

AN AMERICAN NATIONAL STANDARD
IAPMO/ANSI USEHC 1 – 2015

2015 UNIFORM SOLAR ENERGY AND HYDRONICS CODE®



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2015 **UNIFORM SOLAR ENERGY AND HYDRONICS CODE**[®]

AN AMERICAN NATIONAL STANDARD
IAPMO/ANSI USEHC 1 – 2015



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The 2015 edition of the *Uniform Solar Energy and Hydronics Code* is developed through a consensus standards development process approved by the American National Standards Institute. This process brings together volunteers representing varied viewpoints and interests to achieve consensus on solar energy and hydronic issues. While the International Association of Plumbing and Mechanical Officials (IAPMO) administers the process and establishes rules to promote fairness in the development of consensus, it does not independently test, evaluate, or verify the accuracy of any information or the soundness of any judgments contained in its codes and standards.

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To access the code information pages for a specific code, go to <http://codes.iapmo.org> to select from the list of IAPMO codes. For Errata, select the archived revision information.

FOREWORD

Origin and Development

The industry has long recognized the advantages of a statewide adopted solar energy and hydronics code. The first edition of the *Uniform Solar Energy and Hydronics Code*® (USEHC®) was adopted by IAPMO in 1976. The widespread use of this code over the past three decades by jurisdictions throughout the United States and internationally is testament to its merit.

Publishing the 2009 *Uniform Solar Energy Code* (USEC), is a significant milestone because it is the first time in the history of the United States, a solar energy code was developed through a true consensus process. Beginning with the development of the 2015 edition, the *Uniform Solar Energy Code* (USEC) will expand to include sustainable energy sources and hydronic provisions, and will serve to coalesce and integrate the hydronics industry. The 2015 edition represents the most current approaches in the solar energy and hydronics field, and is the third edition developed under the ANSI consensus process. Contributions to the content of this code consists of diverse interests as consumers, enforcing authorities, installers/maintainers, labor, manufacturers, research/standards/testing laboratories, special experts, and users.

The *Uniform Solar Energy and Hydronics Code* (USEHC) provides consumers with complete requirements for the installation and maintenance of solar thermal energy, hydronics, geothermal energy, and solar photovoltaic (PV) systems, while, at the same time, allowing latitude for innovation and new technologies. The public at large is invited and encouraged to take part in IAPMO's open consensus code development process. This code is updated every three years. The *Uniform Solar Energy and Hydronics Code* is dedicated to all those who in working to achieve "the ultimate solar energy and hydronics code," have unselfishly devoted their time, effort, and personal funds to create and maintain this, the finest solar energy and hydronics code in existence today.

The *Uniform Solar Energy and Hydronics Code* updates every three years in revision cycles that takes two years to complete.

Each revision cycle advances according to a published schedule that includes final dates for all major events and contains three basic steps as follows:

1. Public and Committee Proposal Stage;
2. Comment Stage;
3. Executive Appeals and Issuance of Code.

IAPMO develops "full consensus" codes built on a foundation of maximum participation and agreement by a broad range of interests. This philosophy has led to producing technically sound codes that promote health and safety, yet do not stifle design or development.

It is important to stress that, the process remains committed to the principles of consensus code development where consensus Technical Committees and Correlating Committees revise codes. The public and membership is offered multiple opportunities to debate, provide input and raise concerns through Amending Motions at Technical Committee meetings. Anyone may submit an appeal related to the issuance of a document through the Executive Committee.

The 2015 *Uniform Solar Energy and Hydronics Code* is supported by the Mechanical Contractors Association of America (MCAA), the Plumbing-Heating-Cooling Contractors National Association (PHCC-NA), the United Association (UA), and the World Plumbing Council (WPC). The presence of these logos, while reflecting support, does not imply any ownership of the copyright to the USEHC, which is held exclusively by IAPMO. Further, the logos of these associations indicate the support of IAPMO's open consensus process being used to develop IAPMO's codes and standards.



The addresses of the organizations are as follows:

MCAA – 1385 Piccard Drive • Rockville, MD 20850 • (301) 869-5800

PHCC-NA – PO Box 6808 • Falls Church, VA 22046 • (800) 533-7694

UA – Three Park Place • Annapolis, MD 21401 • (410) 269-2000

WPC – World Plumbing Council Secretariat, 353 Shepperton Road • East Victoria Park 6101
• Western Australia • +61 (439) 943-098

Adoption

The *Uniform Solar Energy and Hydronics Code* is available for adoption and use by jurisdictions in the United States and Internationally. Its use within a governmental jurisdiction is accomplished through adoption by reference in accordance with applicable jurisdictional laws. At adoption, jurisdictions should insert the applicable information in bracketed words in the sample ordinance. The sample legislation for adoption of the *Uniform Solar Energy and Hydronics Code* on page ix provides key components, regulations and resolutions.

Revision Markings

Solid vertical lines in the margins indicate a technical change from the requirements of the 2012 edition. An arrow (←) in the margin indicates where an entire section, paragraph, exception or table has been deleted, or an item in a list of items or a table has been deleted.

A double right angle (↻) in the margin indicates that the text or a table has been relocated within the code. The table found on page xi points out the relocations in the 2015 edition of the *Uniform Solar Energy and Hydronics Code*.

A reference in brackets [] following a section or paragraph indicates material that has been extracted from another document. This reprinted material is not the complete and official position of the source document on the referenced subject that is represented by the standard in its entirety.

Text that is extracted pursuant to IAPMO's Extract Guidelines, but outside of the regular revision process is denoted with the use of the source document in the margin. This text is not fully processed by IAPMO in accordance with ANSI's public announcement consensus requirements for an American National Standard (ANS) nor approved by ANSI's Board of Standards Review. The next revision cycle processes such text in accordance with those requirements.

FORMAT OF THE UNIFORM SOLAR ENERGY AND HYDRONICS CODE

The format of the *Uniform Solar Energy and Hydronics Code* (USEHC) arranges each chapter in accordance with a specific subject matter. However, Chapter 3 is dedicated to general requirements that are applicable to every chapter. The subject matters are divided as follows:

CHAPTERS	SUBJECTS
1	Administration
2	Definitions
3	General Regulations
4	Hydronics
5	Solar Thermal Systems
6	Thermal Storage
7	Geothermal Energy Systems
8	Duct Systems
9	Solar Photovoltaic Systems
10	Referenced Standards
Appendix A	Engineered Solar Energy Systems
Appendix B	Solar Photovoltaic System Installation Guidelines
Appendix C	Supplemental Checklist for Solar Photovoltaic Systems

FORMAT OF THE UNIFORM SOLAR ENERGY AND HYDRONICS CODE

The following is a summary of the scope and intent of the provisions addressed within the chapters and appendices of the *Uniform Solar Energy and Hydronics Code*:

Chapter 1 Administration.

Chapter 1 regulates the application, enforcement, and administration of subsequent requirements of the code. As well as establishing the scope of the code, this chapter is concerned with enforcing the requirements contained in the body of the code. A solar energy and hydronics code, as with any other code, is intended to be adopted as a legally enforceable document to safeguard health, safety, property and public welfare. The code cannot be effective without satisfactory provisions for its administration and enforcement. The Authority Having Jurisdiction is to review the proposed and completed work and to decide whether a system conforms to the code requirements. As a public servant, the Authority Having Jurisdiction enforces the code in an unbiased, proper manner. The design professional is responsible for the design of a safe system. The contractor is responsible for installing the system in accordance with the plans.

Chapter 2 Definitions.

