analysis (Knowledge & Skills) Survey

Determining the Number of Items that Should be Tested in Each Domain

The next 10 lines reflect the domains (main content areas) that will be covered in the nationally recognized Residential Electrician/Residential Electrical Contractor examination. Please provide your input as to the approximate number of questions that should be tested in each of these areas.

For example, assume the exam consists of 100 questions. Therefore, the total of your estimate for these 10 domains must equal 100. If your answers do not equal 100 an error message will pop up asking you to adjust.

***Please note, the number of actual examination questions has not yet been determined, the 100 example is simply for an even number to calculate.**

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2. Personal/Jobsite Safety (OSHA, NFPA 70E)	
3. Project Design, Estimating and Management	
4. Grounding and Bonding	
5. Special System and Special Equipment Installations	
6. Tools and Test Equipment	
7. Circuit Design, Protection and Installation	
8. Wiring Methods and Practices	
9. Equipment for General Use	
10. Energy Efficiency/Management	

You have now completed SECTION III of this survey. Thank you so much for your input!

Appendix Q

Residential Electrical Contractor Job Analysis Survey Respondent Demographics

Residential Electrical Contractor Job Analysis Survey Respondent Demographics

The tables listed below detail the demographics of the respondents for the NASCLA Residential Electrical Contractor job analysis survey.

The number of years that the Respondents reported that they spent working in the electrical profession, supervising electricians, estimating, or preparing contracts, each ranged from 1 year to 50 years. Table 20 depicts their estimate of the average cost of contracts their company undertakes, ranging from less than $10,000 per job to over $100,000 per job, as follows:

Table 20
Size of Job Undertaken by Respondent's Companies

Average Size of Job	No. of Respondents
Less than $10K	69
$10K to $50K	41
$50K to $100K	11
Greater than $100K	15

Table 21 depicts how many people are employed by their organization:

Table 21
Number of People Employed by their Organization

Employee Range	No. of Respondents
Less than 6 people	87
6 – 25 people	24
25 -50 people	10
More than 50 people	16

Not all Respondents answered this question, as a few of them now work for electrical associations or licensing or code authority agencies or other public agencies, and do not perform independent contract work.

Table 22 indicates the states where the Respondents are licensed or have performed work as a Residential Electrical Contractor or equivalent to:

Table 22
States in Which the Respondents are Licensed or have Performed work as a Residential Electrical Contractor

State	No. of Respondents Licensed
Alabama	11
Alaska	0
Arizona	3
Arkansas	8
California	14
Colorado	8
Connecticut	1
Delaware	0
District of Columbia	2
Florida	13
Georgia	9
Hawaii	0
Idaho	4
Illinois	4
Iowa	2
Kansas	1
Kentucky	4
Louisiana	9
Maine	3
Maryland	8
Massachusetts	4
Michigan	6
Minnesota	3
Mississippi	8
Missouri	3
Montana	2

State	No. of Respondents Licensed
Nebraska	1
Nevada	3
New Hampshire	1
New Jersey	15
New Mexico	4
New York	7
North Carolina	13
North Dakota	2
Ohio	24
Oklahoma	2
Oregon	1
Pennsylvania	9
Rhode Island	0
South Carolina	31
South Dakota	1
Tennessee	11
Texas	17
Utah	2
Vermont	1
Virginia	12
Washington	4
West Virginia	12
Wisconsin	4
Wyoming	4

