NABCEP PV Entry Level Exam

Quick Facts

Eligibility

Santa Monica College Students

Students must successfully complete coursework in *Photovoltaic (PV) 3: Advanced Solar Photovoltaic Systems and Installation* at Santa Monica College with a grade of C or higher in order to be eligible to sit down for the North American Board of Certified Energy Practitioners (NABCEP) **PV Entry Level Exam**.

Fees

Paper and Pencil Examination Fee: $150.00
Or
Computer Based Examination Fee: $120.00

Payments are to be made in advance. Accepted forms of payment include: cash, checks, and credit cards (Visa or Mastercard only).

Re-Test: Candidates may retake the exam up to three times within a two-year period of completing the course, for a total of four attempts, before they must take another course to become eligible again. Full examination fees will be charged, there are no discounts for retakes.

Registration

To register, please visit http://commed.smc.edu or call (310) 434-3400.

The following items must be provided to Santa Monica College in advance:

- Examination Fee
  - Paper and Pencil Exam $150.00
    Or
  - Computer Based Test $120.00
- Completed and signed NABCEP Candidate Eligibility form (Form B).
  - Fill out the form and give to your PV 3 instructor.
  - Instructor will send the form to the Office of Workforce & Economic Development.
  - Candidates will not be allowed to take the exam without this form on file.
- Completed Special Accommodations request form if needed (Form C).
  - Please submit as soon as possible to:
    Ruth Casillas
    Workforce & Economic Development
    In Person – 3171 S. Bundy Drive
    Los Angeles, CA 90066

    By Mail - 1900 Pico Blvd
    Santa Monica, CA 90405

    Candidates must make requests for accommodation as far in advanced as possible as the process for review and approval can take several weeks or more. If granted, specific instruction will be provided to the Candidate and SMC prior to the scheduled exam.

Contents:

Updated 7/6/12

Paper and Pencil Exam - What to Bring

The exam is **NOT** an open book exam. The only material to be provided will be any formulas to answer questions, provided in the Exam Booklet by NABCEP.

Rulers, textbooks, reference materials and notes are **NOT** permitted in the examination area. Watches or hats may **NOT** be worn during the exam.

On the day of the exam, Candidates will be provided with a non-programmable calculator and two #2 pencils.

Candidates are required to provide **photo identification** to sit for the exam. The name you register with must match the name exactly as it is printed on your government issued photo identification. The following are acceptable photo identifications:

- Valid state Driver's License
- Current Passport
- Current Military Identification
- Valid State Identification with Photo
- International Photo Identification issued by a foreign country

Also, please be advised that due to circumstances beyond our control, examination sites may experience minor disturbances. It is recommended that Candidates who are sensitive to noise bring earplugs.

Computer Based Test (CBT)

CBT Candidates are provided six (6) months to schedule and sit for the Exam upon submission of payment and the Candidate Eligibility form (Form B) by SMC to NABCEP. If the Candidate does not take the Exam within 6 months, he/she will need to pay an additional examination fee.

About the Exam

FORMAT
The exam consists of sixty (60) multiple choice questions and is based on the NABCEP PV Entry Level Learning Objectives**. Candidates must complete the Exam within two (2) hours.**

TIME/LENGTH
Candidates will be given up to two (2) hours to sit for the examination. Note: 30-60 minutes of time is typically required for pre-Exam administrative activities once all Candidates have arrived.

PASSING SCORE
Candidates must earn a score of 70% or higher to pass. Candidates can expect to receive their scores four to six weeks after the answer sheets have been received for scoring.

MINIMUM CANDIDATES
In order for the test to be administered, there is a minimum number of Candidates that need to be registered. In the event that there are not enough Candidates, you will be notified and your fees will be refunded in full.

Questions?

If you still have questions regarding the exam, please contact us.

casillas_ruth@smc.edu or (310) 434-4023

http://www.smc.edu/workforcedevelopment

EXAM SCHEDULE

Thursday, August 9th, 2012: 5:30 – 8:30pm

CLASS SCHEDULE- Fall 2012

Course	Section #	Days	Time	Location	Begin date
PV 1	4446	M W	6:30 - 9:35pm	AIR 102	8/27/12
		F	8:00am - 5:00pm	AIR 101	
	4447	T Th	6:30 - 9:35pm	AIR 102	8/28/12
		F	8:00AM - 5:00pm	AIR 101	
Above sections 4446 & 4447 meet for 8 weeks					
PV 2	4448	MW	6:30 - 9:35pm	AIR 102	10/22/12
		Sat	8:00am - 5:00pm	AIR 101	
	4449	MW	6:30 - 9:35pm	AIR 102	10/23/12
		Sat	8:00am - 5:00pm	AIR 101	
Above sections 4448 & 4449 meet for 8 weeks					

Santa Monica College
1900 Pico Boulevard
Santa Monica, CA 90405

(310) 434-4040

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NABCEP ENTRY LEVEL EXAM

CANDIDATE INFORMATION SHEET

(To be distributed to all eligible candidates during a course that confers eligibility.)

Introduction:

The North American Board of Certified Energy Practitioners (NABCEP) coordinates an Entry Level Program that provides a basis for testing an individual's knowledge of the fundamentals of various renewable energy technologies. Each technology in the program (Photovoltaics, Solar Heating and Cooling, etc.) has a set of Entry Level Learning Objectives from which a NABCEP Entry Level Exam is developed. Passing the NABCEP Entry Level Exam is a way for an individual to demonstrate that he or she has achieved a basic knowledge of the fundamental principles of the application, design, installation and operation of the technology covered on the specific exam.

