

NABCEP[®]

Solar Heating System Inspector Job Task Analysis Guide

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NABCEP's mission is to establish and operate high quality credentialing programs for renewable energy professionals. NABCEP credentials promote worker safety, provide value to practitioners and consumers, and set the standard for measurable cognitive skill levels.

Introduction

This document presents a comprehensive Job Task Analysis (JTA) for individuals who understand how and why solar water and pool heating systems function. Ideal exam candidates will have, at a minimum, a 10 hour OSHA Construction Card, be familiar with best practice standards and be competent in identifying system components and applications. It is important to note that the tasks outlined in this JTA are applicable to a range of personnel including but not limited to code officials; project managers; installation foreman/supervisors, and other renewable energy professionals engaged in the examination and commissioning of solar heating systems. The common thread among these individuals is they will need to be fully conversant with and able to apply the knowledge areas contained in this document.

This JTA introduces a specialty certificate providing a mechanism for inspection professionals to demonstrate their knowledge in the solar energy industry. The industry has grown and matured over the past decade and this document reflects these changes in job roles.

This task list assumes the NABCEP System Inspector is able to identify solar heating system components, their function and how they are installed. Whether or not the NABCEP Solar Heating System Inspector is an Authority Having Jurisdiction (AHJ) with wide experience, solar heating systems must be among their areas of specialization.

Job description for NABCEP Solar Heating System Inspector

A Solar Heating System Inspector (SHSI) is responsible for inspecting solar heating systems. They provide inspection services for Authorities Having Jurisdiction (AHJ), utilities, state incentive programs, and financing companies. An SHSI is familiar with solar heating system installations, is knowledgeable of applicable codes and industry standards, and is tasked with assessing the safety and operation of a solar heating system. They verify code compliance via interpretation of design plans and building documents, conduct on-site inspections, and report results.

In this JTA, tasks are categorized according to their priority or importance using three levels

- **CRITICAL** items are considered high priority tasks and are expected competencies for all System Inspectors. These include items involving safety and other tasks with a high chance of error that could lead to system failure, destruction of components to which the system is attached, etc.
- **VERY IMPORTANT** items are medium priority tasks, and are generally expected of all quality Inspectors.
- **IMPORTANT** items are considered low priority tasks, but are usually performed by all Inspectors.



I. APPROPRIATE SYSTEM DESIGN FOR APPLICATIONS

Task 1 Identify System Type And Application In Order To Determine Appropriateness Of The Design.		
1.1	Identify solar heating system type (e.g., closed-loop antifreeze, drainback, direct recirculation, integral collector storage, thermosiphon).	CRITICAL
1.2	Identify the end-use application of the system (e.g., residential water heating, residential water and space heating, commercial water heating, commercial water and space heating, swimming pool heating, process heat).	CRITICAL

Knowledge of

- a. Major system types
- b. Typical end-use applications
- c. System operation

Task 2 Verify System Is Appropriate For Application To Ensure Proper Functionality And Durability.		
2.1	Verify freeze protection is appropriate for geographic region of installation.	CRITICAL
2.2	Verify overheat protection is present to ensure proper system operation.	CRITICAL
2.3	Identify major collector siting concerns.	IMPORTANT

Knowledge of

- a. Shading and collector orientation
- b. Proper collector siting
- c. Output ratings
- d. Local climate data
- e. System operation
- f. System freeze ratings
- g. Manufacturer specifications and technical documentation

Task 3 Verify complete system documentation has been provided to the system owner for operation and maintenance.		
3.1	Assess that owner's operation and maintenance manual is complete.	IMPORTANT
3.2	Verify permit is present (if applicable).	USEFUL

Knowledge of

- a. Proper system documentation
- b. Schematics
- c. Applicable codes and standards

II. STRUCTURAL

Task 1 Verify Integrity Of Building And Building-Mounted Structures To Ensure Safety And Durability.		
1.1	Determine permitting requirements for building-mounted solar arrays.	IMPORTANT
1.2	Identify applications where design loads from the solar array may significantly impact structural integrity of the building.	CRITICAL
1.3	Verify integrity of structural attachments.	CRITICAL
1.4	Verify mounting attachments are flashed and sealed in accordance with applicable codes, standards, and roof manufacturer recommendations.	CRITICAL
1.5	Confirm mounting hardware has been installed in accordance with manufacturer recommendations or other approved design.	IMPORTANT
1.6	Identify the proper installation of any dissimilar metals to avoid corrosion and deterioration.	IMPORTANT