Appendix R

Residential Electrical Contractor Job Analysis Survey Results

Residential Electrical Contractor Survey Results					
Task	**Mean Task Frequency Rating**	**Mean Task Importance Rating**		**KSA**	**Mean KSA Importance Rating**
Domain 1: Theory					
Calculate Voltage Drop	1.74	2.08	1	Knowledge of Ohm's Law elements	2.42
			2	Skill in using formulas for calculating voltage drop	2.25
Determine Voltage, Current, Resistance and Power for Circuits	2.41	2.49	3	Knowledge of direct and inverse relationship between the elements	1.86
			4	Knowledge of single and three phase systems and voltages	2.67
			5	Skill in using formulas for calculating voltage, current, resistance and power for circuits	2.62
Calculate Load Requirements based on Volts and Amperage	2.46	2.63	6	Knowledge of code requirements for determining loads	2.77
			7	Knowledge of the relationship between voltage, current and power	2.67
			8	Skill in applying the code load calculation rules/tables	2.71
Determine Short Circuit Current and Overcurrent Protection Rating	2	2.31	9	Knowledge of types/sizes of overcurrent protection	2.73
			10	Knowledge of selecting equipment based on the available short circuit rating	2.31
			11	Knowledge of requirements for selecting overcurrent protective devices	2.75
			12	Skill in using short circuit calculation formulas	1.9
			13	Skill in selecting overcurrent protective devices	2.71
Determine Watthour Usage	1.18	1.3	14	Knowledge of formulas for calculating watthours	1.4
			15	Skill in calculating watthours	1.44
Determine the Conductive Properties of Materials	1.19	1.3	16	Knowledge of electron theory	1.42
			17	Knowledge of conductors and insulating materials	2.44
			18	Skill in selecting conductor materials (aluminum or copper)	2.6
Calculate Series and Parallel Circuits	1.4	1.72	19	Knowledge of series and parallel circuit calculations	2.13
			20	Knowledge of differences between series and parallel circuit calculations	2.29
			21	Skill in calculating circuit values for series circuits	1.96
			22	Skill in calculating circuit values for parallel circuits	2.15
Domain 2: Personal/Jobsite Safety (OSHA, NFPA 70E)					
Mitigate Hazards or Select PPE (Personal Protective Equipment)	2.17	2.49	23	Knowledge of the various types of PPE	2.36
			24	Knowledge of OSHA and other standards	2.46
			25	Knowledge of identifying and mitigating jobsite hazards	2.73
			26	Knowledge of demarcation point for primary and secondary conductor installation	2.35
			27	Knowledge of requirements for pre-trenching notification and inspection (public/private)	2.63
			28	Knowledge of utility color coding standards	2.42
			29	Skill in applying the hierarchy of controls	1.88
			30	Skill in identifying and mitigating jobsite hazards (overhead clearances, fall hazards, shock hazards)	2.73
			31	Skill in selecting PPE for the specific task	2.49
			32	Skill in shock and arc flash hazards implementation protection	2.58
			33	Skill in locating underground utilities/systems	2.25
Determine Temporary Wiring/Lighting Requirements	1.94	1.95	34	Knowledge of the proper rating of extension cords	2.29
			35	Knowledge of requirements for temporary wiring/lighting	2.21
			36	Knowledge of GFCI requirements and assured grounding programs	2.79
			37	Knowledge of temporary service equipment, grounding	2.63
Select and Use Ladders/Scaffolding/Lifts based on Application	2.43	2.54	38	Knowledge of safe ladder/scaffolding/lift use practices	2.63
			39	Knowledge of types of ladders/scaffolding/lifts	2.42
			40	Knowledge of ratings of ladders/scaffolding/lifts	2.5
			41	Knowledge of setting up a scaffold	2.23

Implement Trench Fall/Collapse Protection	1.2	1.97	42	Knowledge of types of shoring protection	1.92
			43	Knowledge of types of fall/collapse protection	2.13
			44	Knowledge of when to use shoring and fall protection	2.23
			45	Skill in identifying and mitigating unsafe conditions	2.71
Implement Lockout/Tagout Procedures	1.95	2.48	46	Knowledge of lockout/tagout requirements	2.6
			47	Skill in implementing lockout/tagout procedures	2.6
Provide a Clean and Safe Work Environment (Temperature/Weather Conditions, SDS, Air Quality)	2.23	2.38	48	Knowledge of hazard communication requirements	2.33
			49	Knowledge of safe work practices in extreme weather and environmental conditions	2.42
			50	Skill in working with chemicals	2.13
			51	Skill in identifying unsafe work conditions	2.81
Establish Public Safety Around the Jobsite	2.23	2.47	52	Knowledge of barriers/signs	2.35
			53	Skill in performing jobsite housekeeping	2.41
Domain 3: Personal/Jobsite Safety (OSHA, NFPA 70E)					
Create a Design Based on Project Requirements	1.97	2.13	54	Knowledge of branch circuit requirements	2.86
			55	Knowledge of reading and interpreting plans and specifications	2.8
			56	Knowledge of the requirements of special systems	2.23
			57	Knowledge of lighting and receptacle layout/type	2.73
			58	Skill in reading and interpreting plans and specifications	2.81
			59	Skill in determining the number and size of branch circuits	2.84
			60	Skill in calculating service and feeder sizes	2.84
			61	Skill in determining cable/raceway routing and supports	2.59
Estimate Material, Tools, Overhead and Labor Costs	2.54	2.57	62	Knowledge of how to procure materials	2.11
			63	Knowledge of different types of materials	2.39
			64	Skill in determining the use of different types of materials	2.36
			65	Skill in estimating labor units	2.29
			66	Skill in estimating overhead costs	2.23
			67	Skill in identifying differences between job costs and overhead costs	2.32
			68	Skill in creating project timeline	2.14
Domain 4: Grounding and Bonding					
Create Grounding Electrode System	2.62	2.74	69	Knowledge of types of grounding electrodes	2.68
			70	Knowledge of intersystem bonding requirements	2.78
			71	Skill in installing grounding electrode systems and conductors	2.8
			72	Skill in determining types/size of grounding electrodes and conductors	2.77
Install Water Pipe, Gas and Metal Structure Bonding Conductors	2.28	2.53	73	Knowledge of bonding requirements	2.9
			74	Knowledge of bonding the electrical system components	2.93
			75	Skill in determining types/size of bonding conductors	2.88
Install Grounding and Bonding for Special Systems	1.67	2.28	76	Knowledge of the requirements for bonding and grounding for pools	2.63
			77	Knowledge of grounding and bonding requirements for separately derived systems or non-separately derived systems (standby power systems)	2.56
			78	Knowledge of grounding and bonding requirements for photovoltaic systems	2.15
Install Equipment Grounding/Bonding Conductors	2.7	2.84	79	Knowledge of requirements for grounding equipment (wells, pumps, motors, appliances, etc.)	2.66
			80	Knowledge of bonding requirements	2.83
			81	Knowledge of types of equipment grounding/bonding conductors	2.78
			82	Skill in determining size of equipment grounding/bonding conductor	2.88
			83	Skill in applying requirements for identification and installation of equipment grounding/bonding conductors	2.85
Install Surge Protection Device/Systems	1.87	2.03	84	Knowledge of differences between lightning and surge protection device/systems	2.24
			85	Skill in installing surge protection device/systems	2.27

