PEARL Technician Certification

# Candidate Level 1 Handbook

## Train. Test. Certify.

**This booklet contains:**

- Exam education and experience requirements
- Selected study references
- Certification policies
- Sample exam questions

LEVEL 1 PEARL CERTIFIED TECHNICIAN

## Certification Development Committee

PEARL extends its gratitude to the following individuals who were part of the PEARL Certification Development Committee and gave their approval for this document. Together, these members possess 222 years of expertise in the electrical equipment reconditioning and remanufacturing sector.

Andre Adams
Paul Beldin
Heath Blundell
Derek Bray
Andy Conklin
Malcolm Frederick
Kristen Habeeb
Howard Herndon
Dan Hook
Clay Huron
Matt Jackson
David King
Robert Koren
Jim Miller
Steve Newton
Douglas Powell
Brian Railsback
David Randolph
David Rosenfield
Josh Rosenfield
Kismet Saglam
Andrew VanWasshnova
Terry Wanamaker
Don West
Robert Wrobel

## Practice Analysis Validation Panel and Exam Question Review Committee

PEARL would like to thank the following individuals who served on the PEARL Validation Panel, reviewing, and offering feedback on the Level 1 practice analysis, and those who participated in the exam question review sessions.

Mark Alascio
Luis Arambula
Eric Beckman
Paul Beldin
Ray Carpenter
Kevin Carter
Andy Conklin
Glen Dangelmayr
Jim Feilbach
Malcom Fredrick
Paul Grein
Mike Griggs
Michael Habeeb
Reggie Houston
Clay Huron
Mark Jenkins
Dave McFarland
Sean Nelms
Kenneth Owens
Mike Petroff
Kurt Poeschl
Stephen Reames
David Rosenfield
Josh Rosenfield
Daniel Shopshear
Ross Smelley
Kevin Somers
Dusty Sprouce
Jimmy Sprouce
Karl Stephens Jr.
Don West
Troy Yosten

**2023 Panel:**

Paul Beldin
Casey Blevins
Andy Conklin
Jim Feilbach
Dave Kreger
Justin Miller
Nick Milstead
Terry Wanamaker
Brad Wetzel
Don West

## Table of Contents


**Introduction** ..... 4

The PEARL Association ..... 4

Why Get Certified? ..... 4

Delineation of Certification Levels ..... 4

Level 1 Technician ..... 5

Level 2 ..... 5

Level 3 ..... 5

Level 4 ..... 5

**PEARL Technician Profile** ..... 6

**The Certification Process** ..... 7

Step One – Complete the Online Technician Application ..... 7

Step Two – Application Review ..... 7

Step Three – Training ..... 7

Step Four – Exam Scheduling ..... 7

Step Five – Taking the Exam and Preliminary Results ..... 7

Step Six – Official Exam Notification ..... 8

Step Seven – PEARL Certification ..... 8

**Training & Exam Design and Administration** ..... 9

Exam Design ..... 9

Exam Format ..... 9

Complexity of Test Questions ..... 9

Exam Content Areas (ECAs) ..... 9

Item Appeals ..... 9

Using the Training To Go Online Training ..... 9

**Code of Ethics** ..... 11

**Level 2 PEARL-Certified Technician** ..... 12

Eligibility Criteria for Taking the Exam ..... 12

**Continuing Professional Development Policy** ..... 13

**Conditions of Application for Technicians** ..... 13

**Exam Payments and Fee Details** ..... 15

**Preparing For Your Test** ..... 16

Determining Applicant's Preparedness ..... 16

Using the Selected References ..... 16

Using the Exam Content Areas as a Guide to Your Study ..... 16

**Sample Test Questions** ..... 23

# Candidate Level 1 Handbook

## Introduction

### The PEARL Association

The **Professional Electrical Apparatus Reconditioning League (PEARL)** is a professional trade association of companies that supply reconditioned, and remanufactured electrical power equipment, apparatus, and components to the industry. The mission of PEARL is to create a marketable distinction in quality, safety, and integrity for PEARL members in the eyes of their customers. PEARL's members must meet strict technical, safety, and operational requirements; and be committed to the safe reconditioning and remanufacturing of electrical apparatus and equipment that has previously been in service. PEARL sponsors an annual conference and exhibition that can be attended by anyone concerned with the safety and reliability of reconditioned, remanufactured, and recycled electrical equipment and apparatus.

### Why Get Certified?

For employers, the PEARL Technician Certification offers a means to highlight companies that employ certified technicians, providing these firms with a competitive advantage and heightened recognition in the industry. By certifying your technicians, you can boost staff morale, decrease attrition, pave the way for prospective management roles, minimize accidents and related expenses, lessen warranty claims, and enhance the company's overall profitability.