The knowledge demonstrated by passing a NABCEP Entry Level Exam does not replace the knowledge, skills or abilities of the electrical or other construction trades, or those of other professions or degree programs that require considerably more academic and/or practical experience. This achievement demonstrates that the individual has passed an industry-designed, NABCEP-issued exam. An Individual who passes the Exam is provided with a Passing Score Achievement -- in no way does passing the exam indicate that an individual is "Certified" by NABCEP. NABCEP does administer several personnel certification programs including: Photovoltaic Installer, Photovoltaic Technical Sales, Solar Thermal Installer, and Small Wind Installer. For more information about NABCEP Certifications please visit www.nabcep.org.

The NABCEP Entry Level Exam is written by industry Subject Matter Experts under the guidance of professional psychometricians (testing specialists). The NABCEP Entry Level Learning Objectives, which are also developed by industry Subject Matter Experts, provides the blueprint for the exam and is the primary document to reference with regards to what topics may or may not be covered on the exam. All candidates should be provided with a copy of these Learning Objectives (found on the NABCEP website under "Entry Level" and "Learning Objectives"), at the beginning of each course that provides eligibility for the exam.

Becoming Eligible to take the NABCEP Entry Level Exam:

The Entry Level Program relies on a network of Registered NABCEP Entry Level Exam Providers to offer courses that prepare individuals to sit for the Entry Level Exam. A list of Registered Exam Providers can be found on the NABCEP website under "Entry Level" and "For Students." During the registration process, Exam Providers agree that they will cover all of the Entry Level Learning Objectives in the course. Completing coursework that covers the NABCEP Entry Level Learning Objectives with a Registered Exam Provider is the only requirement to sit for the Entry Level Exam; furthermore, this is the only method by which one can become an eligible candidate for the NABCEP Entry Level Exam. Candidates are eligible to sit for the Entry Level Exam for a period of six months after completing a course with a Registered Entry Level Exam Provider.

Candidate Eligibility Form:

Upon completion of a course that covers the NABCEP Entry Level Learning Objectives with a Registered Exam Provider, students who wish to take the NABCEP Entry Level Exam will be asked to complete a *Candidate Eligibility Form*. This form must be filled out completely by the candidate and signed by the Instructor. The contact information entered on this form will be used for communication from NABCEP about the exam. An e-mail address must be provided; e-mail is used by NABCEP to send Authorization-to-Test notifications for Computer Based exams, Failing Score Reports, and other Exam related communications. A mailing address must also be provided; score reports and Passing Score Achievement paperwork are delivered via the postal service. Exam personnel will use the name provided on the Candidate Eligibility Form to confirm eligibility and identification on exam day. THE NAME PROVIDED ON THE FORM MUST MATCH THE NAME ON THE GOVERNMENT ISSUED PHOTO ID THAT WILL BE USED TO PROVE IDENTIFICATION ON THE DAY OF THE EXAM. THE CANDIDATE WILL NOT BE ADMITTED TO THE EXAM IF THE NAMES DO NOT MATCH EXACTLY.

In addition to contact information, the *Candidate Eligibility Form* has some other items, including: acknowledgment that the candidate has received this *Candidate Information Sheet* and *the Entry Level Learning Objectives*; an opportunity to opt-out of releasing scores to the Registered Exam Provider; and a place to indicate if any special accommodations are needed for the exam.

Exam Delivery Options:

The NABCEP Entry Level Exam is available in Paper and Pencil and Computer Based Test (CBT) formats. All registered NABCEP Entry Level Exam Providers are permitted to provide candidate eligibility for CBT exams; most are also able to directly administer the Paper and Pencil exam following a course that confers eligibility to take the exam. CBT exams are delivered at Prometric Test Centers that are located all across North America. A candidate may schedule CBT exams at any time after an Authorization-to-Test notification has been received from NABCEP. Paper and Pencil Exams are only available from a Registered Exam Provider at date(s) and time(s) selected by the Provider. Candidates may only take a Paper and Pencil exam with the Registered Exam Provider who conferred eligibility to the candidate.

Cost and Payment:

The NABCEP Entry Level Exam costs $75 (US) for the Paper and Pencil version and $95 (US) for the Computer Based Test version. NABCEP bills the Registered Exam Provider for the cost of the Exam for all of the candidates who they submit to NABCEP. Some Providers include the cost of the Exam in the cost of the course and others allow candidates to choose to pay for the Exam or not. Providers are authorized by NABCEP to charge additional administrative fees of no more than $75 (US) for Paper and Pencil Exams and no more than $25 (US) for submitting CBT eligibility. Examination fees, once collected by NABCEP, are non-refundable.

Paper & Pencil Examination Procedures:

To be admitted into the examination, a candidate must present a government-issued photo identification. The name on the ID must exactly match the name on a *Candidate Eligibility Form* that was signed by an Instructor of a course that provides eligibility to sit for the exam.

A Candidate may use a basic-scientific, non-programmable, non-graphing calculator (defined as a device used solely for mathematical computations), such as a Casio fx260, a Texas Instruments TI-30Xa, or similar. Candidates should bring their own calculators to the Exam.

Exam Answer Sheets are scored using an automated scoring machine. All answers must be completed using a #2 pencil. Candidates should bring at least two #2 pencils with them to the exam.

If permitted by the testing site, Candidates may bring a non-alcoholic, un-carbonated beverage in a clear, screw top bottle, such as bottled water or tea. No other food or beverage will be allowed.

No other personal items are allowed except the above mentioned calculator, pencils, and water. The exam is not an open book exam; no notes or reference material of any kind will be allowed. No digital devices of any kind (cell phones, digital music players, laptops, cameras, etc.) will be allowed. All personal items brought into the examination room will be collected and stored by the Exam Proctor until the candidate is finished with the exam and exits the room. Additionally, no hats or hoods will be allowed to be worn during the exam.

Please Note: Procedures for CBT exams will differ from paper and pencil exams in several ways. Candidates will not be permitted to bring water or beverages into the testing room. These must be left in a locker. Personal calculators may not be brought into the testing room. A calculator is available on screen, as part of the test package.