Install Main and Supply Side Bonding Jumpers	2.47	2.64	86	Knowledge of requirements for the installation of main and supply side bonding jumpers	2.73
			87	Skill in determining the size and type of main and supply side bonding jumpers	2.71
			88	Skill in installing main and supply side bonding jumpers	2.73
Domain 5: Special System and Special Equipment Installations					
Install Photovoltaic Electric Systems	0.78	1.31	89	Knowledge of principles of operation of photovoltaic electric systems	1.84
			90	Knowledge of the different types of photovoltaic electric systems	1.84
			91	Knowledge of the installation requirements for photovoltaic electric systems	1.82
			92	Knowledge of energy storage systems	1.79
			93	Knowledge of building and fire code requirements	2.61
			94	Knowledge of the requirements for interconnected power production sources	2.05
			95	Skill in installing different types and sizes of photovoltaic electric systems	1.84
			96	Skill in identifying power sources	2.61
			97	Skill in installing interconnected power production sources	2.16
Install Electrical Wiring and Components for Swimming Pools, Spas, Hot Tubs, Hydromassage Bath Tubs and Fountains	1.95	1.95	98	Knowledge of overhead conductor clearances for swimming pools, spas, hot tubs, hydromassage bath tubs and fountains	2.79
			99	Knowledge of wiring methods for swimming pools, spas, hot tubs, hydromassage bath tubs and fountains	2.79
			100	Knowledge of requirements for pool related electrically supplied equipment (pumps, lighting, filters, outlets etc.)	2.76
			101	Knowledge of equipotential bonding requirements for electrically supplied and non-electrical equipment	2.71
			102	Knowledge of special protection requirements (ground fault, low voltage contact limit)	2.76
			103	Knowledge of the difference in requirements for permanent and storable swimming pools, spas, hot tubs, hydromassage bath tubs and fountains	2.55
			104	Knowledge of specialized systems (audio, pool heating/cooling)	2.18
			105	Skill in installing wiring and equipment associated with swimming pools, spas, hot tubs, hydromassage bath tubs and fountains	2.61
			106	Skill in installing the equipotential bonding system/conductors	2.71
Install Smoke/CO Detection/Alarm Devices	2.67	2.81	107	Knowledge of location/spacing and clearance requirements	2.74
			108	Knowledge of connection requirements for smoke/CO alarms and associated components	2.74
			109	Knowledge of the difference between a fire alarm system and single/multiple station smoke/CO alarms	2.65
			110	Knowledge of power and non-power limiting systems	2.21
			111	Skill in installing smoke/CO alarms	2.63
Install Electric Vehicle Supply Equipment (EVSE)	0.77	1.31	112	Knowledge of overcurrent protection requirements	2.11
			113	Knowledge of requirements necessary to install EVSE	1.92
			114	Knowledge of disconnecting means	2.21
			115	Knowledge of protection from physical damage	2.05
			116	Knowledge of impact of installing EVSE on existing load	1.82
			117	Knowledge of different types of EVSE	2.21
			118	Skill in sizing conductors for EVSE	2.11
Install Data/ Communications/ Audio Visual (AV)	1.62	1.5	119	Knowledge of the types of cabling (performance)	1.87
			120	Knowledge of installation requirements for limited energy systems	1.87
			121	Knowledge of specialized tools and test equipment for cable installation	1.82
			122	Skill in installing cabling and equipment	2.05
Install Wiring for Chair Lifts, Elevators, Dumbwaiters and Light Lifts	0.9	1.54	123	Knowledge of specific wiring methods for chair lifts, elevators, dumbwaiters and light lifts	1.81
			124	Knowledge of overcurrent protection and shunt trip equipment	2.05
			125	Knowledge of the safety equipment that is required for elevators	2
			126	Knowledge of working clearance	2.22
			127	Skill in installing wiring for chair lifts, elevators, dumbwaiters and light lifts	1.94