To maintain consistency and encourage the use of common terminology, Chapter 2 establishes definitions to provide clarity of terms and promote the use of a common language throughout the code. Understanding definitions within the context of their application enables greater collaboration, efficiency, standardization and interpretation in applying and enforcing terms used throughout the code. Codes are technical documents, and every term can impact the meaning of the code text. Terms not defined have a normally accepted meaning.

Chapter 3 General Regulations.

Chapter 3 regulates the general requirements, not specific to other chapters, for installing solar energy, hydronics or geothermal systems. Many regulations are not specific solar energy, hydronics or geothermal requirements, but relate to the overall system. This chapter contains safety requirements for appliance location and installation, appliance and system access, condensate disposal, and clearances to combustibles. Listing or labeling method of approval, based on applicable nationally recognized standards, for the safe and proper installation of solar energy, hydronics or geothermal systems is essential to ensure protection of public health, safety, and welfare. The safety requirements provide protection for piping, material, and structures, with provisions for installation practices, removing stress and strain of the pipe, sleeving, and hanger support. The building's structural stability is protected by the regulations for cutting and notching of structural members.

Chapter 4 Hydronics.

Chapter 4 regulates hydronic systems that are part of heating, cooling, ventilation, and conditioning systems. Such piping systems include steam, hot water, chilled water, steam condensate, and the ground source heat pump systems. The ground source heat pumps provisions in this chapter apply to the hydronics portions of the system. It is worth noting Chapter 7 address added provisions for ground source heat pumps.

Materials for piping and tubing must meet the working temperature and pressure of the system. In addition, materials must be compatible with the transfer medium to prevent deformation, bursting, or any chemical action between the material and the transfer medium. The allowable joining methods for piping or tubing are provided for application and enforcement purposes.

Chapter 5 Solar Thermal Systems.

Chapter 5 regulates the design, installation, and construction requirements of solar thermal systems. This chapter provides the minimum safety requirements for all types of solar thermal systems, such as draindown, drainback, thermosiphon, open-loop and closed-loop systems.

Materials for piping and tubing must meet the working temperature and pressure of the system. In addition, materials must be compatible with the transfer medium to prevent deformation, bursting, or any chemical action between the material and the transfer medium. The allowable joining methods for piping or tubing are provided in Chapter 4 for application and enforcement purposes.

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Chapter 6 Thermal Storage.

Chapter 6 regulates the design, installation, construction and location of thermal storage. Pressure-type storage tanks store large amounts of energy and, when the pressure exceeds 15 psi, the tank must comply with ASME Boiler Pressure Vessel Code (BPVC) Section VIII. The stored energy must be contained to prevent disastrous failures. Installing a safety relief valve and expansion tank prevents pressures in the tank from exceeding the design threshold.

Chapter 7 Geothermal Energy Systems.

Chapter 7 regulates the design, installation, construction and location of geothermal energy systems. In order to properly design a geothermal system, it is important to know the seasonal variation in the soil temperature, as well as the soil's inherent capability to store and transmit heat, namely its heat capacity and thermal conductivity.

Materials for piping and tubing must meet the working temperature and pressure of the system. In addition, materials must be compatible with the transfer medium to prevent deformation, bursting, or any chemical action between the material and the transfer medium. The allowable joining methods for piping or tubing are provided for application and enforcement purposes.

Chapter 8 Duct Systems.

Chapter 8 regulates requirements for ducts and plenums that are portions of a heating, cooling, absorption or evaporative cooling systems. This chapter contains material and installation requirements for metal, gypsum, factory-made, flexible, and plastic ducts. It also contains fire protection requirements, smoke dampers, and automatic shutoff for the building's air distribution system.

Chapter 9 Solar Photovoltaic Systems.

Chapter 9 regulates the installation of solar photovoltaic (PV) systems, including array circuit(s), inverter(s), and controller(s) for such systems. Solar PV systems covered by this chapter are permitted to be interactive with other electrical power production sources or standalone, with or without electrical energy storage such as batteries.

Chapter 10 Referenced Standards.

Chapter 10 provides a comprehensive list of referenced standards. Referenced standards set forth specific details of accepted practices, materials specifications, or test methods in many specialized applications. Standards provide an efficient method of conveying complex information and specifications on the performance requirements for materials, products, systems, application, and installation. The manner and purpose for a standard's use and, in turn, code compliance, must be definitive in all references to the standard. If the standard is intended to be a requirement for judging code compliance, the code must state its intent for use. The standard should adequately address a defined need and at the same time specify the minimum performance requirements, technical characteristics and methods of testing, and required test results.

The referenced standards table is organized in a manner that makes it easy to find specific standards in alphabetical order, and by acronym of the publishing agency of the standard. The table lists the title of the standard, the edition, any addenda, and the section or sections of the code that reference the standard. Contact information for each publishing agency is provided at the end of the chapter.

Appendix A Engineered Solar Energy Systems.

Appendix A provides requirements for the design, installation, and inspection of an engineered solar energy system, alternate materials and equipment not specifically covered in other parts of the code.

Appendix B Solar Photovoltaic System Installation Guidelines.

Appendix B provides installation guidelines for solar photovoltaic (PV) systems. The installation guidelines provided in this appendix are not applicable to PV installations for non-habitable structures such as parking shade structures, solar trellises, etc.

Appendix C Supplemental Checklist for Solar Photovoltaic Systems.

Appendix C provides a supplemental checklist for solar photovoltaic (PV) installation that should be provided with the plan details.

SAMPLE LEGISLATION FOR ADOPTION OF THE UNIFORM SOLAR ENERGY AND HYDRONICS CODE

The Uniform Codes are designed to be adopted by jurisdictions through an ordinance. Jurisdictions wishing to adopt the 2015 *Uniform Solar Energy and Hydronics Code* as an enforceable regulation governing solar energy, hydronics and geothermal systems should ensure the legal basis under which adoption and implementation are included in the ordinance.

The following sample ordinance is a guide for drafting an ordinance for adoption that addresses key components regulations and resolutions.

ORDINANCE NO.

An ordinance of the [JURISDICTION] adopting the 2015 edition of the *Uniform Solar Energy and Hydronics Code*, regulating the design, construction, quality of materials, erection, installation, alteration, repair, location, relocation, replacement, addition to, use or maintenance of solar energy, hydronics and geothermal systems in the [JURISDICTION]; providing for the issuance of permits and collection of fees therefor; repealing Ordinance No. of the [JURISDICTION] and all other ordinances and parts of the ordinances in conflict therewith.

The [GOVERNING BODY] of the [JURISDICTION] does ordain as follows:

Section 1 Codes Adopted by Reference. That certain documents, three (3) copies of which are on file in the office of the [JURISDICTION'S KEEPER OF RECORDS] and the [JURISDICTION], being marked and designated as the 2015 *Uniform Solar Energy and Hydronics Code*, including Appendix Chapters [FILL IN THE APPENDIX CHAPTERS BEING ADOPTED], as published by the International Association of Plumbing and Mechanical Officials, be and is hereby adopted as the Code of the [JURISDICTION], in the State of [STATE NAME] regulating and controlling the design, construction, quality of materials, erection, installation, alteration, repair, location, relocation, replacement, addition to, use or maintenance of solar energy, hydronics and geothermal systems as herein provided; providing for the issuance of permits and collection of fees therefor; and each and all of the regulations, provisions, penalties, conditions and terms of such 2015 *Uniform Solar Energy and Hydronics Code* on file in the office of the [JURISDICTION] are hereby referred to, adopted, and made a part hereof, as if fully set out in this ordinance.

Section 2 Modifications. The following sections are hereby revised:

Section 101.1. Insert: [NAME OF JURISDICTION]

Section 104.5. Insert: [APPROPRIATE FEE SCHEDULE]

Section 3 Conflicting Ordinances Repealed. That Ordinance No. of [JURISDICTION] entitled [TITLE OF THE ORDINANCE OR ORDINANCES IN EFFECT AT THE PRESENT TIME SO THAT THEY WILL BE REPEALED BY MENTION] and all other ordinances or parts of ordinances in conflict herewith are hereby repealed.