For technicians, PEARL Technician Certification can enhance your career journey, paving the way for new opportunities within your organization. It can foster a deeper sense of professional satisfaction and garner respect from your colleagues, both in the workplace and throughout the broader electrical reconditioning community.

The PEARL Technician Certification Program is an online self-paced program that ensures your technicians get the safety and technical training they need to excel in their careers. Each level of the training has prerequisite modules that must be completed to help prepare the technician for the exam.

The PEARL Technician Certification Program is only available for PEARL Accredited Companies (PAC). PACs are dealer or service members that have passed a rigorous review by a third-party, are peer approved by industry experts, and comply with the PEARL electrical standards: ANSI/PEARL Electrical Equipment Reconditioning Standard (EERS) and the PEARL Inspect & Test Standard.

### Delineation of Certification Levels

The PEARL Technician Certification program was created to offer multi-level technical certification for individuals employed in the reconditioned electrical equipment field. Exams are designed by vocational specialists and span four levels of practice, ranging from the entry-level technician (Level 1) to the supervisory technician (Level 4). Levels 2, 3, and 4 are defined in terms of general experience in the electrical equipment reconditioning business and the complexity of the equipment on which they perform work. The certification design committee developed a general delineation of the levels of certification, which are presented below.

## Level 1 Technician

Level 1 technicians are qualified to work safely within a shop environment and around de-energized electrical power equipment. They recognize and possess a fundamental understanding of the PEARL reconditioning standards. These technicians can identify various types of electrical apparatus, shop equipment, warehouse equipment, test and measurement equipment, and cleaning equipment used in the electrical equipment reconditioning process, all under the supervision of a higher-level technician.

## Level 2

Level 2 technicians can work independently to inspect, test, and perform reconditioning procedures in compliance with PEARL and other industry standards on a wide range of electrical power equipment. They can also accurately interpret equipment drawings, specifications, and electrical schematics at the component level as they relate to the PEARL reconditioning standards.

## Level 3

Level 3 technicians can supervise Level 1 and 2 technicians, conduct, and oversee large equipment reconditioning projects, work safely in the field around energized electrical equipment, develop equipment test plans and analyze test results, plan and lead jobs, evaluate shop safety plans, and provide training to others.

## Level 4

Level 4 technicians can manage multiple individuals and projects, conduct complex metering and protection projects, make recommendations on power system diagnostic testing and corrective actions, and evaluate electrical equipment modifications and upgrades for adherence to PEARL and industry standards.

## PEARL Technician Profile

This certification program is intended for technicians who are engaged in inspection, reconditioning, and/or remanufacturing, testing, periodic maintenance of electrical power equipment and evaluation of such equipment for acceptance for service, continued serviceability, or required maintenance.

| | **Level 1** | **Level 2** | **Level 3** | **Level 4** |
|---|---|---|---|---|
| **Technician Title:** | Entry Technician | Journey Technician | Lead Technician | Supervisory Technician |
| **Certified Specialist Requirement:** | Not Applicable | Level 1 certificate | Level 2 certificate | Under development |
| **Education:** | None | Same as Level 1 | Same as Level 1 | Same as Level 1 |
| **Training:** | None | 20 hours of safety training<br>40 hours of electrical training | Additional 24 hours of safety training | Under Development |
| **Experience:** | None | 2 years | 5 years | 10 years |
| **Technical Essential Duties Category:** | Level 1 Duties | Level 2 Duties | Level 3 Duties | Level 4 Duties |

## The Certification Process

### Step One – Complete the Online Technician Application

To become certified, all applicants must complete an online certification application. The application verifies an applicant's work experience and qualifications. PEARL certification mandates that applicants be currently employed by a PEARL Accredited Company (service or dealer). Additionally, applicants must satisfy all education, training, and work experience prerequisites as outlined in the PEARL Technician Profile. All applicants are required to pay in advance for the PEARL Technician Certification process to offset costs associated with application review, training, exam creation, and certification.

### Step Two – Application Review

Upon payment and submission of your application, your confirmation email will provide information on how your Primary Training Contact can verify the education/training, work experience, and employment details provided in the application. This information must be verified within 30 days of your application submission. If the application is approved, the applicant will receive an email confirmation and enrollment letter. If the application is rejected, the applicant will be notified via email and may be requested to provide additional information, if warranted. A fee of $50.00 will be charged if the employer does not verify or approve the application within 30 days of application submission.