Domain 6: Tools and Test Equipment					
Use Test Equipment to Test/Measure Voltage, Current, Resistance and Other Circuit Characteristics	2.88	2.88	128	Knowledge of the various categories of electrical test equipment	2.6
			129	Skill in test equipment selection	2.51
			130	Skill in use of the various types of electrical test equipment	2.57
Selects Hand or Power Tools	2.85	2.83	131	Knowledge of how to use the appropriate hand tools for working on energized circuits and equipment	2.89
			132	Knowledge of the difference between grounded and double insulated power tools	2.6
Domain 7: Circuit Protection and Installation					
Select Conductor Size and Type for Feeders and Branch Circuits	2.78	2.93	133	Knowledge of the temperature rating of terminations	2.6
			134	Knowledge of ampacity adjustment	2.69
			135	Knowledge of ampacity temperature correction	2.66
			136	Knowledge of the ampacity of the conductors	2.94
			137	Knowledge of conductor properties	2.47
			138	Skill in determining conductor ampacity	2.88
			139	Skill in calculating branch circuit loads	2.91
Install Required Branch Circuits	2.95	2.9	140	Knowledge of the required branch circuits/outlets	2.76
			141	Knowledge of voltage limitations for residential branch circuits/outlets	2.65
			142	Knowledge of device ratings and types	2.56
			143	Knowledge of AFCI and GFCI protection requirements	2.88
			144	Knowledge of the disconnecting means requirement for multiwire branch circuits	2.71
			145	Skill in installing branch circuit wiring and outlets	2.85
			146	Skill in installing AFCI and GFCI devices	2.82
			147	Skill in identifying circuit conductors	2.74
			148	Skill in installing multiwire branch circuits	2.68
			149	Skill in installing split wired receptacles and switches	2.62
Install Overcurrent Protective Devices	2.93	2.91	150	Knowledge of sizing of overcurrent protective devices	2.88
			151	Knowledge of the physical location of overcurrent protective devices	2.71
			152	Knowledge of branch circuit tap rules	2.47
Domain 8: Wiring Methods and Practices					
Select Wiring Method for Services, Feeders and Branch Circuits	2.78	2.82	153	Knowledge of the various types of wiring methods	2.66
			154	Skill in selecting the appropriate cable/raceway types	2.61
Determines Routing and Physical Protection Requirements based on the Construction Type	2.83	2.77	155	Knowledge of protection against corrosion and deterioration	2.66
			156	Knowledge of clearances related to openings and windows	2.59
			157	Knowledge of protection from physical damage	2.72
			158	Knowledge of the impact of notching and boring on structural elements	2.59
			159	Knowledge of fireproofing requirements and methods at penetrations	2.56
			160	Skill in notching, boring and installing protective/steel plates	2.69
Terminates Electrical Conductors	2.9	2.88	161	Knowledge of conductor termination requirements	2.71
			162	Knowledge of dissimilar metals	2.65
			163	Skill in terminating electrical conductors	2.81
			164	Skill in selecting electrical equipment based on conductor type	2.58
Install Equipment based on Product Certification and Manufacturers' Requirements	2.78	2.74	165	Knowledge of the effect that certification/listing and manufacturers' requirements have on the installation	2.32
Select Wiring Methods and Equipment based on Environmental Conditions (Wet, Damp, Dry, Exposed, Sunlight, Concealed, Temperature)	2.71	2.79	166	Knowledge of the uses permitted, uses not permitted and other installation requirements for the respective wiring methods	2.87
			167	Knowledge of the environmental markings on electrical equipment and electrical equipment enclosures	2.74
			168	Skill in selecting wiring methods and equipment based on conditions of use	2.77

Determine Box and Raceway Conductor Fill	2.64	2.61	169	Knowledge of free conductor length	2.32
			170	Knowledge of requirements for calculating conductor fill	2.55
			171	Knowledge of requirements of pull boxes, junction boxes and conduit bodies	2.55
			172	Knowledge of requirements for cable entry into a box	2.45
			173	Skill in selecting the size of boxes and raceways	2.71
Determine Working/Dedicated Space Requirements for Electrical Equipment	2.51	2.71	174	Knowledge of working space requirements	2.71
			175	Knowledge of dedicated equipment space requirements	2.74
			176	Skill in arranging equipment to meet working/dedicated space requirements	2.71
Domain 9: Equipment for General Use					
Install Luminaires/Lampholders	2.79	2.58	177	Knowledge of installation requirements for luminaires/lampholders	2.45
			178	Skill in installing luminaires/lampholders	2.58
Install Switches	2.88	2.71	179	Knowledge of installation requirements for switches	2.48
			180	Skill in installing switches	2.61
Install Metering Enclosures, Panel Boards and Disconnects	2.69	2.82	181	Knowledge of installation requirements for metering enclosures, panel boards and disconnects	2.77
			182	Skill in installing metering enclosures, panel boards and disconnects	2.77
Install Receptacles	2.93	2.8	183	Knowledge of installation requirements for receptacles	2.63
			184	Skill in installing receptacles	2.68
Install Wiring for HVAC Equipment	2.71	2.64	185	Knowledge of installation requirements for HVAC equipment	2.1
			186	Skill in installing HVAC equipment	1.97
Install Wiring for Appliances	2.84	2.71	187	Knowledge of installation requirements for appliances	2.32
			188	Skill in installing appliances	2.13
Install Optional Standby System	1.59	1.94	189	Knowledge of installation requirements for generators and optional standby systems	2.32
			190	Skill in installing generators and optional standby systems	2.26
Install Flexible Cords and Cables	2.12	2.11	191	Knowledge of installation requirements for flexible cords and cables	2.32
			192	Skill in installing flexible cords and cables	2.33
Domain 10: Energy Efficiency/Management					
Install Energy Efficient Equipment	1.89	1.92	193	Knowledge of the impact of energy codes on electrical installations	2.1
			194	Knowledge of energy saving devices	1.97