Exam Time-limit, Length, and Format:

Candidates are allowed a maximum of two hours to complete 60 multiple choice questions. It is important to note that pre-examination procedures may take 30-60 minutes (or more) before the exam time-limit begins, so individuals should expect to be in the room for a period of up to three hours. ANY LATE ARRIVING CANDIDATE THAT ARRIVES AFTER THE PRE-EXAM PROCEDURES HAVE BEGUN WILL NOT BE ADMITTED TO THE EXAM.

Special Accommodations:

Special testing accommodations for physical or mental disabilities must be pre-approved by NABCEP. Accommodation requests should be made as far in advance as possible, as the review process can take several weeks or more. Requests must be submitted using the *Special Accommodation Request Form* that is available from the Registered Exam Provider or directly from NABCEP. All requests must be accompanied by documentation from an appropriate professional.

Terms and Conditions:

Before sitting for the NABCEP Entry Level Exam, all candidates are required to sign the NABCEP Entry Level Exam Candidate Agreement. The Agreement is printed on the front of the Paper and Pencil Exam Booklet and is displayed on the screen at the start of a CBT Exam. The Agreement states:

> *I understand that the NABCEP Entry Level Exam is intended to test basic knowledge.*
> *I further understand that the Entry Level Program is not equivalent to NABCEP Certifications, and that passing this exam does not represent any permission or license to work in any field or position.*

I further understand that receiving a passing score on the NABCEP Entry Level Exam does not provide any guarantee of employment.

I further understand that I am prohibited from making any such claims concerning this NABCEP Program, and agree to abide by all applicable NABCEP policies.

I understand and agree to these terms as a condition of taking the NABCEP Entry Level Exam. I understand that if I fail to sign below, my Examination will not be accepted for scoring.

Scoring and Passing Achievement:

All Exam Candidates should expect a score report within 4-6 weeks of taking the exam. Passing score reports will be mailed via postal service to the address provided on the *Candidate Eligibility Form* along with Passing Score Achievement documents. Failing scores will be delivered via e-mail to the address provided on the *Candidate Eligibility Form*. NABCEP does not release scores over the phone or by fax.

A Candidate who achieves a passing score will receive a letter signed by the Chairperson of the NABCEP Board of Directors along with a suitable-for-framing document listing the Candidate's name, date and identification number along with a statement indicating that the individual has demonstrated basic knowledge of the fundamental principles of the application, design, installation and operation of the applicable energy system for the Exam taken (PV, Solar Heating & Cooling, etc.).

Answer sheets are computer-scanned multiple times to ensure accurate scoring. NABCEP does not provide the ability to request rescoring of Entry Level examinations. All scores reported are final.

Candidates may retake the exam one additional time at a regularly scheduled exam administration without repeating the course. If a candidate wishes to retake the exam, the individual will need to make arrangements with the Registered Exam Provider who conferred eligibility. Full examination fees are charged for each exam administration; there are no discounts for retakes. The candidate is responsible for making arrangements with a Registered Exam Provider to sit for the Paper and Pencil Exam. Retakes can be taken via CBT whether the first exam was CBT or Paper and Pencil. Request and payment for a retake must be received within 30 days of Candidate notification of failing score. Once payment is received, the Candidate will have six months to schedule and re-take the Exam.

Use of a Passing Score Achievement:

A PASSING SCORE ON THE NABCEP ENTRY LEVEL EXAM DOES NOT CONFER THE TITLE OF A NABCEP CERTIFIED INSTALLER™ OR ANY OTHER TITLE OR CREDENTIAL FROM NABCEP. A successful candidate may state that he or she has passed an Entry Level Exam issued by the North American Board of Certified Energy Practitioners (NABCEP). The passing score achievement document may only be displayed in association with the individual who achieved the passing score, as the achievement is personal and may not be transferred, assigned to, displayed or used by any other individual, organization, business, or entity.

Replacement documents are available from NABCEP for a fee of $25.00

Contact Information:

NABCEP Entry Level Program
56 Clifton Country Road, Suite 202
Clifton Park, NY, 12065

Phone: (800) 654-0021
Fax: (518) 899-1092
Email: cwolf@nabcep.org, Chad Wolf

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NABCEP Entry Level Exam
CANDIDATE ELIGIBILITY FORM

Please PRINT all information clearly. This form must be signed and filled out in its entirety.

Name: In the boxes below enter your name exactly as it appears on your Government Issued Photo ID. NOTE: If the name does not match your Photo ID you will not be admitted into the Exam.					
Last Name		**First Name**		**MI**	
An **E-mail Address** is required in order to receive communications from NABCEP about the Entry Level Exam. The e-mail will not be used for any other purpose. NOTE: your eligibility cannot be processed without an email.					
E-mail					
Mailing Address: In the boxes below enter the mailing address that should be used to send Passing Achievement Documents if you pass the Exam.					
Street 1					
Street 2					
City		**State**		**Zip**	

Check the box next to the format of the Exam that you plan to take: (Note: the Computer Based Testing Exam costs $95 and Providers can charge up to an additional $25 administrative fee; Paper and Pencil Exams cost $75 and Providers can charge up to an additional $75.)	**Paper & Pencil with my Provider**	
	Computer Based with Prometric	

Special Accommodations are available for individuals who can document a physical, mental, or learning disability that qualifies under the Americans with Disability Act. Initial the box to the right if you plan on requesting special accommodations for the NABCEP Entry Level Exam. A Special Accommodation Request form will need to be filled out and submitted to NABCEP along with supporting documentation from a qualified professional before any accommodations are granted.	
Release of Scores: NABCEP releases the individual score results to the registered Entry Level Exam Provider for all of the candidates that the Provider confers eligibility to. If you would prefer to not have your score released to the Provider, you may "**opt-out**" by initialing the box to the right.	

By signing below I acknowledge that I have received and read the *NABCEP Entry Level Exam Candidate Information Sheet* and the *NABCEP Entry Level Exam Learning Objectives*. Furthermore, I acknowledge that I understand that the NABCEP Entry Level Exam is intended to test basic knowledge, that the Entry Level Program is not equivalent to NABCEP Certification, and that passing this exam does not confer or imply any permission or license to work in any field or position.