Knowledge of

- Applicable codes and standards
- Corrosive properties of metals
- Roofing materials
- Manufacturer specifications and technical documentation
- Building structure types and practices

Task 2 Verify Integrity Of Ground-Mounted Solar Arrays To Ensure Safety And Durability.		
2.1	Confirm mounting hardware has been installed in accordance with manufacturer recommendations or other approved design.	CRITICAL
2.2	Verify the foundation is sized and installed in accordance with applicable codes and standards.	IMPORTANT
2.3	Identify the proper installation of any dissimilar metals to avoid corrosion and deterioration.	IMPORTANT
2.4	Verify the ground-mounted array location meets the approved design or setback requirements.	USEFUL

Knowledge of

- Applicable codes and standards
- Corrosive properties of metals
- Manufacturer specifications and technical documentation
- Foundation structure types and practices
- Local frost depth

Task 3 Verify Integrity Of Penetrations To Prevent Structural Damage.		
3.1	Verify penetrations through building envelope are flashed and sealed in accordance with applicable codes, standards, and manufacturer recommendations.	CRITICAL
3.2	Verify penetrations through structural members are made in accordance with applicable codes and standards.	CRITICAL
3.3	Verify penetrations through firestops/draftstops are made in accordance with applicable codes and standards.	CRITICAL

Knowledge of

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|--|---|
| a. Roofing practices | d. Methods of air sealing |
| b. Applicable codes and standards | e. Flashing systems |
| c. Manufacturer specifications and technical documentation | f. Firestop and draftstop systems |
| | g. Compatibility of roof materials and sealants |

Task 4 Verify capability of structure to support storage tank load.		
4.1	Identify applications where design loads from the storage tank may significantly impact structural integrity of the building.	CRITICAL
4.2	Verify seismic attachments are installed in accordance with applicable codes and standards as required.	CRITICAL

Knowledge of

- Applicable codes and standards
- Manufacturer specifications and technical documentation
- Weight of water

III. MECHANICAL AND SOLAR LOOP

Task 1 Visually And Physically Verify Installed Solar Components Adhere To Applicable Codes And Standards And Match Those On The Approved Plans Or Manufacturer Guidelines To Ensure Safe And Effective Operation Of The Solar Heating System.		
1.1	Verify collectors are listed or labeled in accordance with applicable codes and standards.	IMPORTANT
1.2	Verify collector make, model, and quantity match system design.	IMPORTANT
1.3	Verify circulator pump make, model, and quantity match system design.	IMPORTANT
1.4	Ensure relief valves are installed in accordance with manufacturer recommendations and applicable codes and standards.	CRITICAL
1.5	Verify freeze valves are installed in accordance with manufacturer recommendations and applicable codes and standards as required.	CRITICAL
1.6	Verify buffer tanks are installed in accordance with manufacturer recommendations and applicable codes and standards as required.	CRITICAL
1.7	Verify external heat exchangers are installed in accordance with manufacturer recommendations and applicable codes and standards as required.	CRITICAL
1.8	Verify isolation valves are installed in accordance with manufacturer recommendations and applicable codes and standards as required.	CRITICAL
1.9	Verify manual or automatic air vents are installed in accordance with manufacturer recommendations and applicable codes and standards as required.	IMPORTANT
1.10	Confirm system labeling indicates appropriate heat transfer fluid type.	IMPORTANT
1.11	Verify expansion tanks are installed in accordance with manufacturer recommendations and applicable codes and standards as required.	IMPORTANT
1.12	Verify check valves are installed in accordance with manufacturer recommendations and applicable codes and standards as required.	IMPORTANT
1.13	Verify drainback tanks are installed in accordance with manufacturer recommendations and applicable codes and standards as required.	IMPORTANT
1.14	Verify heat dissipation devices are installed in accordance with manufacturer recommendations and applicable codes and standards as required.	IMPORTANT
1.15	Verify pumps are installed in accordance with manufacturer recommendations and applicable codes and standards as required.	IMPORTANT
1.16	Verify pressure and temperature gauges are installed in accordance with manufacturer recommendations and applicable codes and standards as required.	IMPORTANT
1.17	Verify non-potable mixing valves are installed in accordance with manufacturer recommendations and applicable codes and standards as required.	IMPORTANT
1.18	Verify air scoops/eliminators are installed in accordance with manufacturer recommendations and applicable codes and standards as required.	IMPORTANT