Appendix S

Residential Electrical Contractor Examination Plan

Domains	# of Items
A. Theory	9
B. Personal/Jobsite Safety (OSHA, NFPA 70E)	8
C. Project Design, Estimating and Management	8
D. Grounding and Bonding	14
E. Special System and Special Equipment Installations	7
F. Tools and Test Equipment	7
G. Circuit Protection and Installation	16
H. Wiring Methods and Practices	17
I. Equipment for General Use	13
J. Energy Efficiency/Management	1

Definition of a Residential Electrician/Residential Electrical Contractor
One who demonstrates competency in performing electrical installations, service, repair and maintenance typically encountered in a permanent dwelling unit.

Domains, Tasks, KSAs

A. Theory	# of Items
Calculate Voltage Drop Knowledge of the elements of Ohm's Law Skill in using formulas for calculating voltage drop	1
Determine Voltage, Current, Resistance and Power for Circuits Knowledge of relationship between voltage, current, power and resistance Knowledge of single and three phase systems and voltages Skill in using formulas for calculating voltage, current, resistance and power for circuits	2
Calculate Load Requirements based on Volts and Amperage Knowledge of code requirements for determining loads Skill in applying the code load calculation rules/tables	2
Determine Short Circuit Current and Overcurrent Protection Rating Knowledge of types/sizes of overcurrent protection Knowledge of the requirements for selecting equipment based on the available short circuit rating Knowledge of requirements for selecting overcurrent protective devices Skill in using short circuit calculation formulas Skill in selecting overcurrent devices	2
Determine Watt-hour Usage Knowledge of formulas for calculating watt-hours Skill in calculating watt-hours	1
Calculate Series and Parallel Circuits Knowledge of series and parallel circuit calculations Knowledge of differences between series and parallel circuit calculations Skill in calculating circuit values for series circuits Skill in calculating circuit values for parallel circuits	1

B. Personal/Jobsite Safety (OSHA, NFPA 70E)	# of Items
Mitigate Hazards or Select PPE (Personal Protective Equipment) Knowledge of the various types of PPE Knowledge of OSHA and other standards Knowledge of identifying and mitigating jobsite hazards Knowledge of demarcation point for primary and secondary conductor installation Knowledge of requirements for pre-trenching notification and inspection (public/private) Knowledge of utility color coding standards Skill in applying hazard mitigation controls (engineering, administrative and PPE) Skill in identifying and mitigating jobsite hazards (overhead clearances, fall hazards, shock hazards) Skill in selecting PPE for the specific task Skill in shock and arc flash hazards implementation protection Skill in locating underground utilities/systems	**2**
Determine Temporary Wiring/Lighting Requirements Knowledge of the proper rating of extension cords Knowledge of requirements for temporary wiring/lighting Knowledge of GFCI requirements and assured grounding programs Knowledge of temporary service equipment, grounding	**1**
Select and Use Ladders/Scaffolding/Lifts based on Application Knowledge of safe ladder/scaffolding/lift use practices Knowledge of types of ladders/scaffolding/lifts Knowledge of ratings of ladders/scaffolding/lifts Knowledge of setting up a scaffold	**1**
Implement Excavation Hazard Protection Knowledge of types of shoring protection Knowledge of types of fall/collapse protection Knowledge of when to use shoring and fall protection Skill in identifying and mitigating unsafe conditions	**1**
Implement Lockout/Tagout Procedures Knowledge of lockout/tagout requirements Skill in implementing lockout/tagout procedures	**1**
Provide a Clean and Safe Work Environment (Temperature/Weather Conditions, SDS, Air Quality) Knowledge of hazard communication requirements Knowledge of safe work practice in extreme weather and environmental conditions Skill in working with chemicals Skill in identifying unsafe work conditions	**1**
Establish Public Safety Around the Jobsite Knowledge of barriers/signs Skill in performing jobsite housekeeping	**1**

C. Project Design, Estimating and Management	# of Items
Create a Design Based on Project Requirements Knowledge of branch circuit requirements Knowledge of reading and interpreting plans and specifications Knowledge of the requirements of special systems Knowledge of lighting and receptacle layout/type Skill in reading and interpreting plans and specifications Skill in determining the number and size of branch circuits Skill in calculating service and feeder sizes Skill in determining cable/raceway routing and supports	**5**
Estimate Material, Tools, Overhead and Labor Costs Knowledge of how to procure materials Knowledge of different types of materials Skill in determining the use of different types of materials Skill in estimating labor units Skill in estimating overhead costs Skill in identifying differences between job costs and overhead costs Skill in creating project timeline	**3**