Section 4 Severability. That if any section, subsection, sentence, clause or phrase of this ordinance is, for any reason, held to be unconstitutional, such decision shall not affect the validity of the remaining portions of this ordinance. The [GOVERNING BODY] hereby declares that it would have passed this ordinance, and each section, subsection, clause or phrase thereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses and phrases be declared unconstitutional.

Section 5 Legal Notice. That the [JURISDICTION'S KEEPER OF RECORDS] is hereby ordered and directed to cause this ordinance to be published. (An additional provision may be required to direct the number of times the ordinance is to be published and to specify that it is to be in a newspaper in general circulation. Posting may also be required.)

Section 6 Violations and Penalties. [INCORPORATE PENALTIES FOR VIOLATIONS]

Section 7 Effective Date. That this ordinance and the rules, regulations, provisions, requirements, orders and matters established and adopted hereby shall take effect and be in full force and effect [TIME PERIOD] from and after the date of its final passage and adoption.

COMMITTEE ON UNIFORM SOLAR ENERGY AND HYDRONICS CODE

The list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred.

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American Society of Plumbing Engineers [U]

Anthony Amable, City and County of San Francisco [E]

Robert Bean, Indoor Climate Consultants Inc. [SE]

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Luis Escobar, Air Conditioning Contractors of America [R/S/T]

Jeffrey Fecteau, Underwriters Laboratories (UL) [R/S/T]

Rex Gillespie, Caleffi North America, Inc. [M]

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Randall Knapp, Plastics Pipe Institute [M]

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Nonvoting

Hugo Aguilar, IAPMO Staff Liaison

COMMITTEE MEMBERSHIP CLASSIFICATION ABBREVIATIONS

These classifications apply to Technical Committee members and represent their principal interest in the activity of a committee.

- M** *Manufacturer*: A representative of a maker or marketer of a product, assembly or system, or portion thereof, that is affected by the standard.
- U** *User*: A representative of an entity that is subject to the provisions of the standard or that voluntarily uses the standard.
- I/M** *Installer/Maintainer*: A representative of an entity that is in the business of installing or maintaining a product, assembly or system affected by the standard.
- L** *Labor*: A labor representative or employee concerned with safety in the workplace.
- R/S/T** *Research/Standards/Testing Laboratory*: A representative of an independent research organization; an organization that develops codes, standards and other similar documents; or an independent testing laboratory.
- E** *Enforcing Authority*: A representative or an agency or an organization that promulgates and/or enforces standards.
- C** *Consumer*: A person who is, or represents, the ultimate purchaser of a product, system, or service affected by the standard, but who is not included in the *User* classification.
- SE** *Special Expert*: A person not representing any of the previous classifications, but who has special expertise in the scope of the standard or portion thereof.

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CHAPTER 1

ADMINISTRATION

101.0 General.

101.1 Title. This document shall be known as the “Uniform Solar Energy and Hydronics Code,” may be cited as such, and will be referred to herein as “this code.”

101.2 Scope. The provisions of this code shall apply to the erection, installation, alteration, addition, repair, relocation, replacement, addition to, use or maintenance of solar energy, water heating, appliances intended for space heating or cooling, swimming pool heating, process heating, geothermal and hydronic systems, snow and ice melt systems and use of any solar energy systems or swimming pool, spa or hot tub systems within this jurisdiction.

101.3 Purpose. This code is an ordinance providing minimum requirements and standards for the protection of the public health, safety, and welfare.

101.4 Unconstitutional. Where a section, subsection, sentence, clause, or phrase of this code is, for a reason, held to be unconstitutional, such decision shall not affect the validity of the remaining portions of this code. The legislative body hereby declares that it would have passed this code, and each section, subsection, sentence, clause, or phrase thereof, irrespective of the fact that one or more sections, subsections, sentences, clauses, and phrases are declared unconstitutional.

101.5 Validity. Where a provision of this code, or the application thereof to a person or circumstance, is held invalid, the remainder of the code, or the application of such provision to other persons or circumstances, shall not be affected thereby.

102.0 Applicability.

102.1 Conflicts Between Codes. Where the requirements within the jurisdiction of this code conflict with the requirements of the plumbing or mechanical code, this code shall prevail. In instances where this code, applicable standards, or the manufacturer’s installation instructions conflict, the more stringent provisions shall prevail. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall prevail.

102.2 Existing Installation. Systems lawfully in existence at the time of the adoption of this code shall be permitted to have their use, maintenance, or repair continued where the use, maintenance, or repair is in accordance with the original design and location and no hazard to life, health, or property has been created by such system.

102.3 Maintenance. Systems, materials, and appurtenances, both existing and new, of a premise under the Authority Having Jurisdiction shall be maintained in operating condition. Devices or safeguards required by this code shall be maintained in accordance with the code edition under which installed.

The owner or the owner’s designated agent shall be responsible for maintenance of the system. To determine compliance with this subsection, the Authority Having Jurisdiction shall be permitted to cause a system to be inspected.

102.4 Additions, Alterations, Renovations, or Repairs. Additions, alterations, renovations or repairs shall conform to that required for a new system without requiring the existing system to be in accordance with the requirements of this code. Additions, alterations, renovations or repairs shall not cause an existing system to become unsafe, insanitary, or overloaded.

Additions, alterations, renovations or repairs to existing system installations shall comply with the provisions for new construction, unless such deviations are found to be necessary and are first approved by the Authority Having Jurisdiction.

102.5 Health and Safety. Where compliance with the provisions of this code fails to eliminate or alleviate a nuisance, or other dangerous or insanitary condition that involves health or safety hazards, the owner or the owner’s agent shall install such additional facilities or shall make such repairs or alterations as ordered by the Authority Having Jurisdiction.

102.6 Changes in Building Occupancy. Systems that are a part of a building or structure undergoing a change in use or occupancy, as defined in the building code, shall be in accordance with the requirements of this code that are applicable to the new use or occupancy.

102.7 Moved Structures. Parts of the system of a building or part thereof that is moved from one foundation to another, or from one location to another, shall be in accordance with the provisions of this code for new installations and completely tested as prescribed elsewhere in this section for new work, except that walls or floors need not be removed during such test where equivalent means of inspection acceptable to the Authority Having Jurisdiction are provided.

102.8 Appendices. The provisions in the appendices are intended to supplement the requirements of this code and shall not be considered part of this code unless formally adopted as such.

103.0 Duties and Powers of the Authority Having Jurisdiction.

103.1 General. The Authority Having Jurisdiction shall be the Authority duly appointed to enforce this code. For such purposes, the Authority Having Jurisdiction shall have the powers of a law enforcement officer. The Authority Having Jurisdiction shall have the power to render interpretations of this code and to adopt and enforce rules and regulations.

plemental to this code as deemed necessary in order to clarify the application of the provisions of this code. Such interpretations, rules, and regulations shall comply with the intent and purpose of this code.

In accordance with the prescribed procedures and with the approval of the appointing authority, the Authority Having Jurisdiction shall be permitted to appoint such number of technical officers, inspectors, and other employees as shall be authorized from time to time. The Authority Having Jurisdiction shall be permitted to deputize such inspectors or employees as necessary to carry out the functions of the code enforcement agency.

The Authority Having Jurisdiction shall be permitted to request the assistance and cooperation of other officials of this jurisdiction so far as required in the discharge of the duties required by this code or other pertinent law or ordinance.