### Step Three – Training

The technician will be required to complete all twelve modules of the Level 1 training program. The coursework to prepare for Level 1 is presented in an interactive online process. The modules include technician safety, component evaluation and basic electrical product courses. The training is designed to supplement the technician's knowledge, skills and abilities required for an entry level PEARL technician.

### Step Four – Exam Scheduling

The acceptance/enrollment email will provide applicants with all the instructions needed to proceed with their exam. Exam candidates are required to present at least one valid government-issued photo identification (such as a state driver's license, ID, or passport). Only after the exam proctor has positively identified a candidate may the exam commence.

**To reschedule your exam**, you must submit a written request via email to the proctor no later than one week before your scheduled exam, requesting an alternative time. If you miss your scheduled exam time, you may reschedule your exam upon payment of an additional $150 administrative fee. An exam may be rescheduled only twice before all exam fees are forfeited, and a new application must be submitted.

**To reschedule an exam after failing**, if you do not pass the exam on your first attempt, you may reschedule it following a 30-day waiting period. A new application and exam fee will be required if you have failed the exam more than twice.

### Step Five – Taking the Exam and Preliminary Results

After completing the required coursework, the candidate is eligible to take the exam. Exams will be administered at specific times during the year at centralized locations throughout the US and at the annual PEARL Conference & Exhibition. Exams are administered online using a proctor. During the exam, the candidate will use their own computer, which must have a

functioning microphone and camera. If an agency is used, the proctoring agency will lock down the users' browser and maintain video contact throughout the exam to ensure a secure exam environment. No reference materials, cell phone, cameras, or computers (other than the computer being used for examination and a standard calculator which is permitted for the math questions.) are allowed during the exam. Candidates are not allowed to use any notes during the exam. Candidates who violate exam rules will be disqualified from that exam. All violations of exam security will be investigated by PEARL and appropriate action will be taken. Exam time limit is 2 hours.

## Exam Grading

After participants have completed all the questions, the exam is automatically scored, tabulated, and the answers are stored in a secure PEARL/Training To Go Learning Management System (LMS). The overall exam score will determine whether you pass or fail. The minimum passing score is 70% of items answered correctly. Each time a certification exam is administered, the questions are altered, resulting in a unique exam. The passing score is established as an overall estimate of minimal acceptable competence in the Exam Content Areas, as determined by subject matter and examination experts. Passing scores are calculated based on an overall performance, not on individual Exam Subject Areas, and are independent of other candidates' scores. No partial credit will be awarded for any items answered incorrectly. Upon completion of the test, applicants are notified immediately online of their pass or fail status.

## Step Six – Official Exam Notification

Exam results are displayed on the computer screen upon completion of the exam as well as in the LMS account of the candidate. No results are provided by phone or fax. All results are confidential and are released only to the certificate candidate. The official exam notification will indicate only whether the applicant passed or failed the exam. To maintain exam security, no additional feedback will be provided to candidates regarding specific exam item answers. The candidate will be provided an on-line form to communicate any feedback about the exam.

## Step Seven – PEARL Certification

All certificates are completed after passing the exam successfully online and stored in the applicant's transcript profile on the PEARL/Training To Go Learning Management System. The Candidate can download a copy from their LMS profile.

## Training & Exam Design and Administration

### Exam Design

All training and certification exams are designed to test knowledge and skills required to perform essential duties with minimal acceptable competence. Research for these assessments was conducted under the guidance of the Employee Development Committee and PEARL staff. Each test question is crafted to measure at least one requisite area of knowledge or skill essential for task performance.

### Exam Format

All PEARL exams are administered in a test format that utilizes a variety of question types. The formats used in the exams include multiple-choice, multiple-response, matching, hotspot, and ranking. Questions may have one, two, or three correct answers. The exam does not feature essay, true/false, or yes/no questions (refer to the Sample Test Questions in this booklet for examples). These objective formats allow for broader content coverage within a given testing time and enhance the reliability of competency measurement.

### Complexity of Test Questions

At Level 1, certificate candidates should possess fundamental job knowledge and the capability to safely execute Essential Duties. The coursework to prepare for Level 1 is presented in an interactive on-line process. The modules include technician safety, component evaluation and basic electrical product courses. The training is designed to supplement the technician's knowledge, skills and abilities required for an entry level PEARL technician. Quiz assessments are integrated throughout to help the technician prepare for the final exam.

### Exam Content Areas (ECAs)

Exam Content Areas (ECAs) encompass the knowledge or skills necessary for performing the essential duties specific to each Level. Every ECA contains crucial knowledge and skills needed for the essential duties of an electrical equipment reconditioning technician. However, the test designers identified certain content areas as more critical, resulting in unequal weighting across the ECAs on the exam.