Signature		**Date**	

EXAM PROVIDER USE ONLY

Provider Name		**Provider Number**	
By the authority invested in me by NABCEP, I confirm that the above named candidate completed coursework that qualifies him or her to sit for the NABCEP Entry Level Exam on: (Fill in the **Course Completion Date** in the space to the right and sign below).		PV Entry Level Exam	
		Solar Heating & Cooling Entry Level Exam	
Instructor Name		**Signature**	**Date**

IMPORTANT: AFTER A PAPER AND PENCIL EXAM ADMINISTRATION THE "IDENTIFICATION NUMBER" MUST BE TRANSFERRED TO THIS FORM FROM THEIR ANSWER SHEET IN ORDER FOR SCORES TO BE PROCESSED	**Candidate ID #**	

C

SPECIAL ACCOMMODATIONS REQUEST FORM

The North American Board of Certified Energy Practitioners, Inc. (NABCEP) complies with the Americans With Disabilities Act of 1990. To ensure equal opportunities for all qualified persons, NABCEP will make reasonable accommodations for candidates when appropriate. If you require special accommodations related to a disability in order to take the examination, please complete this form and return it with your examination application. The information you provide and any documentation regarding your disability and your need or accommodation will be treated with strict confidentiality. Review of requests for accommodations can take 3-4 weeks or more and should be submitted as far in advanced as possible.

For which of the examinations below are you requesting accommodation:

- ○ Small Wind Installer Certification (SWI)
- ○ Photovoltaic Installer (PVI)
- ○ Solar Thermal (STI)
- ○ Entry Level Photovoltaic (PVE)
- ○ Photovoltaic Technical Sales (PVT)
- ○ Entry Level Solar Thermal (STE)

Please type or print all information clearly

1.Personal Information		
Name: **Last**	**First**	**Middle Initial**
Phone Number:	**Anticipated Exam Date:**	
Email Address:	**Anticipated Exam Site:**	
2.Reason for Request		
I am requesting an exam accommodation due to: a disability ☐ a religious observance ☐ other ☐		
Please provide a detailed explanation of the reason(s) why you are seeking accommodation(s). For example, if you are seeking accommodation due to a disability, you should explain how it substantially limits one or more of your sensory, manual, speaking or other functional skills (e.g., disability that significantly impairs your ability to read, concentrate, or otherwise complete the examination). Attach additional pages if need.		

North American Board of NABCEP Certified Energy Practitioners

C

3.Special Accommodation Needed

Please select the accommodation(s) you are requesting

☐ **Time and a half**	☐ **Additional _____ minutes**	☐ **Assistance completing answer sheet**
☐ **Reader**	☐ **Magnified print**	☐ **Separate Room**
☐ **Extra or extended breaks (without additional exam time)**	☐ **Sign language interpreter or printed copies of verbal instructions**	☐ **Paper and pencil version of computerized exam**

☐ **Other:** (please specify)

4. Accommodation History

Have you ever received special accommodations: **Yes** ☐ **No** ☐

If you have ever received special accommodation please provide the following information

Year of accommodation	Type of accommodation	Name of institution/organization that provided accommodation

5. Documentation of Need for Accommodation

If you are requesting an accommodation due to a health condition or a functional disability, you must provide NABCEP with written documentation from an appropriate health care professional supporting the accommodation you are requesting. This documentation must include a specific diagnosis of your health condition and/or functional disability, results from all assessments that were used to determine the diagnosis, and a specific recommendation for the special testing accommodation(s) that you require. In most cases, this documentation cannot be dated later than three years previous. NABCEP will not pay any cost you may incur in obtaining the required diagnosis and recommendation; however, NABCEP will pay for any reasonable accommodations that are provided for you.

If you are requesting an accommodation due to a religious observance, you must provide a letter from an appropriate religious authority attesting to the nature of the religious observance that is in conflict with the scheduled examination date.