103.2 Liability. The Authority Having Jurisdiction charged with the enforcement of this code, acting in good faith and without malice in the discharge of the Authority Having Jurisdiction's duties, shall not thereby be rendered personally liable for damage that accrues to persons or property as a result of an act or by reason of an act or omission in the discharge of such duties. A suit brought against the Authority Having Jurisdiction or employee because of such act or omission performed in the enforcement of provisions of this code shall be defended by legal counsel provided by this jurisdiction until final termination of such proceedings.

103.3 Applications and Permits. The Authority Having Jurisdiction shall be permitted to require the submission of plans, specifications, drawings, and such other information in accordance with the Authority Having Jurisdiction, prior to the commencement of, and at a time during the progress of, work regulated by this code.

The issuance of a permit upon construction documents shall not prevent the Authority Having Jurisdiction from thereafter requiring the correction of errors in said construction documents or from preventing construction operations being carried on thereunder where in violation of this code or of other pertinent ordinance or from revoking a certificate of approval where issued in error.

103.3.1 Licensing. Provision for licensing shall be determined by the Authority Having Jurisdiction.

103.4 Right of Entry. Where it is necessary to make an inspection to enforce the provisions of this code, or where the Authority Having Jurisdiction has reasonable cause to believe that there exists in a building or upon a premises a condition or violation of this code that makes the building or premises unsafe, insanitary, dangerous, or hazardous, the Authority Having Jurisdiction shall be permitted to enter the building or premises at reasonable times to inspect or to perform the duties imposed upon the Authority Having Jurisdiction by this code, provided that where such building or premises is occupied, the Authority Having Jurisdiction shall present credentials to the occupant and request entry. Where such building or premises is unoccupied, the Authority Having Jurisdiction shall first make a reasonable effort to

locate the owner or other person having charge or control of the building or premises and request entry. Where entry is refused, the Authority Having Jurisdiction has recourse to every remedy provided by law to secure entry.

Where the Authority Having Jurisdiction shall have first obtained an inspection warrant or other remedy provided by law to secure entry, no owner, occupant, or person having charge, care, or control of a building or premises shall fail or neglect, after a request is made as herein provided, to promptly permit entry herein by the Authority Having Jurisdiction for the purpose of inspection and examination pursuant to this code.

104.0 Permits.

104.1 Permits Required. It shall be unlawful for a person, firm, or corporation to make an installation, alteration, repair, replacement, or remodel a system regulated by this code except as permitted in Section 104.2, or to cause the same to be done without first obtaining a separate permit for each separate building or structure.

104.2 Exempt Work. A permit shall not be required for the following:

- (1) The repairing of leaks in pipes, valves, or components, provided such repairs do not involve or require the replacement or rearrangement of valves, pipes, or components.
- (2) Replacement of a component part that does not alter its original approval and is in accordance with other applicable requirements of this code.

Exemption from the permit requirements of this code shall be deemed not to grant authorization for work to be done in violation of the provisions of the code or other laws or ordinances of this jurisdiction.

104.3 Application for Permit. To obtain a permit, the applicant shall first file an application therefore in writing on a form furnished by the Authority Having Jurisdiction for that purpose. Such application shall:

- (1) Identify and describe the work to be covered by the permit for which application is made.
- (2) Describe the land upon which the proposed work is to be done by legal description, street address, or similar description that will readily identify and definitely locate the proposed building or work.
- (3) Indicate the use or occupancy for which the proposed work is intended.
- (4) Be accompanied by construction documents in accordance with Section 104.3.1.
- (5) Be signed by the permittee or the permittee's authorized agent. The Authority Having Jurisdiction shall be permitted to require evidence to indicate such authority.
- (6) Give such other data and information in accordance with the Authority Having Jurisdiction.

104.3.1 Construction Documents. Construction documents, engineering calculations, diagrams, and other

data shall be submitted in two or more sets with each application for a permit. The construction documents, computations, and specifications shall be prepared by, and the system designed by, a registered design professional. Construction documents shall be drawn to scale with clarity to identify that the intended work to be performed is in accordance with the code.

Exception: The Authority Having Jurisdiction shall be permitted to waive the submission of construction documents, calculations, or other data where the Authority Having Jurisdiction finds that the nature of the work applied for is such that reviewing of construction documents is not necessary to obtain compliance with the code.

104.3.2 Plan Review Fees. Where a plan or other data is required to be submitted in accordance with Section 104.3.1, a plan review fee shall be paid at the time of submitting construction documents for review.

The plan review fees for system work shall be determined and adopted by this jurisdiction.

The plan review fees specified in this subsection are separate fees from the permit fees specified in Section 104.5.

Where plans are incomplete or changed so as to require additional review, a fee shall be charged at the rate shown in Table 104.5.

104.3.3 Time Limitation of Application. Applications for which no permit is issued within 180 days following the date of application shall expire by limitation, plans and other data submitted for review thereafter, shall be returned to the applicant or destroyed by the Authority Having Jurisdiction. The Authority Having Jurisdiction shall be permitted to extend the time for action by the applicant for a period not to exceed 180 days upon request by the applicant showing that circumstances beyond the control of the applicant have prevented action from being taken. No application shall be extended more than once. In order to renew action on an application after expiration, the applicant shall resubmit plans and pay a new plan review fee.

104.4 Permit Issuance. The application, construction documents, and other data filed by an applicant for a permit shall be reviewed by the Authority Having Jurisdiction. Such plans shall be permitted to be reviewed by other departments of this jurisdiction to verify compliance with applicable laws under their jurisdiction. Where the Authority Having Jurisdiction finds that the work described in an application for permit and the plans, specifications, and other data filed therewith are in accordance with the requirements of the code and other pertinent laws and ordinances, and that the fees specified in Section 104.5 have been paid, the Authority Having Jurisdiction shall issue a permit therefore to the applicant.

104.4.1 Approved Plans or Construction Documents. Where the Authority Having Jurisdiction issues the permit where plans are required, the Authority Having Jurisdiction shall endorse in writing or stamp the

construction documents “APPROVED.” Such approved construction documents shall not be changed, modified, or altered without authorization from the Authority Having Jurisdiction, and the work shall be completed in accordance with approved plans.

The Authority Having Jurisdiction shall be permitted to issue a permit for the construction of a part of a system before the entire construction documents for the whole system have been submitted or approved, provided adequate information and detailed statements have been filed in accordance with the pertinent requirements of this code. The holder of such permit shall be permitted to proceed at the holder’s risk without assurance that the permit for the entire building, structure, or system will be granted.

104.4.2 Validity of Permit. The issuance of a permit or approval of construction documents shall not be construed to be a permit for, or an approval of, a violation of the provisions of this code or other ordinance of the jurisdiction. No permit presuming to give authority to violate or cancel the provisions of this code shall be valid.

The issuance of a permit based upon plans, specifications, or other data shall not prevent the Authority Having Jurisdiction from thereafter requiring the correction of errors in said plans, specifications, and other data or from preventing building operations being carried on thereunder where in violation of this code or of other ordinances of this jurisdiction.

104.4.3 Expiration. A permit issued by the Authority Having Jurisdiction under the provisions of this code shall expire by limitation and become null and void where the work authorized by such permit is not commenced within 180 days from the date of such permit, or where the work authorized by such permit is suspended or abandoned at a time after the work is commenced for a period of 180 days. Before such work is recommenced, a new permit shall first be obtained to do so, and the fee therefore shall be one-half the amount required for a new permit for such work, provided no changes have been made or will be made in the original construction documents for such work, and provided further that such suspension or abandonment has not exceeded 1 year.