### Item Appeals

Candidates wishing to appeal a specific exam item must do so after the exam period by completing the Evaluation Form. All candidate feedback will be evaluated, and necessary adjustments to the exam content will be made accordingly. However, candidates providing feedback will not receive any direct response.

### Using the Training To Go Online Training

Training To Go is the Training Partner for PEARL. It operates in a Cloud Based Learning Management System (LMS) environment. Courses have been selected to correspond with the specific levels of PEARL certification. Some of the content was prepared especially for the certification program. The candidate will have their own account on the LMS that will show the coursework assigned, certificates for each course, and ultimately the PEARL Level Certificate(s). This system also tracks the amount of time spent on each course.
The web site used is TrainingToGo.net. Email communications are sent from this website as part of the LMS. It is recommended that the candidate make sure that TrainingToGo.net is added to their safe email list.

Upon completion of the required coursework, the candidate should contact Training To Go to schedule a time to take the exam or be added to the convenient geographic location. Once registered the TrainingToGo.net site becomes the interface between the candidate and certification.

## Code of Ethics

The purpose of the Code of Ethics is to ensure industry confidence in the integrity and service of PEARL member companies while performing their duties. Additionally, it is intended to reflect the standards and behavior that PEARL certificate-holders and applicants expect of each other as they perform their work meeting strict technical, safety, and operational requirements that reaffirm the value of holding a PEARL technical certificate. PEARL-certified technicians recognize the services they render have a significant impact on the clients and industry they serve. As they perform their duties, PEARL technical certificate holders and applicants are expected to meet the following standards of professional conduct and ethics:

1. To protect themselves, their coworkers, property, and the environment by performing the Essential Duties of the PEARL-certified vocation safely and effectively, and complying with all applicable federal, state, and local regulations.
2. To represent themselves truthfully and honestly when performing their duties and throughout the entire certification process.
3. Undertake only those assignments for which they are competent by way of their education, training, and experience.
4. To adhere to all examination rules and make no attempt to complete the exam dishonestly or to assist any other person in doing so.
5. To refrain from activities that may jeopardize the integrity of the PEARL Technical Certification program.
6. Have due regard for the physical environment and for public safety, health, and well-being. If their judgment is overruled under circumstances where the safety, health, property, or welfare of the public may be endangered, they shall notify their employer, client, and such other authority as may be appropriate. An employee shall initially express those concerns to the employer.
7. Admit and accept their own errors when proven wrong and never distort nor alter the facts to justify their decisions.
8. Avoid conflicts of interest whenever possible. When unavoidable, they shall disclose to their employer or client, in writing, any action that might create the appearance of a conflict of interest.
9. Avoid receiving and granting bribery in all its forms.
10. Strive to maintain their proficiency by updating their technical knowledge and skills within the industry.
11. Not reveal facts, data, or information obtained in connection with services rendered without prior consent of the client or employer except as authorized by law.
12. Any duplication of the online training materials is strictly prohibited.

# Level 1 PEARL - Certified Technician

## Eligibility Criteria for Taking the Exam

The PEARL Level 1 Certification is designed to measure competency at an introductory level. Technicians are qualified to work safely within a shop environment, and around de-energized electrical power equipment. They recognize and have a fundamental understanding of the PEARL reconditioning standards. These technicians can identify various types of electrical apparatus, shop equipment, warehouse equipment, test and measurement equipment, and cleaning equipment used in the electrical equipment reconditioning process, all under the supervision of a higher-level technician. Certificate candidates should be familiar with mechanical and electrical duties listed in the Level 1 PEARL Technician section of this handbook.

Each certification level has individual eligibility requirements, including required education and training, work history requirements, and the ability to perform specific essential duties. To receive technical certification from PEARL, a Level 1 technician must have met the following eligibility requirements:

1. Be currently employed by a PAC (dealer or service members). PEARL Partner members do not qualify.
2. Completed the online application.
3. Paid the training and exam fee.
4. PTC Candidate Confirmation Form completed.

## Continuing Professional Development Policy

Certification renews on an annual basis. Starting in 2025, renewal notices will be included in the annual membership renewal dues. A copy of the renewal notices will be emailed to the PTC for their review eight weeks prior to membership renewal. If payment is not received by PEARL within 90 days, certification will expire. Certificate renewals that are less than one year past due are subject to the renewal fee of $75.

Payment to level up does not substitute for payment of the full renewal fee when due. Certification will be required on a lower-level certification before a higher certification can be awarded. See page 12 for eligibility requirement.