1.19	Verify drain valves are installed in accordance with manufacturer recommendations and applicable codes and standards as required.	IMPORTANT
1.20	Verify motorized valves are installed in accordance with manufacturer recommendations and applicable codes and standards as required.	USEFUL
1.21	Verify flow meters are installed in accordance with manufacturer recommendations and applicable codes and standards as required.	USEFUL
1.22	Verify strainers are installed in accordance with manufacturer recommendations and applicable codes and standards as required.	USEFUL

Knowledge of

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|---|---|
| a. Proper system design and application | d. Applicable codes and standards |
| b. Manufacturer specifications | e. Safety practices |
| c. System operation | f. Common system operating temperatures and pressures |

Task 2 Visually And Physically Verify Solar Loop Piping Adheres To Applicable Codes And Standards And Matches The Approved Plans Or Manufacturer Guidelines To Ensure Safe And Effective Operation Of The Solar Heating System.

2.1	Ensure there is provision for thermal expansion on solar piping where applicable.	CRITICAL
2.2	Verify proper pitch of piping to allow for system draining where applicable.	CRITICAL
2.3	Verify piping is installed and supported in accordance with manufacturer recommendations and applicable codes and standards.	CRITICAL
2.4	Verify piping is rated for maximum operating temperature and pressure of system.	CRITICAL
2.5	Visually inspect there are no leaks.	CRITICAL
2.6	Verify pipe insulation is installed in accordance with manufacturer recommendations and applicable codes and standards as required.	IMPORTANT
2.7	Verify pipe insulation is rated for operating temperature and is protected from UV degradation as required.	IMPORTANT
2.8	Verify labeling is installed in accordance with manufacturer recommendations and applicable codes and standards as required.	IMPORTANT
2.9	Verify underground piping is backfilled properly and installed at appropriate depth.	IMPORTANT
2.10	Verify multiple collector banks are piped and balanced in accordance with design.	IMPORTANT

Knowledge of

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|---|---|
| a. Proper system design and application | f. Common system operating temperatures and pressures |
| b. Manufacturer specifications | g. Common piping types |
| c. System operation | h. Common piping practices |
| d. Applicable codes and standards | i. Insulation properties |
| e. Safety practices | |

IV. PLUMBING/POTABLE PIPING

Task 1 Visually And Physically Verify Potable Components Adhere To Applicable Codes And Standards And Match Those On The Approved Plans Or Manufacturer Guidelines To Ensure Safe And Effective Operation Of The Solar Heating System.		
1.1	Verify storage tank is installed in accordance with manufacturer recommendations and applicable codes and standards as required.	CRITICAL
1.2	Ensure temperature and pressure relief valves are installed in accordance with manufacturer recommendations and applicable codes and standards.	CRITICAL
1.3	Verify thermostatic mixing valves have been installed in accordance with manufacturer recommendations, applicable codes and standards, and system design.	CRITICAL
1.4	Verify thermostatic mixing valves are set to a temperature in accordance with applicable codes and standards.	CRITICAL
1.5	Verify fittings and components are rated for domestic water in accordance with applicable codes and standards.	CRITICAL
1.6	Verify heat transfer fluid is isolated from potable water supply in accordance with applicable codes and standards.	CRITICAL
1.7	Verify heat exchangers are installed in accordance with manufacturer recommendations, applicable codes and standards, and system design.	CRITICAL
1.8	Verify storage tank is listed or labeled in accordance with applicable codes and standards.	IMPORTANT
1.9	Verify storage tank make, model, and quantity match system design.	IMPORTANT
1.10	Verify components have sufficient temperature ratings in accordance with manufacturer recommendations and applicable codes and standards.	IMPORTANT
1.11	Verify isolation valves are installed in accordance with manufacturer recommendations, applicable codes and standards, and system design.	IMPORTANT
1.12	Verify vacuum relief valves are installed in accordance with manufacturer recommendations, applicable codes and standards, and system design as required.	IMPORTANT
1.13	Verify thermal expansion tanks are installed in accordance with manufacturer recommendations, applicable codes and standards, and system design as required.	IMPORTANT
1.14	Verify potable circulator pumps are installed in accordance with manufacturer recommendations, applicable codes and standards, and system design as required.	IMPORTANT
1.15	Verify potable circulator pump make, model, and quantity match system design.	IMPORTANT
1.16	Verify drain pans are installed in accordance with manufacturer recommendations, applicable codes and standards, and system design as required.	USEFUL

Knowledge of

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| a. Manufacturer specifications and installation instructions | e. Solar water heating system design |
| b. Applicable codes and standards | f. Different system types |
| c. Design documentation | g. Types of heat exchangers |
| d. Domestic hot water piping systems | h. Safety practices |