D. Grounding and Bonding	# of Items
Create Grounding Electrode System Knowledge of types of grounding electrodes Knowledge of intersystem bonding requirements Skill in installing grounding electrode systems and conductors Skill in determining types/size of grounding electrodes and conductors	**3**
Install Water Pipe, Gas and Metal Structure Bonding Conductors Knowledge of bonding requirements Knowledge of bonding the electric system Skill in determining types/size of bonding conductors	**2**
Install Grounding and Bonding for Special Systems Knowledge of the requirements for bonding and grounding for pools Knowledge of grounding and bonding requirements for separately derived systems or non-separately derived systems (standby power systems) Knowledge of grounding and bonding requirements for photovoltaic systems	**3**
Install Equipment Grounding/Bonding Conductors Knowledge of requirements for grounding equipment (wells, pumps, motors, appliances, etc.) Knowledge of bonding requirements Knowledge of types of equipment grounding/bonding conductors Skill in determining size of equipment grounding/bonding conductor Skill in applying requirements for identification and installation of equipment grounding/bonding conductors	**3**
Install Surge Protection Device/Systems Knowledge of differences between lightning and surge protection device/systems Skill in installing surge protection device/systems	**1**
Install Main and Supply Side Bonding Jumpers Knowledge of requirements for the installation of main and supply side bonding jumpers Skill in determining the size and type of main and supply side bonding jumpers Skill in installing main and supply side bonding jumpers	**2**

E. Special System and Special Equipment Installations	# of Items
Install Photovoltaic Electric Systems Knowledge of principles of operation of photovoltaic electric systems Knowledge of the different types of photovoltaic electric systems Knowledge of the installation requirements for photovoltaic electric systems Knowledge of energy storage systems Knowledge of building and fire code requirements Knowledge of the requirements for interconnected power production sources Skill in installing different types and sizes of photovoltaic electric systems Skill in identifying power sources Skill in installing interconnected power production sources	**1**
Install Electrical Wiring and Components for Swimming Pools, Spas, Hot Tubs, Hydromassage Bath Tubs and Fountains Knowledge of overhead conductor clearances for swimming pools, spas, hot tubs, hydromassage bath tubs and fountains Knowledge of wiring methods for swimming pools, spas, hot tubs, hydromassage bath tubs and fountains Knowledge of requirements for pool related electrically supplied equipment (pumps, lighting, filters, outlets etc.) Knowledge of equipotential bonding requirements for electrically supplied and non-electrical equipment Knowledge of special protection requirements (ground fault, low voltage contact limit) Knowledge of the difference in requirements for permanent and storable swimming pools, spas, hot tubs, and fountains Knowledge of specialized systems (audio, pool heating/cooling) Skill in installing wiring and equipment associated with swimming pools, spas, hot tubs, hydromassage bath tubs and fountains Skill in installing the equipotential bonding system/conductors	**2**
Install Smoke/CO Detection/Alarm Devices Knowledge of location/spacing and clearance requirements Knowledge of connection requirements for smoke/CO alarms and associated components Knowledge of the difference between a fire alarm system and single/multiple station smoke/CO alarms Knowledge of power and non-power limiting systems Skill in installing smoke/CO alarms	**1**
Install Electric Vehicle Supply Equipment (EVSE) Knowledge of overcurrent protection requirements Knowledge of requirements necessary to install EVSE Knowledge of disconnecting means Knowledge of protection from physical damage Knowledge of impact of installing EVSE on existing load Knowledge of different types of EVSE Skill in sizing conductors for EVSE Skill in determining the location of EVSE (ventilated and non-ventilated)	**1**
Install Data/Communications/Audio Visual (AV) Knowledge of the types of cabling (performance) Knowledge of installation requirements for limited energy systems Knowledge of specialized tools and test equipment for cable installation Skill in installating cabling and equipment	**1**
Install Wiring for Chair Lifts, Elevators, Dumbwaiters and Light Lifts Knowledge of specific wiring methods for chair lifts, elevators, dumbwaiters and light lifts Knowledge of overcurrent protection and shunt trip equipment Knowledge of the safety equipment that is required for elevators Knowledge of working clearance Skill in installing wiring for chair lifts, elevators, dumbwaiters and light lifts	**1**

F. Tools and Test Equipment	# of Items
Use Test Equipment to Test/Measure Voltage, Current, Resistance and Other Circuit Characteristics Knowledge of the various categories of electrical test equipment Skill in test equipment selection Skill in use of the various types of electrical test equipment	**4**
Selects Hand or Power Tools Knowledge of how to use the appropriate hand tools for working on energized circuits and equipment Knowledge of the difference between grounded and double insulated power tools	**3**