104.4.4 Extensions. A permittee holding an unexpired permit shall be permitted to apply for an extension of the time within which work shall be permitted to commence under that permit where the permittee is unable to commence work within the time required by this section. The Authority Having Jurisdiction shall be permitted to extend the time for action by the permittee for a period not exceeding 180 days upon written request by the permittee showing that circumstances beyond the control of the permittee have prevented action from being taken. No permit shall be extended more than once. In order to renew action on a permit after expiration, the permittee shall pay a new full permit fee.

104.4.5 Suspension and Revocation. The Authority Having Jurisdiction shall be permitted to, in writing, suspend or revoke a permit issued under the provisions of this code where the permit is issued in error or on the basis of incorrect information supplied or in violation of other ordinance or regulation of the jurisdiction.

104.4.6 Retention of Plans. One set of approved construction documents and computations shall be retained by the Authority Having Jurisdiction until final approval of the work covered therein.

One set of approved construction documents, computations, and manufacturer's installation instructions shall be returned to the applicant, and said set shall be kept on the site of the building or work at times during which the work authorized thereby is in progress.

104.5 Fees. Fees shall be assessed in accordance with the provisions of this section and as set forth in the fee schedule, Table 104.5. The fees are to be determined and adopted by this jurisdiction.

104.5.1 Work Commencing Before Permit Issuance. Where work for which a permit is required by this code has been commenced without first obtaining said permit, a special investigation shall be made before a permit is issued for such work.

104.5.2 Investigation Fees. An investigation fee, in addition to the permit fee, shall be collected whether or not a permit is then or subsequently issued. The investigation fee shall be equal to the amount of the permit fee that is required by this code, if a permit were to be issued. The payment of such investigation fee shall not exempt a person from compliance with other provisions of this code, nor from a penalty prescribed by law.

104.5.3 Fee Refunds. The Authority Having Jurisdiction shall be permitted to authorize the refunding of a fee as follows:

- (1) The amount paid hereunder that was erroneously paid or collected.
- (2) Refunding of not more than a percentage, as determined by this jurisdiction where no work has been done under a permit issued in accordance with this code.

The Authority Having Jurisdiction shall not authorize the refunding of a fee paid except upon written application filed by the original permittee not to exceed 180 days after the date of fee payment.

105.0 Inspections and Testing.

105.1 General. Systems for which a permit is required by this code shall be inspected by the Authority Having Jurisdiction.

No system or portion thereof shall be covered, concealed, or put into use until inspected and approved as prescribed in this code. Neither the Authority Having Jurisdiction nor the jurisdiction shall be liable for expense entailed

in the removal or replacement of material required to permit inspection. Systems regulated by this code shall not be connected to the water, energy fuel supply, or the sewer system until authorized by the Authority Having Jurisdiction.

105.2 Required Inspection. New system work and such portions of existing systems as affected by new work, or changes, shall be inspected by the Authority Having Jurisdiction to ensure compliance with the requirements of this code and to ensure that the installation and construction of the system is in accordance with approved plans. The Authority Having Jurisdiction shall make the following inspections and other such inspections as necessary. The permittee or the permittee's authorized agent shall be responsible for the scheduling of such inspections as follows:

- (1) Underground inspection shall be made after trenches or ditches are excavated and bedded, piping installed, and before backfill is put in place.
- (2) Rough-in inspection shall be made prior to the installation of wall or ceiling membranes.
- (3) Final inspection shall be made upon completion of the installation.

105.2.1 Uncovering. Where a system, or part thereof, which is installed, altered, or repaired, is covered or concealed before being inspected, tested, and approved as prescribed in this code, it shall be uncovered for inspection after notice to uncover the work has been issued to the responsible person by the Authority Having Jurisdiction. The requirements of this section shall not be considered to prohibit the operation of system equipment installed to replace existing equipment serving an occupied portion of the building in the event a request for inspection of such equipment has been filed with the Authority Having Jurisdiction not more than 72 hours after such replacement work is completed, and before a portion of such system is concealed by a permanent portion of the building.

105.2.2 Other Inspections. In addition to the inspections required by this code, the Authority Having Jurisdiction shall be permitted to require other inspections to ascertain compliance with the provisions of this code and other laws that are enforced by the Authority Having Jurisdiction.

105.2.3 Inspection Requests. It shall be the duty of the person doing the work authorized by a permit to notify the Authority Having Jurisdiction that such work is ready for inspection. The Authority Having Jurisdiction shall be permitted to require that a request for inspection be filed not less than 1 working day before such inspection is desired. Such request shall be permitted to be made in writing or by telephone, at the option of the Authority Having Jurisdiction.

It shall be the duty of the person requesting inspections in accordance with this code to provide access to and means for proper inspection of such work.

105.2.4 Advance Notice. It shall be the duty of the person doing the work authorized by the permit to notify the Authority Having Jurisdiction, orally or in writing that said work is ready for inspection. Such notification shall be given not less than 24 hours before the work is to be inspected.

105.2.5 Responsibility. It shall be the duty of the holder of a permit to make sure that the work will stand the test prescribed before giving the notification.

The equipment, material, and labor necessary for inspection or tests shall be furnished by the person to whom the permit is issued or by whom inspection is requested.

105.2.6 Reinspections. A reinspection fee shall be permitted to be assessed for each inspection or reinspection where such portion of work for which inspection is called is not complete or where required corrections have not been made.

This provision shall not be interpreted as requiring reinspection fees the first time a job is rejected for failure to be in accordance with the requirements of this code, but as controlling the practice of calling for inspections before the job is ready for inspection or reinspection.

Reinspection fees shall be permitted to be assessed where the approved plans are not readily available to the inspector, for failure to provide access on the date for which the inspection is requested, or for deviating from plans requiring the approval of the Authority Having Jurisdiction.

To obtain reinspection, the applicant shall file an application therefore in writing upon a form furnished for that purpose and pay the reinspection fee in accordance with Table 104.5.

In instances where reinspection fees have been assessed, no additional inspection of the work will be performed until the required fees have been paid.

105.3 Testing of Systems. Systems shall be tested and approved in accordance with this code or the Authority Having Jurisdiction. Tests shall be conducted in the presence of the Authority Having Jurisdiction or the Authority Having Jurisdiction's duly appointed representative. No test or inspection shall be required where a system, or part thereof, is set up for exhibition purposes and has no connection with a water or an energy fuel supply. In cases where it would be impractical to provide the required water or air tests, or for minor installations and repairs, the Authority Having Jurisdiction shall be permitted to make such inspection as deemed advisable in order to be assured that the work has been performed in accordance with the intent of this code. Joints and connections in a system shall be airtight, gastight, or watertight for the pressures required by the test.

105.3.1 Defective Systems. In buildings or premises condemned by the Authority Having Jurisdiction because of an insanitary condition of the system, or part thereof, the alterations in such system shall be in accordance with the requirements of this code.

105.3.2 Retesting. Where the Authority Having Jurisdiction finds that the work will not pass the test, necessary corrections shall be made, and the work shall be resubmitted for test or inspection.

105.3.3 Approval. Where prescribed tests and inspections indicate that the work is in accordance with this code, a certificate of approval shall be issued by the Authority Having Jurisdiction to the permittee on demand.

105.4 Connection to Service Utilities. No person shall make connections from a source of energy or fuel to a system or equipment regulated by this code and for which a permit is required until approved by the Authority Having Jurisdiction. No person shall make connection from a water-supply line nor shall connect to a sewer system regulated by this code and for which a permit is required until approved by the Authority Having Jurisdiction. The Authority Having Jurisdiction shall be permitted to authorize temporary connection of the system equipment to the source of energy or fuel for the purpose of testing the equipment.

106.0 Violations and Penalties.

106.1 General. It shall be unlawful for a person, firm, or corporation to erect, construct, enlarge, alter, repair, move, improve, remove, convert, demolish, equip, use, or maintain a system or permit the same to be done in violation of this code.