## Conditions of Application for Technicians

1. **PEARL has established policies, procedures, and fees** that govern certification decisions, the uses of certification, and interactions with applicants, certified technicians, and PTCs. These policies, procedures, and fees may be changed by PEARL at any time without prior notification. Each person who signs any PEARL application accepts and agrees to follow these policies and procedures in all dealings with PEARL.
2. **Each PEARL certification may have multiple criteria** that must be met by a candidate for the certification to be conferred. These criteria may be changed by PEARL at any time without prior notification. Individuals who do not resident in or work in the United States, Canada or a U.S. territory may not be eligible for certification. These individuals must contact PEARL before applying and may be required to follow additional procedures, with additional fees, to demonstrate they meet the criteria.
3. All applicants and certified technicians **must comply with the PEARL Code of Ethics (see page 11)** and always follow ethical practices. For example, acquiring and/or providing specific knowledge of test questions prior to testing, or acquiring or aiding during an examination; intentionally providing information to PEARL that is incomplete or inaccurate; or knowingly providing technical services in an unsafe, inaccurate, or unprofessional manner may be cause for denial, suspension, or revocation of certification.
4. PEARL reserves the right to **deny, suspend, or revoke any certification** (pending or awarded) should the association determine that an applicant or certified technician has misrepresented information, violated a PEARL policy or procedure, or violated the PEARL Code of Ethics.
5. Maintenance of **current accurate contact information** is the responsibility of the applicant. PEARL requires accurate contact information to communicate to the applicant important information related to testing, certification, and renewal.
6. **The PEARL name, logo, and certification mark** are the property of PEARL and may not be used without the expressed written permission of PEARL.
7. **PEARL approval letters, wallet cards, and certificates** are issued to certified technicians on an annual basis for their use but always remain PEARL property and may be recalled by the association at any time without prior notification.

8. **PEARL training materials, test questions, and examinations** are the property of PEARL. Any copying, sharing, or distribution of the content of the training materials, test questions and/or examinations will be cause for denial, suspension, or revocation of certification.
9. Each person who completes a PEARL application grants PEARL the **right to contact individuals** named in the application and the PTC to confirm the accuracy of information provided by the applicant.
10. **PEARL certification must be used, represented, and displayed** in accordance with PEARL policies.
11. Each person who is certified by PEARL grants PEARL the **right to provide that information** to others in response to bona fide inquiries. Test scores will be given to the test-taker only, unless the test taker submits a release form authorizing PEARL to give the scores to another specified individual.
12. **All certifications renew on an annual basis** after an individual's initial certification is awarded.

## Exam Payments and Fee Details

Payment for the PEARL Technician Certification Program is required with the application and includes the training and exam.

| | |
|---|---|
| PEARL Level 1 training and exam. | $500 |
| Annual certification renewal. * | $75 |
| Certification reactivation free (if renewal is not paid within one year of due date). | $125 |

* If the renewal fee is not paid within 2 years, certification is no longer valid, and the technician will have to retest.

## Preparing For Your Test

This section addresses a few possible methods for preparing for the PEARL certification exam. Since the applicants and sponsoring PEARL member companies are the most familiar with the applicant's abilities, they are responsible for determining the best method for preparing for the certification exam. Following the suggestions in this section does not guarantee an applicant will pass the certification exam.

### Determining Applicant's Preparedness

An individual's preparedness for the certification test depends on a number of things, including amount of practical experience in the vocation and years of education. If you are unsure how prepared you are for the exam, you should review the Exam Content Areas for the associated PEARL Technician Certification level. If the applicant is not familiar with the required subjects for that level, he/she should consider reviewing some of the material listed in the Selected References section of this booklet.

### Using the Selected References

After reviewing the Exam Content Areas, the applicant may want to review some of the selected references. The references in this list were selected to supplement the applicant's knowledge in relevant Exam Content Areas. Experienced candidates only may have to brush-up on a few topics while those with less practical experience may have to study extensively.

### Using the Exam Content Areas as a Guide to Your Study

The Exam Content Areas provide a basic outline of the exam subject matter. You can use these areas as a study guide by referring to them alongside the primary selected study references.

For example, if an applicant is unfamiliar with the requirements for Motor Protection, they can refer to NEC 430 for details (as listed in the Selected References section of this booklet). Many of the selected study references can be found online at no cost. Other unlisted sources may also be helpful for reviewing these subjects. The best preparation for the exam is practical industry experience in an electrical equipment reconditioning and repair facility. No single book is sufficient to prepare individuals for the variety of experiences they will encounter while working in such a facility.