G. Circuit Protection and Installation	# of Items
Select Conductor Size and Type for Feeders and Branch Circuits Knowledge of the temperature rating of terminations Knowledge of ampacity adjustment Knowledge of ampacity temperature correction Knowledge of the ampacity of the conductors Knowledge of conductor properties Skill in determining conductor ampacity Skill in calculating branch circuit loads	**5**
Install Required Branch Circuits Knowledge of the required branch circuits/outlets Knowledge of voltage limitations for residential branch circuits/outlets Knowledge of device ratings and types Knowledge of AFCI protection requirements Knowledge of GFCI protection requirements Knowledge of the disconnecting means requirement for multiwire branch circuits Skill in installing branch circuit wiring and outlets Skill in installing AFCI devices Skill in installing GFCI devices Skill in marking/labeling grounded and ungrounded circuit conductors Skill in installing multiwire branch circuits Skill in installing split wired receptacles and switches	**8**
Install Overcurrent Protective Devices Knowledge of proper sizing of overcurrent protective devices Knowledge of the physical location of overcurrent protective devices Knowledge of branch circuit tap rules	**3**

H. Wiring Methods and Practices	# of Items
Select Wiring Method for Services, Feeders and Branch Circuits Knowledge of the various types of wiring methods Skill in selecting the appropriate cable/raceway types	**2**
Determines Routing and Physical Protection Requirements Knowledge of required cover/burial depth requirements for underground conductors and raceways Knowledge of protection against corrosion and deterioration Knowledge of clearances related to openings and windows Knowledge of protection from physical damage Knowledge of the impact of notching and boring on structural elements Knowledge of fireproofing requirements and methods at penetrations Skill in underground installation Skill in notching, boring and installing protective/steel plates	**3**
Terminates Electrical Conductors Knowledge of conductor termination requirements Knowledge of dissimilar metals Skill in terminating electrical conductors Skill in selecting electrical equipment based on conductor type	**2**
Install Equipment based on Product Certification and Manufacturers' Requirements Knowledge of the effect that certification/listing and manufacturers' requirements have on the installation	**1**
Select Wiring Methods and Equipment based on Environmental Conditions (Wet, Damp, Dry, Exposed, Sunlight, Concealed, Temperature) Knowledge of the uses permitted, uses not permitted and other installation requirements for the respective wiring methods Knowledge of the environmental markings on electrical equipment and electrical equipment enclosures Skill in selecting wiring methods and equipment based on conditions of use	**3**
Determine Box and Raceway Conductor Fill Knowledge of free conductor length Knowledge of requirements for calculating conductor fill Knowledge of requirements of pull boxes, junction boxes and conduit bodies Knowledge of requirements for cable entry into a box Skill in selecting the size of boxes and raceways	**4**
Determine Working/Dedicated Space Requirements for Electrical Equipment Knowledge of working space requirements Knowledge of dedicated equipment space requirements Skill in arranging equipment to meet working/dedicated space requirements	**2**

I. Equipment for General Use	# of Items
Install Luminaires/Lampholders Knowledge of installation requirements for luminaires/lampholders Skill in installing luminaires/lampholders	**2**
Install Switches Knowledge of installation requirements for switches Skill in installing switches	**2**
Install Metering Enclosures, Panel Boards and Disconnects Knowledge of installation requirements for metering enclosures, panel boards and disconnects Skill in installing metering enclosures, panel boards and disconnects	**2**
Install Receptacles Knowledge of installation requirements for receptacles Skill in installing receptacles	**2**
Install Wiring for HVAC Equipment Knowledge of electrical installation requirements for HVAC equipment Skill in providing electrical connections to HVAC equipment	**1**
Install Wiring for Appliances Knowledge of electrical installation requirements for appliances Skill in providing electrical connections to appliances	**2**
Install Optional Standby System Knowledge of installation requirements for generators and optional standby systems Skill in installing generators and optional standby systems	**1**
Install Flexible Cords and Cables Knowledge of installation requirements for flexible cords and cables Skill in installing flexible cords and cables	**1**

J. Energy Efficiency/Management	# of Items
Install Energy Efficient Equipment Knowledge of energy saving/management devices	1
Total	**100**

Psychometric Criteria for Residential Electrical Contractor/Residential Electrician

Open Book

Use last two revisions of the Code

4-Choice Multiple Choice Format

No more than 5% negatively worded items

Cut score based on Standard Setting workshop

Number of scored items on exam: 100

Number of pre-test items: 15

The % of non-code items must be at least equal to 100% minus the cut-score plus 1%

Number of items relating to visual aids, graphs, charts, blueprints: 15% - no more than 2 items per diagram

Cannot use "none of the above" or "all of the above" as an option

All items must be referenced (math items can be referenced as basic math)

Items measuring skill statements from the KSAs shall be written at the application and analysis level

No true/false or essay items

Generally avoid absolute items with words such as "always", "all" or "never" – may use "shall" or "shall not"

No weighted items

Clones should be created when feasible although they must be designated as such so that clones do not appear on the same version of an examination

Other "Enemies" shall be marked so that they do not appear on the same version of an examination

Appendix T

List of SMEs Participating in the Test Development Meeting

Test Development Meeting

January 9 – 13, 2017, Phoenix, Arizona
Location: NASCLA Association Office

Jose Barragan
Owner, Barragan Construction Services
California City, CA

Jay Cannava
President, P.I. Electric, Inc.
Lake Park, FL

Julie Gauthreaux
CEO, Pelican Electrical Services, LLC
Theriot, LA

Steve Grayson
Construction Inspector, John Guth Associates
Shreveport, LA

Jesse Jameson
Construction Compliance Supervisor, Washington Department of Labor & Industries
Tumwater, WA