Documentation from a healthcare professional is attached: Yes ☐ **No** ☐

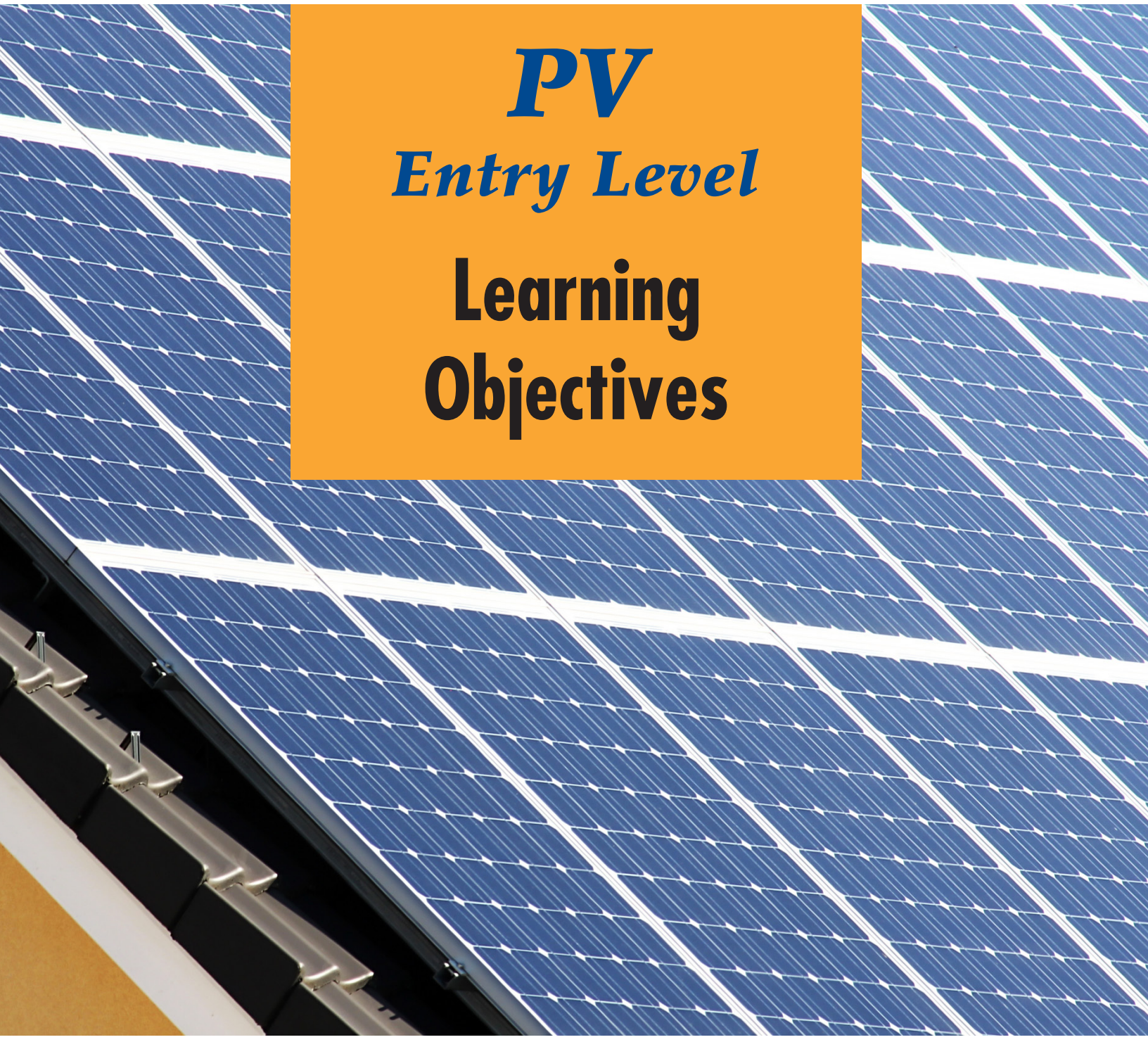
Documentation from a religious authority is attached: Yes ☐ **No** ☐

5. Signature

I attest that the information contained in this document or attached to it is true and correct.

Signature: Date:

NABCEP



PV
Entry Level
Learning Objectives

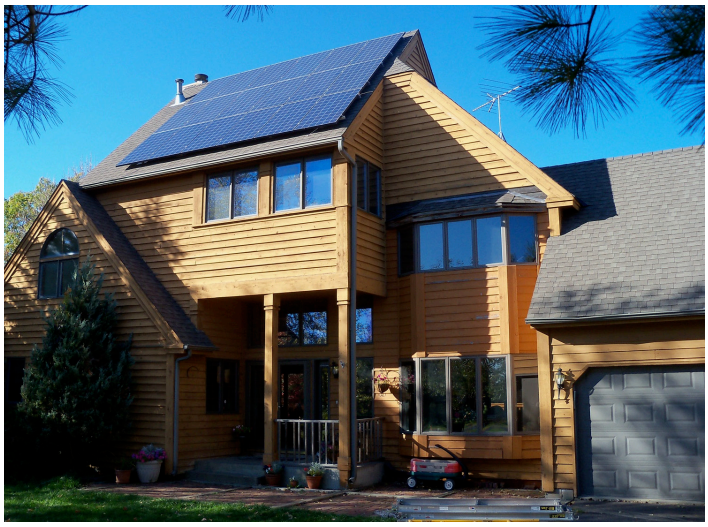
www.nabcep.org

North American Board of NABCEP Certified Energy Practitioners

PV Entry Level Learning Objectives

Objectives and Scope

Upon completion of the course(s) taught in accordance with the NABCEP PV entry level learning objectives, and prior to taking the NABCEP PV Entry Level Exam, students should have demonstrated a basic understanding of the following principles outlined in the learning objectives. A person who passes the NABCEP PV Entry Level Exam has demonstrated a very basic, elementary knowledge of photovoltaic systems. The knowledge demonstrated by passing this test does not replace the knowledge, skills or abilities of the electrical or other construction trades, or those of other professions or degree programs that require considerably more academic and/or practical experience. It should also be noted that individuals passing the NABCEP PV Entry Level Exam should not be confused with NABCEP Certified PV Installers. The latter can only be achieved by highly experienced individuals who have passed a much more rigorous examination and have demonstrated the capability to supervise complete PV system installations, and who have a detailed working knowledge of the electrical codes, standards and accepted industry practice associated with PV installations.



Residential PV solar installation in Minnesota

Learning Objective Categories

Listed below are the ten major categories for the NABCEP Entry Level Program:

1. PV Markets and Applications
2. Safety Basics
3. Electricity Basics
4. Solar Energy Fundamentals
5. PV Module Fundamentals
6. System Components
7. PV System Sizing Principles
8. PV System Electrical Design
9. PV System Mechanical Design
10. Performance Analysis, Maintenance and Troubleshooting

Students taking the entry level exam will be tested to some degree in all ten categories. Consequently, in teaching preparatory courses for the exam, it is important that all ten categories be adequately covered. For each major category, a suggested percentage time allotment is indicated. For example, NABCEP suggests devoting 15% of training to Category 8, PV System Electrical Design (see below). In addition to the suggested time allotment, a learning priority has been assigned to each learning objective. The three assigned learning priorities are *critical* (must be taught), *important* (should be taught), and *useful* (could be taught). This is to assist instructors in budgeting their time so that the most important items are covered. Please see the overall course and test specification blueprint for a typical course at the end of this document.