Task 2 Visually And Physically Verify Potable Piping Adheres To Applicable Codes And Standards And Matches Those On The Approved Plans Or Manufacturer Guidelines To Ensure Safe And Effective Operation Of The Solar Heating System.		
2.1	Verify piping is installed and supported in accordance with manufacturer recommendations and applicable codes and standards.	CRITICAL
2.2	Verify piping is rated for maximum operating temperature and pressure of system.	CRITICAL
2.3	Visually inspect there are no leaks.	CRITICAL
2.4	Verify pipe insulation is installed in accordance with manufacturer recommendations and applicable codes and standards as required.	IMPORTANT
2.5	Verify pipe insulation is rated for operating temperature and is protected from UV degradation as required.	IMPORTANT
2.6	Verify labeling is installed in accordance with manufacturer recommendations and applicable codes and standards as required.	IMPORTANT
2.7	Verify underground piping is backfilled properly and installed at appropriate depth as required.	IMPORTANT
2.8	Verify heat traps are installed in accordance with manufacturer recommendations and applicable codes and standards as required.	IMPORTANT

Knowledge of

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|---|---|
| a. Proper system design and application | f. Common system operating temperatures and pressures |
| b. Manufacturer specifications | g. Common piping types |
| c. System operation | h. Common piping practices |
| d. Applicable codes and standards | i. Insulation properties |
| e. Safety practices | |

V. Electrical

Task 1 Verify Wiring Conforms To Applicable Codes And Standards To Ensure Safety.		
1.1	Confirm conductors are sized for rated amperage in accordance with manufacturer recommendations and applicable codes and standards.	CRITICAL
1.2	Ensure conductors are protected from physical damage and excessive temperatures in accordance with manufacturer recommendations and applicable codes and standards.	CRITICAL
1.3	Verify electrical connections are made in appropriate enclosures in accordance with applicable codes and standards as required.	CRITICAL
1.4	Verify cables or raceways are adequately supported in accordance with applicable codes and standards as required.	IMPORTANT
1.5	Confirm correct location of pump motor disconnect in accordance with applicable codes and standards as required.	IMPORTANT
1.6	Confirm correct location of controller disconnect in accordance with applicable codes and standards as required.	IMPORTANT
1.7	Ensure conductors installed in outdoor locations are protected from UV radiation in accordance with applicable codes and standards as required.	IMPORTANT

Knowledge of

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| a. Differential controls | g. Applicable codes and standards |
| b. Sensor types | h. Manufacturer specifications and technical documentation |
| c. PV modules and controls | i. UV degradation and techniques for protecting conductors |
| d. Pump motors and ratings | j. Common operating temperatures of solar heating systems and techniques for protecting conductors |
| e. Conductor ampacity ratings | k. Code requirements for support of raceways |
| f. Disconnect requirements | |

Task 2 Verify Electrical Components Conform To Applicable Codes And Standards To Ensure Safety.		
2.1	Ensure components are listed and labeled for intended use and installed in accordance with system design.	CRITICAL
2.2	Verify differential controllers are installed in accordance with manufacturer specifications, applicable codes and standards, and system design.	CRITICAL
2.3	Verify sensors are securely installed in accordance with manufacturer specifications, applicable codes and standards, and system design.	CRITICAL
2.4	Verify differential controller make, model, and quantities match system design as required.	IMPORTANT
2.5	Verify photovoltaic (PV) modules are installed in accordance with manufacturer specifications, applicable codes and standards, and system design.	IMPORTANT
2.6	Verify additional electrical components are installed in accordance with manufacturer specifications, applicable codes and standards, and system design.	IMPORTANT

Knowledge of

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| a. Differential controls | d. Pump motors and ratings |
| b. Sensor types and applications | e. Applicable codes and standards |
| c. PV modules and controls | f. Manufacturer specifications and technical documentation |



Primary References

- *NABCEP Solar Heating Installer Resource Guide*, v.1.0, 2012, by Chuck Marken and Vaughan Woodruff, North American Board of Certified Energy Practitioners (NABCEP), www.nabcep.org
- *Solar Water and Pool Heating Manual: Design and Installation & Repair and Maintenance*, January, 2009, Florida Solar Energy Center, www.fsec.ucf.edu, download here
- *2015 ISEP International Solar Energy Provisions*, International Code Council , www.ICC.org
- *2015 Uniform Solar Energy and Hydronics Code*, IAPMO www.IAPMO.org