Mike Johnston
Executive Director Standards and Safety, National Electrical Contractors Association (NECA)
Bethesda, MD

Robert Jones
Deputy Executive Director, IEC Texas Gulf Coast
Houston, TX

Jack Lyons
Northeast Field Representative, National Electrical Manufacturers Association (NEMA)
West Chesterfield, MA

Jeff Masterson
Services License/Compliance Manager, The Home Depot
Rock Hill, SC

David Mims
President, Georgia-Florida Alarm Company
Tallahassee, FL

Craig Monin
President, Lon's Electrical Service, Inc.
San Bernardino, CA

Tim Norman
Executive Director, North Carolina State Board of Examiners of Electrical Contractors
Raleigh, NC

Richard Tousey
Regional Compliance Manager, The Home Depot
Old Bethpage, NY

Michael Travers, Sr.
Master Electrician, State of Delaware
Milton, DE

Joseph Wages Jr.
Technical Advisor, Education, Codes and Standards, International Association of Electrical Inspectors (IAEI)
Richardson, TX

Wesley Lamar Wheeler
National Director of Safety, National Electrical Contractors Association (NECA)
Bethesda, MD

Appendix U

List of SMEs Participating in the Standard Setting Meeting

Standard Setting Meeting

February 6 – 10, 2017, Phoenix, Arizona
Location: NASCLA Association Office

Pierre Bellemare
President, Bellemare, Inc.
Ellenton, FL

Steve Grayson
Construction Inspector, John Guth Associates
Shreveport, LA

Jesse Jameson
Construction Compliance Supervisor, Washington Department of Labor & Industries
Tumwater, WA

Mike Johnston
Executive Director Standards and Safety, National Electrical Contractors Association (NECA)
Bethesda, MD

Robert Jones
Deputy Executive Director, IEC Texas Gulf Coast
Houston, TX

Jack Lyons
Northeast Field Representative, National Electrical Manufacturers Association (NEMA)
West Chesterfield, MA

Craig Monin
President, Lon's Electrical Service, Inc.
San Bernardino, CA

Brooks Myers
Regional Compliance Manager, The Home Depot
Bandera, TX

Tim Norman
Executive Director, North Carolina State Board of Examiners of Electrical Contractors
Raleigh, NC

Lou Petrucci
Manager, L & M Electric, LLC
Cranston, RI

Mark Ptashkin
Consultant, MEP Consulting
Surprise, AZ

Clarence Tibbs
President, STE Electrical Systems, Inc.
Apopka, FL

Michael Travers, Sr.
Master Electrician, State of Delaware
Milton, DE

Joseph Wages Jr.
Technical Advisor, Education, Codes and Standards, International Association of Electrical Inspectors (IAEI)
Richardson, TX

Appendix V

Item Review/Sample Angoff Rating Sheet

			Master/Contractor							Journeyman							Residential							
	ITEM ID	KEY	DELETE?	RETAIN?	Acceptability: OK as Edited	KSA	Relevance: 0 - 4	Recall/Application	Angoff: %	DELETE?	RETAIN?	Acceptability: OK as Edited	KSA	Relevance: 0 - 4	Recall/Application	Angoff: %	DELETE?	RETAIN?	Acceptability: OK as Edited	KSA	Relevance: 0 - 4	Recall/Application	Angoff: %	Comments
1	0399	D				A1A							A5A							C14B				

Relevance Scale:

4=Extremely Relevant
3=Very Relevant
2=Moderately Relevant
1=Little Relevance
0=No Relevance

Name: _____

Appendix W

Pilot Testing Item/Test Review Sheet

NASCLA Accredited Electrical Examination Program Test Review Sheet

Test (circle one): Electrical Contractor (Master) Journeyman Residential Electrician

Version (circle one): Form 1 Form 2 Form 3

	Item #																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
The item's instructions are clear																									
The item content is clearly written																									
There are no formatting issues with the item																									
The item is suitable for computer presentation																									
The item's graphics or plans are clear																									

Prior to exiting the examination and selecting "I Am Done", please take a moment to go back through all of the Plans (PDFs) for your version of the examination in the **Reference Library and report back if they were **legible, easily accessible, information was complete, etc.**

Plan #_____: Y N If no, please explain: _____

Plan #_____: Y N If no, please explain: _____

Plan #_____: Y N If no, please explain: _____

Plan #_____: Y N If no, please explain: _____

Plan #_____: Y N If no, please explain: _____

Name: _____ Date: _____

Test Administration Questions (circle one):

1. The log on process was easy: Y N If no, please explain: _____
2. The test administration platform was easy to navigate: Y N If no, please explain: _____
3. The information in the Score Reporting System was sufficient: Y N If no, please explain: _____
4. Indicate any concerns or problems you had with the test administration process as a whole: _____

_____

_____

_____

Name: _____ Date: _____