NABCEP Learning Objectives for the PV Entry Level Program

1. PV Markets and Applications *Suggested Percentage Time Allotment: 5% or less*

		Learning Priority
1.1	Identify key contributions to the development of PV technology.	Useful
1.2	Identify common types of PV system applications for both stand-alone and utility interactive systems with and without energy storage.	Important
1.3	Associate key features and benefits of specific types of PV systems, including residential, commercial, BIPV, concentrating PV, and utility-scale.	Useful
1.4	List the advantages and disadvantages of PV systems compared to alternative electricity generation sources.	Useful
1.5	Describe the features and benefits of PV systems that operate independently of the electric utility grid.	Useful
1.6	Describe the features and benefits of PV systems that are interconnected to and operate in parallel with the electric utility grid.	Useful
1.7	Describe the roles of various segments of the PV industry and how they interact with one other.	Useful
1.8	Understand market indicators, value propositions, and opportunities for both grid-tied and stand-alone PV system applications.	Useful
1.9	Discuss the importance of conservation and energy efficiency as they relate to PV system applications.	Useful

Note: Establishing safety competencies and qualified persons are beyond the scope of the NABCEP entry level program. Refer to the OSHA Safety and Health Regulations for Construction: 29 CFR 1926 for further details on requirements for safety training and certification.

2. Safety Basics *Suggested Percentage Time Allotment: 5%*

		Learning Priority
2.1	Identify the various safety hazards associated with both operating and nonoperating PV systems and components.	Critical
2.2	List different types of personal protective equipment (PPE) commonly required for installing and maintaining PV systems.	Critical
2.3	List different methods and indentify safe practices for hoisting and rigging, the use of ladders, stairways and guardrails, the use of head, feet, hearing and face protection, the use of power tools, and the use of the appropriate fall protection, including the requirements for personal fall arrest and safety-monitoring systems according to OSHA standards.	Critical
2.4	Recognize the principal electrical safety hazards associated with PV systems, including electrical shock and arc flash.	Critical

Note: The NABCEP entry level program is not a substitute for recognized electrical systems training, experience, and credentials. The electrical concepts introduced in the learning objectives are very basic, and considerable additional electrical training and experience are required of practicing PV system installers.

3. Electrical Basics *Suggested Percentage Time Allotment: 10%*

		Learning Priority
3.1	Understand the meaning of basic electrical parameters including electrical charge, current, voltage, power and resistance, and relate these parameters to their hydraulic analogies (volume, flow, pressure, hydraulic power and friction).	Important
3.2	Explain the difference between electrical power (rate of work performed) and energy (total work performed).	Important
3.3	Describe the function and purpose of common electrical system components, including conductors, conduits/raceways and enclosures, overcurrent devices, diodes and rectifiers, switchgear, transformers, terminals and connectors, grounding equipment, resistors, inductors, capacitors, etc.	Useful
3.4	Identify basic electrical test equipment and its purpose, including voltmeters, ammeters, ohmmeters and watt-hour meters.	Useful
3.5	Demonstrate the ability to apply Ohm's Law in analyzing simple electrical circuits, and to calculate voltage, current, resistance or power given any other two parameters.	Important
3.6	Understand the fundamentals of electric utility system operations, including generation, transmission, distribution and typical electrical service supplies to buildings and facilities.	Important

4. Solar Energy Fundamentals *Suggested Percentage Time Allotment: 10%*

		Learning Priority
4.1	Define basic terminology, including solar radiation, solar irradiance, solar irradiation, solar insolation, solar constant, air mass, ecliptic plane, equatorial plane, pyranometer, solar declination, solstice, equinox, solar time, solar altitude angle, solar azimuth angle, solar window, array tilt angle, array azimuth angle, and solar incidence angle.	Critical
4.2	Diagram the sun's apparent movement across the sky over any given day and over an entire year at any given latitude, and define the solar window.	Important
4.3	For given dates, times and locations, identify the sun's position using sun path diagrams, and determine when direct solar radiation strikes the north, east, south and west walls and horizontal surfaces of a building.	Important
4.4	Differentiate between solar irradiance (power), solar irradiation (energy), and understand the meaning of the terms peak sun, peak sun hours, and insolation.	Critical
4.5	Identify factors that reduce or enhance the amount of solar energy collected by a PV array.	Important
4.6	Demonstrate the use of a standard compass and determine true geographic south from magnetic south at any location given a magnetic declination map.	Important

Continued

4.7	Quantify the effects of changing orientation (azimuth and tilt angle) on the amount of solar energy received on an array surface at any given location using solar energy databases and computer software tools.	Important
4.8	Understand the consequences of array shading and best practices for minimizing shading and preserving array output.	Critical
4.9	Demonstrate the use of equipment and software tools to evaluate solar window obstructions and shading at given locations, and quantify the reduction in solar energy received.	Important
4.10	Identify rules of thumb and spacing distances required to avoid inter-row shading from adjacent sawtooth rack mounted arrays at specified locations between 9 am and 3 pm solar time throughout the year.	Important
4.11	Define the concepts of global, direct, diffuse and albedo solar radiation, and the effects on flat-plate and concentrating solar collectors.	Important
4.12	Identity the instruments and procedures for measuring solar power and solar energy.	Important

5. PV Module Fundamentals *Suggested Percentage Time Allotment: 10%*

		Learning Priority
5.1	Explain how a solar cell converts sunlight into electrical power.	Useful
5.2	Distinguish between PV cells, modules, panels and arrays.	Useful
5.3	Identify the five key electrical output parameters for PV modules using manufacturers' literature (Voc, Isc, Vmp, Imp and Pmp), and label these points on a current-voltage (I-V) curve.	Critical
5.4	Understand the effects of varying incident solar irradiance and cell temperature on PV module electrical output, illustrate the results on an I-V curve, and indicate changes in current, voltage and power.	Critical
5.5	Determine the operating point on a given I-V curve given the electrical load.	Important
5.6	Explain why PV modules make excellent battery chargers based on their I-V characteristics.	Useful
5.7	Understand the effects of connecting similar and dissimilar PV modules in series and in parallel on electrical output, and diagram the resulting I-V curves.	Critical
5.8	Define various performance rating and measurement conditions for PV modules and arrays, including STC, SOC, NOCT, and PTC.	Critical
5.9	Compare the fabrication of solar cells from various manufacturing processes.	Useful
5.10	Describe the components and the construction for a typical flat-plate PV module made from crystalline silicon solar cells, and compare to thin-film modules.	Important
5.11	Given the surface area, incident solar irradiance and electrical power output for a PV cell, module or array, calculate the efficiency and determine the power output per unit area.	Important
5.12	Discuss the significance and consequences of PV modules being limited current sources.	Useful
5.13	Explain the purpose and operation of bypass diodes.	Important
5.14	Identify the standards and design qualification testing that help ensure the safety and reliability of PV modules.	Important