## Level 1 Exam Content Areas

| Exam Content Areas | Skills to: | References |
|---|---|---|
| **Technician Safety** | • Understand how to determine the proper height of an extension ladder<br>• Know the 4 to 1 rule of using an extension ladder<br>• Understand the OSHA rules for fall protection<br>• Recognize the different classes of fire extinguishers and when to use them<br>• Understand the fire triangle<br>• How to operate a fire extinguisher<br>• Be familiar with Lockout-Tagout procedures<br>• Know the difference between authorized and affected employees<br>• Understand simple and complex LOTO<br>• Know when a written LOTO plan is needed and what needs to be included<br>• Understand the differences between barriers and barricades<br>• Recognize the proper electrical clearances<br>• Recognize electrical symbols | OSHA<br><br>National Safety Council<br><br>American Ladder Institute<br><br>NFPA 70E<br><br>NEC Table 495.24<br><br>NEC Table 110.26 |
| **Contactors** | • Understand IEC Utilization Categories of Contactors<br>• Recognize the differences of IEC vs NEMA contactors<br>• Know how to apply lighting contactors<br>• Apply Definite Purpose Contactors<br>• Distinguish between Electrically Held and Mechanically Held<br>• Know the basic operation of a contactor<br>• Identify the parts of a contactor<br>• How to inspect the contacts of a contactor<br>• Know the difference between 2 wire and 3 wire control | IEC 60947<br>NEMA<br>Asco Publication 3203 R2 and 381339–015 B |
| **Operators Devices** | • Recognize the types of devices<br>• Know the various sizes available<br>• Recognize the different Hazardous Duty Devices<br>• Know the differences between maintained and momentary devices<br>• Know the cam positions of selector switches<br>• Select the proper contact blocks for harsh environments<br>• Associate the various colors with the control functions | Rockwell Publication 800-TD009J and 800-TD008E |

| | | |
|---|---|---|
| | • Understand the reasons for using stack lights<br>• Know the acronyms associated with pushbuttons and selector switches<br>• Understand when to use Specialty Operators Devices<br>• Be aware of the various enclosures available for pushbutton stations<br>• | |
| **Component Evaluation** | • Know the 4 steps in the evaluation process<br>• Make determinations of whether a part can be re-used<br>• Remember the SMART Acronym<br>• Recognize that Inspection is the most important part of the process | ANSI/PEARL EERS |
| **Low Voltage Control** | • Understand UL 508<br>• Know the reasons to use group motor control<br>• Be familiar with the PEARL reconditioning process for motor starters<br>• Understand the classes of overload relays<br>• Know the requirements for motor protection under NEC Article 430<br>• Beware of different NEMA and IEC ratings of enclosures<br>• Recognize differences between power and control voltages<br>• Understand the differences between bi-metal, eutectic and solid-state overload relays<br>• Know the function of the M auxiliary contact in a control circuit<br>• Be familiar with the available modifications for motor control<br>• Be aware of NEMA sizes and IEC Utilization table<br>• Understand reversing, multi-speed, reduced voltage starters | UL 508 Type E<br>NEC Article 430<br>ANSI/PEARL EERS<br>NEMA<br>UL Table 76.2<br>Rockwell Publication 500-TD014D-EN-P |
| **Molded Case Circuit Breakers** | • Breaker basics<br>• Breaker brands and models<br>• Breaker components<br>• Breaker symbols<br>• Breaker components<br>• Understand differences between molded case breakers and motor circuit protectors<br>• Know how to read a time vs. current trip curve<br>• Understand cable ratings and selecting the proper terminals | NEC 70E<br>UL489<br>UL1066<br>NEMA AB3 |

| | | |
|---|---|---|
| | • Installing terminals with the proper torque rating<br>• Handle positions of molded case circuit breakers<br>• Accessories for molded case circuit breakers<br>• Application considerations for molded case circuit breakers<br>• Know basic arc flash rules<br>• Ability to derate a circuit breaker<br>• Understand how 100% rated breakers are applied<br>• Know the differences between I2T, interrupting, and let through ratings<br>• Be able to identify the meaning of LSIG trip units | |
| **Low Voltage Distribution Equipment** | • Understand the term Service Entrance<br>• Maximum breaker sizes in Distribution panel<br>• Know 3 wire and 4 wire voltages<br>• Understand through and sub feed terms<br>• Understand the difference between a panelboard and switchboard<br>• Recognize the differences between a panelboard and load center<br>• Distinguish between live front and dead front<br>• Know the differences between Main Lug Only and Main Breaker<br>• How power is distributed in a Load Center<br>• Understand where single, double and three pole breakers are used<br>• Know the specialty breakers, ground fault and arc fault breaker<br>• Difference between twin and dual breakers<br>• Understand plug-in and bolt-on breakers<br>• Difference between appliance, lighting, and distribution panelboards<br>• Know the components of a panelboard<br>• Be familiar with how power is distributed from the service entrance<br>• Understand the differences between fully and series ratings<br>• Know the different neutral sizes<br>• Be aware of the manufacturer's panelboard designations<br>• Six disconnect rule<br>• Features of front and rear access | NEC Article 230<br><br>UL50<br><br>UL67<br><br>UL489<br><br>UL 891<br><br>CSA 22.2 No. 29<br><br>NEC Article 110<br><br>NEC Article 408<br><br>NEMA PB2<br><br>NEC 240.87<br><br>Siemens Publication Order No.: SI-LP-1667 |