106.2 Notices of Correction or Violation. Notices of correction or violation shall be written by the Authority Having Jurisdiction and shall be permitted to be posted at the site of the work, mailed, or delivered to the permittee or their authorized representative.

Refusal, failure, or neglect to comply with such notice or order within 10 days of receipt thereof, shall be considered a violation of this code and shall be subject to the penalties set forth by the governing laws of the jurisdiction.

106.3 Penalties. A person, firm, or corporation violating a provision of this code shall be deemed guilty of a misdemeanor, and upon conviction thereof, shall be punishable by a fine, imprisonment, or both set forth by the governing laws of the jurisdiction. Each separate day or portion thereof, during which a violation of this code occurs or continues, shall be deemed to constitute a separate offense.

106.4 Stop Orders. Where work is being done contrary to the provisions of this code, the Authority Having Jurisdiction shall be permitted to order the work stopped by notice in writing served on persons engaged in the doing or causing such work to be done, and such persons shall forthwith stop work until authorized by the Authority Having Jurisdiction to proceed with the work.

106.5 Authority to Disconnect Utilities in Emergencies. The Authority Having Jurisdiction shall have the authority to disconnect a system to a building, structure, or equipment regulated by this code in case of emergency where necessary to eliminate an immediate hazard to life or property.

106.6 Authority to Condemn. Where the Authority Having Jurisdiction ascertains that a system or portion thereof, regulated by this code, has become hazardous to life, health, or property, or has become insanitary, the Authority Having Jurisdiction shall order in writing that such system either be removed or placed in a safe or sanitary condition. The order shall fix a reasonable time limit for compliance. No person shall use or maintain a defective system after receiving such notice.

Where such system is to be disconnected, written notice shall be given. In cases of immediate danger to life or property, such disconnection shall be permitted to be made immediately without such notice.

107.0 Board of Appeals.

107.1 General. In order to hear and decide appeals of orders, decisions, or determinations made by the Authority Having Jurisdiction relative to the application and interpretations of this code, there shall be and is hereby created a Board of Appeals consisting of members who are qualified by experience and training to pass upon matters pertaining to a system design, construction, and maintenance and the public health aspects of such systems and who are not employees of the jurisdiction. The Authority Having Jurisdiction shall be an ex-officio member and shall act as secretary to said board but shall have no vote upon a matter before the board. The Board of Appeals shall be appointed by the governing body and shall hold office at its pleasure. The board shall adopt rules of procedure for conducting its business and shall render decisions and findings in writing to the appellant with a duplicate copy to the Authority Having Jurisdiction.

107.2 Limitations of Authority. The Board of Appeals shall have no authority relative to interpretation of the administrative provisions of this code, nor shall the board be empowered to waive requirements of this code.

TABLE 104.5
SYSTEM PERMIT FEES²

Permit Issuance

- | | | |
|---|---|-------|
| 1. For issuing each permit..... | 1 | _____ |
| 2. For issuing each supplemental permit | 1 | _____ |

Unit Fee Schedule (in addition to items 1 and item 2 above)

- | | |
|---|---------|
| 1. For Collectors (including related piping and regulating devices): | |
| Up to 1000 square feet..... | 1 _____ |
| Between 1001 square feet and 2000 square feet | 1 _____ |
| More than 2000 square feet, \$5.00 plus \$1.00 per | |
| 1000 square feet or fraction thereof over 2000 square feet..... | 1 _____ |
| 2. For Storage Tanks (including related piping and regulating devices): | |
| Up to 750 gallons..... | 1 _____ |
| Between 751 gallons and 2000 gallons | 1 _____ |
| Exceeding 2000 gallons, \$3.00 plus \$1.00 per | |
| 1000 or fraction thereof exceeding 2000 gallons | 1 _____ |
| 3. For Rock Storage: | |
| Up to 1500 cubic feet..... | 1 _____ |
| Between 1501 cubic feet and 3000 cubic feet..... | 1 _____ |
| More than 3000 cubic feet, \$3.00 plus \$1.00 per | |
| 1000 cubic feet or fraction thereof over 3000 cubic feet | 1 _____ |
| 4. For each appliance or piece of equipment regulated by this code for which no fee is listed | 1 _____ |

Other Inspections and Fees

- | | |
|--|---------|
| 1. Inspections outside of normal business hours | 1 _____ |
| 2. Reinspection fee | 1 _____ |
| 3. Inspections for which no fee is specifically indicated | 1 _____ |
| 4. Additional plan review required by changes, additions, or | |
| revisions to approved plans (minimum charge - ½ hour)..... | 1 _____ |
| 5. Plan Check Fee: | |
| Where specific plans are required, a plan check fee shall be charged | |
| equal to one-half the total permit fee, excluding the permit issuance fee..... | 1 _____ |

For SI units: 1 square foot = 0.0929 m², 1 gallon = 3.785 L, 1 cubic foot = 0.0283 m³

Notes:

¹ Jurisdiction will indicate its fees here.

² These fees do not include permit fees for parts of the system that are subject to the requirements of other applicable codes.

CHAPTER 2

DEFINITIONS

201.0 General.

201.1 Applicability. For the purpose of this code, the following terms have the meaning indicated in this chapter.

No attempt is made to define ordinary words, which are used in accordance with their established dictionary meanings, except where a word has been used loosely and it is necessary to define its meaning as used in this code to avoid misunderstanding.

202.0 Definition of Terms.

202.1 General. The definitions of terms are arranged alphabetically according to the first word of the term.

202.2 Terms Defined in Other Documents. Where terms are not defined in this chapter and defined in the building code, mechanical code, plumbing code, electrical code, and fire code; such terms shall have meanings as defined in those codes.

203.0 – A –

Absorber. That part of the solar collector that receives the incident radiation energy.

Absorptance. The collecting of heat, measured as percent of total radiation available.

Accepted Engineering Practice. That which conforms to technical or scientific-based principles, tests, or standards that are accepted by the engineering profession.

Accessible. Where applied to a device, appliance, or equipment, “accessible” means having access thereto, but which first may require the removal of an access panel, door, or similar obstruction.

Accessible, Readily. Having a direct access without the necessity of removing panel, door, or similar obstruction.

Air Break, Drainage. The drain from an appliance or appurtenance that discharges indirectly into another receptor at a point below the flood level rim and above the trap seal.

Air Gap, Drainage. The unobstructed vertical distance through the free atmosphere between the lowest openings from a pipe, appliance, or appurtenance conveying waste to the flood-level rim of the receptor.

Air Mass. The ratio of the mass of atmosphere, in the actual earth-sun path, to the mass that would exist if the sun were directly overhead at sea level.

Alternating-Current (ac) Module (Alternating-Current Photovoltaic Module). A complete, environmentally protected unit consisting of solar cells, optics, inverter, and other components, exclusive of tracker, designed to generate ac power where exposed to sunlight. [NFPA 70:690.2]

Ambient Temperature. Surrounding temperature.

Angle of Incidence. The angle between the direct solar irradiation and the normal to the aperture plane.

Appliance. A device that utilizes an energy source to produce light, heat, power, refrigeration, or air conditioning.

Approved. Acceptable to the Authority Having Jurisdiction.

Approved Testing Agency. An organization primarily established for purposes of testing to approved standards and approved by the Authority Having Jurisdiction.

Appurtenance, Plumbing. A manufactured device, a prefabricated assembly, or an on-the-job assembly of component parts that is an adjunct to the basic piping system. An appurtenance demands no additional water supply, nor does it add a discharge load to the drainage system. It performs some useful function in the operation, maintenance, servicing, economy, or safety of the system.