6. System Components *Suggested Percentage Time Allotment: 15%*

		Learning Priority
6.1	Describe the purpose and principles of operation for major PV system components, including PV modules and arrays, inverters and chargers, charge controllers, energy storage and other sources.	Critical
6.2	List the types of PV system balance of system components, and describe their functions and specifications, including conductors, conduit and raceway systems, overcurrent protection, switchgear, junction and combiner boxes, terminations and connectors.	Important
6.3	Identify the primary types, functions, features, specifications, settings and performance indicators associated with PV system power processing equipment, including inverters, chargers, charge controllers, and maximum power point trackers.	Important
6.4	Understand the basic types of PV systems, their major subsystems and components, and the electrical and mechanical BOS components required.	Important

7. PV System Sizing Principles *Suggested Percentage Time Allotment: 10%*

		Learning Priority
7.1	Understand the basic principles, rationale and strategies for sizing stand-alone PV systems versus utility-interactive PV systems.	Important
7.2	Given the power usage and time of use for various electrical loads, determine the peak power demand and energy consumption over a given period of time.	Important
7.3	Beginning with PV module DC nameplate output, list the de-rating factors and other system losses, and their typical values, and calculate the resulting effect on AC power and energy production, using simplified calculations, and online software tools including PVWATTS.	Critical
7.4	For a specified PV module and inverter in a simple utility-interactive system, determine the maximum and minimum number of modules that may be used in source circuits and the total number of source circuits that may be used with a specified inverter, depending upon the expected range of operating temperatures, the inverter voltage windows for array maximum power point tracking and operation, using both simple calculations and inverter manufacturers' online string sizing software tools.	Critical
7.5	Given a stand-alone application with a defined electrical load and available solar energy resource, along with PV module specifications, size and configure the PV array, battery subsystem, and other equipment as required, to meet the electrical load during the critical design period.	Critical

D

Note: Qualified electrical contractors and engineering approvals are required for many PV installations. The NABCEP entry level program is not intended as a substitute for recognized training, competencies and qualifications of electrical contractors or design professionals. The PV system electrical design and installation concepts covered in the learning objectives are intended to provide a very basic overview of the considerations involved, and are not intended to imply an in-depth understanding of the electrical codes and their application.

8. PV System Electrical Design *Suggested Percentage Time Allotment: 15%*

		Learning Priority
8.1	Draw and prepare simple one-line electrical diagrams for interactive and standalone PV systems showing all major components and subsystems, and indicate the locations of the PV source and output circuits, inverter input and output circuits, charge controller and battery circuits, as applicable, and mark the directions of power flows through the system under various load conditions.	Critical
8.2	Understand how PV modules are configured in series and parallel to build voltage, current and power output for interfacing with inverters, charge controllers, batteries and other equipment.	Critical
8.3	Identify basic properties of electrical conductors including materials, size, voltage ratings and insulation coverings and understand how conditions of use, such as location, other conductors in the same conduit/raceway, terminations, temperature and other factors affect their ampacity, resistance and corresponding overcurrent protection requirements.	Critical
8.4	Understand the importance of nameplate specifications on PV modules, inverters and other equipment on determining allowable system voltage limits, and for the selection and sizing of conductors, overcurrent protection devices, disconnect means, wiring methods and in establishing appropriate and safe interfaces with other equipment and electrical systems.	Critical
8.5	Determine the requirements for charge control in battery-based PV systems, based on system voltages, current and charge rates.	Important
8.6	Identify the labeling requirements for electrical equipment in PV systems, including on PV modules, inverters, disconnects, at points of interconnection to other electrical systems, on battery banks, etc.	Important
8.7	Understand the basic principles of PV system grounding, the differences between grounded conductors, grounding conductors, grounding electrode conductors, the purposes of equipment grounding, PV array ground-fault protection, and the importance of single-point grounding.	Critical
8.8	Apply Ohm's Law and conductor properties to calculate voltage drop for simple PV source circuits.	Important
8.9	Identify the requirements for plan review, permitting, inspections, construction contracts and other matters associated with approvals and code-compliance for PV systems.	Critical
8.10	Demonstrate knowledge of key articles of the National Electrical Code, including Article 690, Solar Photovoltaic Systems.	Important

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Note: Roofing systems and structural engineering expertise are required for many PV installations. The NABCEP entry level program is not intended as a substitute for recognized training, competencies and qualifications of roofing contractors or professional engineers. The PV system mechanical design and installation concepts covered in the learning objectives are intended to provide a very basic overview of the considerations involved.