| | | |
|---|---|---|
| | • Know Arc Energy Reduction NEC 240.87<br>• Be familiar with Switchboard Construction<br>• Understand the main feeds of a switchboard<br>• Know when a cable pull box is needed<br>• Understand how multiple switchboard sections are connected<br>• Know the features and benefits of an Integrated Power Systems Switchboard<br>• Be aware of the differences between switchboards and switchgear | |
| **Low Voltage Fuses** | • Know why fuses are used and the types of faults<br>• Recognize fuse construction<br>• Be familiar with the types of fuses<br>• Be able to select the correct fuse type and class<br>• Dual element fuse and when to use it<br>• Understand the different type of protection provided with fuses<br>• Understand voltage rating of fuses and how to apply them<br>• Select the proper fuse for a motor application<br>• Understand how to de-rate a fuse<br>• Be familiar with a fuse melt curve<br>• Understand slash voltages<br>• Know the differences between Live and Dead Front<br>• Rejection feature<br>• Fuse Blocks<br>• Be knowledgeable of the 2 PEARL Standards for fuses<br>• What equipment to use to check if a fuse is blown<br>• Understand the terms “Peak Let-through, Current Limiting, and clearing time<br>• Know how to select the proper size fuse from the NEC Motor Tables | ANSI/PEARL EERS<br><br>NEC 240.86<br><br>NEC 430.83<br><br>UL248-1<br>UL 198<br><br>UL 977 BPS<br><br>UL 512<br><br>Eaton Catalog CA01303001E |
| **Insulated Case Breakers** | • Understand PEARL Servicing Standards for Insulated Case Circuit Breakers with Series and Solid-State Trip Units<br>• Differences between molded case breakers, insulated case breakers and Low Voltage Power Breakers<br>• Know the meaning of the terms Interrupting, Withstand, and short time rating | UL 489<br>UL 1066<br>NEMA SG3 - C37.16<br>ANSI C37.13 .16 .17 .50 |

| | | |
|---|---|---|
| | • Be familiar with the types of mounting for ICCB<br>• Be aware of front and rear connections on an ICCB as well as primary and secondary connections<br>• Understand the importance of 100 % Rating<br>• Be familiar with the different manufacturer's models and catalog numbering system<br>• Know the features of a stored energy device<br>• Recognize if a breaker is manually or electrically operated<br>• Know the different methods of charging the stored energy mechanism<br>• Be aware of the application of Kirk Key Interlocks<br>• Be familiar with the accessories available for Insulated Case Breakers<br>• Be capable of reading a time current trip curve<br>• Understand LSIG trip curve<br>• Be familiar with the retro fit trip units that are available | NEMA<br>AB 4-2017 - August 2017 |
| **Variable Frequency Drives** | • Know the benefits of using VFDs<br>• Understand how VFDs operate<br>• Know the differences between Constant Torque, Variable Torque and Constant Horsepower<br>• Be familiar with Sine Wave and Square Wave<br>• Know the meaning of the term Pulse Width Modulation<br>• Be aware of the effects for RFI Radio Frequmency Interference and EFI Electronic Frequency Interference<br>• How an IGBT (insulated-gate bipolar transistor) operates<br>• Know how Isolation and Harmonic Mitigating Transformers can be used with VFDs<br>• Be familiar with the term Mini and Micro Drives<br>• Understand Packaged Drive and the different bypass methods<br>• How Dynamic Braking works<br>• Be familiar with the term PID (Proportional, Integrative, and Derivative) Control<br>• Be aware of the different types of Keypads and their functionality | EMC Directive EN 61800-3<br>NEMA ICS 61800-2-2005<br>UL adoption of IEC standard 61800-5-1<br>Rockwell Publication PFLEX-SG002Q-EN-P |