Appurtenance, Solar. A manufactured device, a prefabricated assembly, or an on-the-job assembly of component parts that is an adjunct to a solar energy system.

Area, Absorber. The total projected heat transfer area from which the absorbed solar irradiation heats the transfer media.

Area, Aperture. The maximum projected area of a solar collector through which the unconcentrated solar radiant energy is admitted.

Area, Gross Collector. The maximum projected area of the complete collector module, including integral mounting means.

Array. A mechanically integrated assembly of modules or panels with a support structure and foundation, tracker, and other components, as required, to form a direct-current power-producing unit. [NFPA 70:690.2]

Authority Having Jurisdiction. The organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, installations, or procedures. The Authority Having Jurisdiction shall be a federal, state, local, or other regional department or an individual such as a plumbing official, mechanical official, labor department official, health department official, building official, or others having statutory authority. In the absence of a statutory authority, the Authority Having Jurisdiction may be some other responsible party. This definition shall include the Authority Having Jurisdiction’s duly authorized representative.

Auxiliary Energy System. Equipment using non-solar energy sources to supplement or backup the output provided by a solar energy system.

204.0 – B –

Backflow. The flow of water or other liquids, mixtures, or substances into the distributing pipes of a potable supply of water from sources other than its intended source.

→ **Balancing Valves.** A valve that regulates the flow rate of liquid, to achieve uniform distribution, throughout multiple collectors.

| **Bipolar Photovoltaic Array.** A PV array that has two outputs, each having opposite polarity to a common reference point or center tap. [NFPA 70:690.2]

| **Blocking Diode.** A diode used to block reverse flow of current into a PV source circuit. [NFPA 70:690.2]

| **Boiler.** A closed vessel used for heating water or liquid, or for generating steam or vapor by direct application of heat from combustible fuels or electricity.

Building. A structure built, erected, and framed of component structural parts designed for the housing, shelter, enclosure, or support of persons, animals, or property of any kind.

Building Code. The building code that is adopted by the jurisdiction.

→ **Building Integrated Photovoltaics.** Photovoltaic cells, devices, modules, or modular materials that are integrated into the outer surface or structure of a building and serve as the outer protective surface of that building. [NFPA 70:690.2]

205.0 – C –

Calcium Hardness. A measure of dissolved calcium compounds and mineral content of water. It is measured as calcium carbonate (CaCO_3).

→ **Charge Controller.** Equipment that controls dc voltage or dc current, or both, used to charge a battery or other energy storage device. [NFPA 70:100]

Circulating Air. Air being conveyed from or to a collector through openings, ducts, plenums, or concealed spaces to a heat exchanger or storage media.

| **Circulators (Circulating Pump).** A device that circulates liquids within a closed circuit for an intended purpose.

Closed Loop System. A system where the fluid is enclosed in a piping system that is not vented to the atmosphere.

| **Coastal High Hazard Areas.** An area within the flood hazard area that is subject to high velocity wave action, and shown on a Flood Insurance Rate Map or other flood hazard map as Zone V, VO, VE or VI-30.

Code. A standard that is an extensive compilation of provisions covering broad subject matter or that is suitable for adoption into law independently of other codes and standards.

Collector. See Solar Collector.

Collector, Concentrating. A solar collector that uses reflectors, lenses, or other optical elements to concentrate the radiant energy passing through the aperture onto an absorber of which the surface area is smaller than the aperture area.

Collector System. That section of the solar system that includes the collector and piping or ducts from the collector to the storage system.

Collector Tilt. The angle above horizontal at which a solar heat collector is positioned.

Combination Temperature and Pressure-Relief Valve. A relief valve that actuates when a set temperature, pressure, or both is reached. Also known as a T&P valve.

Combustible Liquid. A liquid having a flash point at or above 100°F (38°C). Combustible liquids shall be divided into the following classifications:

- (1) Class II liquids having a flash point above 100°F (38°C) and below 140°F (60°C).
- (2) Class IIIA liquids having a flash point at or above 140°F (60°C) and below 200°F (93°C).
- (3) Class IIIB liquids having a flash point at or above 200°F (93°C).

The classifications of combustible liquids do not include compressed gases or cryogenic fluids.

Concentration Ratio. The ratio of the aperture area to the absorber area (in concentrating solar collectors).

Concentrator. Reflector of lens designed to focus solar energy into a reduced area.

Condensate. The liquid phase produced by condensation of a particular gas or vapor.

Conditioned Space. An area, room, or space normally occupied and being heated or cooled for human habitation by any equipment.

Construction Documents. Plans, specifications, written, graphic, and pictorial documents prepared or assembled for describing the design, location, and physical characteristics of the elements of a project necessary for obtaining a permit.

Contamination. An impairment of the quality of the potable water that creates an actual hazard to the public health through poisoning or through the spread of disease by sewage, industrial fluids, or waste. Also defined as High Hazard.

Cooling. Air cooling to provide a room or space temperature of 68°F (20°C) or above.

Cooling System. All of the equipment, including associated refrigeration, intended or installed for the purpose of cooling air by mechanical means and discharging such air into any room or space. This definition shall not include an evaporative cooler.

Copper Alloy. A homogenous mixture of two or more metals in which copper is the primary component, such as brass and bronze.

Cover, Collector (Glazing). The material covering the aperture to provide thermal and environmental protection.

Crawl Space. In a building, an area accessible by crawling, having a clearance less than human height, for access to plumbing or wiring, storage, etc.

Critical Level. The critical level (C-L or C/L) marking on a backflow prevention device or vacuum breaker is a point conforming to approved standards and established by the testing laboratory (usually stamped on the device by the

manufacturer) that determines the minimum elevation above the flood-level rim of the fixture or receptor served at which the device may be installed. Where a backflow prevention device does not bear a critical level marking, the bottom of the vacuum breaker, combination valve, or the bottom of such approved device shall constitute the critical level.

Cross-Connection. A connection or arrangement, physical or otherwise, between a potable water supply system and a tank, receptor, equipment, or device through which it may be possible for nonpotable, used, unclean, polluted and contaminated water, or other substances to enter into a part of such potable water system under any condition.

206.0

– D –

DC-to-DC Converter. A device installed in the PV source circuit or PV output circuit that can provide an output dc voltage and current at a higher or lower value than the input dc voltage and current.

Department Having Jurisdiction. The Authority Having Jurisdiction, including other law enforcement agencies affected by a provision of this code, whether such agency is specifically named or not.

Design Flood Elevation. The elevation of the “design flood,” including wave height, relative to the datum specified on the community’s legally designated flood hazard map. In areas designated as Zone AO, the design flood elevation shall be the elevation of the highest existing grade of the building’s perimeter plus the depth number in feet (m) specified on the flood hazard map. In areas designated as Zone AO where a depth number is not specified on the map, the depth number shall be taken as being equal to 2 feet (610 mm).

Design Pressure. The maximum allowable pressure for which a specific part of a system is designed.

Design Temperature. The maximum allowable continuous or intermittent temperature for which a specific part of a solar energy system is designed to operate safely and reliably.

Developed Length. The length along the center line of a pipe and fittings.

Diameter. Unless specifically stated, “diameter” is the nominal diameter as designated commercially.

Direct-Current (DC) Combiner. A device used in the PV source and PV output circuits to combine two or more dc circuit inputs and provide on dc circuit output.

Direct Exchange (DX). A ground-source heat pump that circulates a refrigerant through a closed-loop system.

Direct Expansion System. See Direct Exchange (DX).

Discrete Products in Plenums. Individual distinct products which are non-continuous such as pipe hangers, duct registers, duct fittings and duct straps.

Distribution System. That section of the solar system from the storage system to the point of use.