9. PV System Mechanical Design *Suggested Percentage Time Allotment: 10%*

		Learning Priority
9.1	Identify the common ways PV arrays are mechanically secured and installed on the ground, to building rooftops or other structures, including rack mounts, ballasted systems, pole mounts, integral, direct and stand-off roof mounts, sun tracking mounts and for other building-integrated applications.	Important
9.2	Compare and contrast the features and benefits of different PV array mounting systems and practices, including their design and materials, standardization and appearance, applications and installation requirements, thermal and energy performance, safety and reliability, accessibility and maintenance, costs and other factors.	Important
9.3	Understand the effects on PV cell operating temperature of environmental conditions, including incident solar radiation levels, ambient temperature, wind speed and direction for various PV array mounting methods.	Important
9.4	List various building-integrated PV (BIPV) applications and compare and contrast their features and benefits with conventional PV array designs.	Useful
9.5	Identify desirable material properties for weathersealing materials, hardware and fasteners, electrical enclosures, wiring systems and other equipment, such as UV, sunlight and corrosion resistance, wet/outdoor approvals and other service ratings appropriate for the intended application, environment and conditions of use, and having longevity consistent with the operating life expectancies of PV systems.	Important
9.6	Understand the requirements for roofing systems expertise, and identify the preferred structural attachments and weathersealing methods for PV arrays affixed to different types of roof compositions and coverings.	Critical
9.7	Identify the types and magnitudes of mechanical loads experienced by PV modules, arrays and their support structures, including dead loads, live loads, wind loads, snow loads, seismic loads, in established combinations according to ASCE 7-05 Minimum Design Loads for Buildings and Other Structures.	Important
9.8	Identify PV system mechanical design attributes that affect the installation and maintenance of PV arrays, including hardware standardization, safety and accessibility, and other factors.	Important
9.9	Identify mechanical design features that affect the electrical and thermal performance of PV arrays, including array orientation, mounting methods and other factors.	Important
9.10	Review and recognize the importance of PV equipment manufacturers' instructions with regard to mounting and installation procedures, the skills and competencies required of installers, and the implications on product safety, performance, code-compliance and warranties.	Critical

10. Performance Analysis, Maintenance and Troubleshooting

Suggested Percentage Time Allotment: 10%

		Learning Priority
10.1	Discuss various potential problems related to PV system design, components, installation, operation or maintenance that may affect the performance and reliability of PV systems.	Useful
10.2	Identify and describe the use and meaning of typical performance parameters monitored in PV systems, including DC and AC voltages, currents and power levels, solar energy collected, the electrical energy produced or consumed, operating temperatures and other data.	Important
10.3	Compare PV system output with expectations based on system sizing, component specifications and actual operating conditions, and understand why actual output may be different than expected.	Important
10.4	Describe typical maintenance requirements for PV arrays and other system components, including inverters and batteries, etc.	Important
10.5	Understand the safety requirements for operating and maintaining different types of PV systems and related equipment.	Critical
10.6	Identify the most common types of reliability failures in PV systems and their causes due to the equipment, quality of installation and other factors.	Important
10.7	Review component manufacturers' instructions for operation, maintenance and troubleshooting for PV modules and power processing equipment, and develop a simple maintenance plan for a given PV system detailing major tasks and suggested intervals.	Important
10.8	Understand basic troubleshooting principles and progression, including recognizing a problem, observing the symptoms, diagnosing the cause and taking corrective actions leading from the system, subsystem to the component level.	Important

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Course and Test Specification

The following provides a blueprint for courses taught to the NABCEP Entry Level Program, including the primary learning objectives and suggested percentage time allotment. NABCEP recognizes the diversity of training programs offered and their participants, including short courses, continuing education programs, and more in depth and lengthy programs of study, including formal apprenticeship, multicourse certificate programs, and degree-track programs. The NABCEP PV Entry Level Program is not intended as an installer in-training credential, but rather as an important first step in preparing individuals to become highly skilled, qualified and experienced tradespersons and professionals in the PV industry.

Category	Course Time By %	Exam Items	Level of Testing	Study Materials
1. PV Markets & Applications	5%	3	Comprehension	References 1 and 5 below
2. Safety Basics	5%	3	Comprehension Application	References 1, 2 and 3 below
3. Electricity Basics	10%	6	Comprehension Problem Solving	References 1 and 5 below
4. Solar Energy Fundamentals	10%	6	Comprehension Application Problem Solving	References 1, 4 and 5 below
5. PV Module Fundamentals	10%	6	Comprehension Application Problem Solving	References 1, 4 and 5 below
6. System Components	15%	9	Comprehension Application Problem Solving	References 1, 4 and 5 below
7. PV System Sizing Principles	10%	6	Application Problem Solving Design	References 1, 4 and 5 below
8. PV System Electrical Design	15%	9	Application Problem Solving Design	References 1, 2, 4 and 5 below
9. PV System Mechanical Design	10%	6	Application Problem Solving Design	References 1, 4 and 5 below
10. Performance Analysis, Maintenance and Troubleshooting	10%	6	Analysis Problem Solving	References 1, 4 and 5 below
Totals	**100%**	**60**		

Notes: Prerequisite or bridge training and/or experience in electrical systems, mathematics, and other subjects may be required for some students to fully comprehend and satisfactorily demonstrate knowledge of all of the learning objectives. Also, for intensive short courses (e.g., 40-hour, one-week workshops) students should be encouraged to spend approximately 2-3 additional hours outside of class (for each hour in class) to review the subject matter, solve problems, and study reference materials prior to taking the PV Entry Level Exam. This will usually require the student to take the exam at a later date rather than immediately following the course.

Suggested References and Study Materials

1. Photovoltaic Systems, 2nd Edition, by James P. Dunlop, ISBN 978-0-8269-1287-9. ©July 2009 National Joint Apprenticeship and Training Committee and American Technical Publishers: www.jimdunlopsolar.com

2. Code of Federal Regulations, Chapter 29 Part 1926 - Safety and Health Regulations for Construction, Occupational Safety and Health Administration: www.osha.gov

3. 2008 National Electrical Code®, NFPA 70 or 2008 National Electrical Code® Handbook, National Fire Protection Association®: www.nfpa.org

4. Study Guide for Photovoltaic System Installers, North American Board of Certified Energy Practitioners, Version 5.1.2, December 2011: www.nabcep.org

5. Photovoltaics Design and Installation Manual, ISBN 978-0-86571-520-2. ©2007 Solar Energy International, New Society Publishers (available in both English and Spanish): www.solarenergy.org

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