| | | |
|---|---|---|
| | • Understand system harmonics and their effects<br>• Know how current limits are handled in a VFD<br>• Understand Ramp Up and Ramp Down<br>• Recognize the components of a VFD and their functions<br>• Be familiar with the control terminal connections<br>• Be aware of the various control networks used with VFDs<br>• Understand operating duplex and triplex systems<br>• Be familiar with the different drive manufacturers and their models<br>• | |
| **Transformers** | • Know how a transformer operates<br>• Know VA, KVA, MVA<br>• Be able to calculate KVA<br>• Understand Taps<br>• Understand Delta Vs. Wye Connections<br>• Calculate VA, KVA, MVA<br>• Slash Vs. X Voltages<br>• Know Temperature Rise Classes of Liquid and Dry Type Transformers<br>• Understand how Temperature Rise can affect the KVA Rating<br>• Recognize types of Compartmental Transformers<br>• Know fuse types available for Pad Mounted (Compartmental) Transformers | General Electric Catalog - Section 14<br><br>Eaton – Bussman Publication covering Short Circuit Calculations |

## Sample Test Questions

The following sample test questions are provided to help candidates become familiar with the question format. The following questions reflect only a sample of the subject matter covered on the test. An answer key is given at the end of this section.

Questions will consist of multiple-choice, single answer, multiple-choice multi-answers, matching, order arrangements, and pictorial images.

Exams are delivered on-line at regional testing locations before a proctor.

1. What size extension ladder should be purchased if the height to support level is 22 feet?
   A – 36 feet
   B – 24 feet
   C – 32 feet
   D – 22 feet

2. Using the 4 to 1 rule, how far from the wall should the base of the ladder be if the height of the wall is 16 feet?
   A – 2 feet
   B – 6 feet
   C – 3 feet
   D – 4 feet

3. Match up the test with the purpose

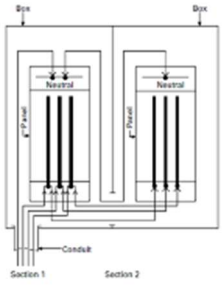
| | | |
|---|---|---|
| ___ Class A | 1. | Wiring electrical |
| ___ Class B | 2. | Combustible metals – magnesium |
| ___ Class C | 3. | Flammable gasoline |
| ___ Class D | 4. | Paper-ordinary |

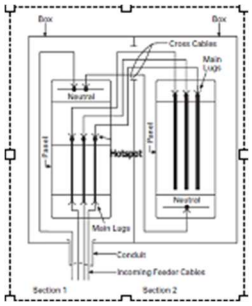
4. Select all the items that comply with National Electric Code Article 430 (choose 3):
   A – Safety switch and magnetic starter
   B – Enclosed breaker and magnetic starter
   C – pushbutton and safety switch
   D – Combination starter and fused disconnect

5. On a 208-volt wye system, any phase to neutral will yield:
   A – 277 volts
   B – 120 volts
   C – 208 volts
   D – 240 volts

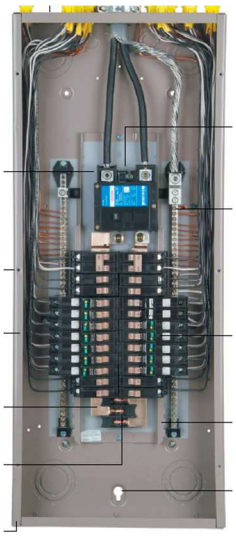
6. Select all the fuse features (choose 3):
   A – Short circuit protection
   B – Equipment protection
   C – Personnel protection
   D – Bimetal trip element

7. Choose the image that represents a through feed lug panelboard:

A 


B 


C 

D 

8. The best way to signal if a breaker is open or closed remotely is to install:
   A – Shunt trip
   B – Auxiliary switch
   C – Bell alarm
   D – Undervoltage release

9. Arrange the PEARL Starter Service procedure in sequence:
   __ Evaluation
   __ Reconditioning
   __ Documentation
   __ Retest
   __ Select the proper test equipment
   __ Certification
   __ Testing

10. Select the approved arc flash reduction methods required on 1200A and above circuit breakers (choose 3):
    A – Zone selective interlocking
    B – Differential relaying
    C – Derating the service entrance
    D – Energy maintenance switch

**Answer Key:**

1. C
2. D
3. Class A = 4
   Class B = 3
   Class C = 1
   Class D = 2
4. A, B, D
5. B
6. A, B, C
7. B
8. B
9. Select the proper test equipment
   Evaluation
   Testing
   Reconditioning
   Retest
   Documentation
   Certification
10. A, B, D