Diversification Charge Controller. Equipment that regulates the charging process of a battery by diverting power from energy storage to direct-current or alternating-current loads or to an interconnected utility service. [NFPA 70:690.2]

Drain. A pipe that carries waste or waterborne wastes in a building drainage system.

Drainage System. Includes the piping within a premise that conveys liquid waste to a legal point of disposal.

Drainback System. A closed loop system, which allows gravity draining of the heat transfer fluid into, lower portions or the solar loop under prescribed circumstances.

Draindown. An active solar energy system in which the fluid in the solar collector is drained from the solar energy system under prescribed circumstances.

Duct. A tube or conduit for transmission of air, fumes, vapors, or dusts. This definition shall not include:

- (1) A vent, vent connector, or chimney connector.
- (2) A tube or conduit wherein the pressure of the air exceeds 1 psi (7 kPa).
- (3) The air passages of listed self-contained systems.

207.0

– E –

Electrical (Auxiliary) Heating. Electrical heating element immersed into the storage.

Electrical Production and Distribution Network. A power production, distribution, and utilization system, such as a utility system and connected loads, that is external to and not controlled by the PV power system. [NFPA 70:690.2]

Emittance. The amount of heat radiated back from the solar collector, measured as percent of energy absorbed by the collector.

Enclosure. A room or box used to store solar components.

Energy Collector Fluid. That fluid used to transfer energy from the collector to the storage system or point of use.

Energy Storage Fluid (or Media). That fluid (or media) used in the storage container for storing collected energy.

Energy Transfer Fluid. That fluid used within a closed system either from the collector to the storage system or from the storage system to the point of use.

Equipment. A general term including materials, fittings, devices and apparatus used as part of or in connection with installations regulated by this code.

Essentially Nontoxic Transfer Fluid. Fluid generally recognized as safe by the Food and Drug Administration (FDA) as food grade.

Existing Work. A solar system or part thereof that has been installed prior to the effective date of this code.

External Auxiliary Heating. Auxiliary heating device located outside the storage. The heat is transferred to the storage by direct or indirect charging via a charge loop.

208.0 – F –

Flammable Liquid. Any liquid that has a flash point below 100°F (38°C), and has a vapor pressure not exceeding 40 psi (276 kPa) at 100°F (38°C). Flammable liquids shall be known as Class I liquids and shall be divided into the following classifications:

- (1) Class IA liquids having a flash point below 73°F (23°C) and a boiling point below 100°F (38°C).
- (2) Class IB liquids having a flash point below 73°F (23°C) and a boiling point at or above 100°F (38°C).
- (3) Class IC liquids having a flash point at or above 73°F (23°C) and below 100°F (38°C).

Flash Point. The minimum temperature corrected to a pressure of 14.7 psi (101 kPa) at which a test flame causes the vapors of a portion of the sample to ignite under the conditions specified by the test procedures and apparatus. The flash point of a liquid shall be determined in accordance with ASTM D56, ASTM D93, or ASTM D3278.

Flat Plate Collector. A panel (nonconcentrating type) of suitable material that converts solar energy into usable energy and the absorbing surface is essentially planar.

Flood Hazard Area. The greater of the following two areas:

- (1) The area within a floodplain subject to a 1 percent or greater chance of flooding in any given year.
- (2) The area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated.

Flood-Level Rim. The top edge of a receptor from which water overflows.

Freeze Protection. Any method for protecting solar thermal systems from damage due to freezing conditions where installed in locations where freezing ambient temperature conditions exist.

Freeze Protection, Fail-Safe. A freeze-protection method that does not rely on the activation or continued operation of any mechanical or electrical component.

209.0 – G –

Georexchange. See Geothermal Energy System.

Geothermal Energy System. A system that uses the earth's interior thermal energy for space heating and cooling, and water heating.

Grade. The slope or fall of a line of pipe in reference to a horizontal plane. In drainage, it is usually expressed as the fall in a fraction of an inch (mm) or percentage slope per foot (m) length of pipe.

Gravity Tank. A water storage tank in which fluid is stored at atmospheric pressure and distributed by gravity flow in a downfeed system.

Ground-Heat Exchanger. An underground closed-loop heat exchanger through which a heat-transfer medium passes to and from a heat pump or other rated mechanical equipment. It includes the buried pipe and connecting main(s) up to and terminating with the building.

Ground-Source Heat Pump. A term that is applied to a variety of systems that use the ground, groundwater, or surface water as a heat source and sink. The general terms include ground-coupled (GCHP), groundwater (GWHP), and surface-water (SWHP) heat pumps. Many parallel terms exist [e.g., geothermal heat pumps (GHP), geo-exchange, and ground-source (GS) systems] and are used to meet a variety of marketing or institutional needs.

Groundwater Source. A geothermal energy system that uses the groundwater as a heat source or sink.

210.0 – H –

Hangers. See Supports.

Hazardous Material. A substance or mixture of substances that is toxic, corrosive, flammable, an irritant, a sensitizer, and that presents a potential threat to the health of humans or animals.

Heat Exchanger. A device that transfers heat from one medium to another.

Heat Transfer Medium. The medium used to transfer energy from the solar collectors to the thermal storage or load.

Heating Degree Day. A unit, based upon temperature difference and time, used in estimating fuel consumption and specifying nominal annual heating load of a building. For any one day when the mean temperature is less than 65°F (18°C), there exist as many degree days as there are Fahrenheit degrees difference in temperature between mean temperature for the day and 65°F (18°C).

Heating Equipment. Includes warm air furnaces, warm air heaters, combustion products vents, heating air-distribution ducts and fans, and all steam and hot water piping, together with all control devices and accessories installed as part of, or in connection with, any environmental heating system or appliance regulated by this code.

Heliostat. A reflecting surface mounted on an axis to direct the sun's rays to a fixed point.

High Hazard. See Contamination.

Horizontal Pipe. A pipe or fitting that is installed in a horizontal position or which makes an angle of less than 45 degrees (0.79 rad) with the horizontal.

Hybrid System. A system comprised of multiple power sources. These power sources may include photovoltaic, wind, micro-hydro generators, engine-driven generators, and others, but do not include electric power production and distribution network systems. Energy storage systems, such as batteries, flywheels, or superconducting magnetic storage equipment do not constitute a power source for the purpose of this definition. The energy regenerated by an overhauling (descending) elevator does not constitute a power source for the purpose of this definition. [NFPA 70:100]

Hydronic System. Relating to, or being a system of heating or cooling that involves transfer of heat by a circulating fluid (such as water or vapor).

Hydronics. Of or relating to a heating or cooling system that transfers energy by circulating a fluid through a system of pipes or tubing.

211.0

– I –

Ignition Source. Appliances or equipment due to their intended use and operation, are capable of providing sufficient temperature and energy to raise its ignition temperature and capable of igniting flammable vapors or fumes. Sources may include appliance or equipment burners, burner igniters or electric switching devices.

Immersed Heat Exchanger. Heat exchanger, which is completely surrounded with the fluid in the storage tank.

Indirect Waste Pipe. A waste pipe that does not connect directly with the drainage system, but that discharges into the drainage system through an air break or air gap into a trap, fixture, receptor or interceptor.

→ **Insolation.** The rate of solar energy received on a unit surface in a unit time.

Instantaneous Efficiency. The amount of energy removed by the transfer fluid per gross collector area. During the specified time period, divided by the total solar radiation incident on the collector per unit area during the same test period, under steady state or quasi-steady state.

Integral Collector Storage. A solar thermal heating system that uses a solar collector that has all or most of its heat transfer liquid inside the collector.

Interactive System. A solar PV system that operates in parallel with and may deliver power to an electrical production and distribution network. For the purpose of this definition, an energy storage subsystem of a solar PV system, such as a battery, is not another electrical production source. [NFPA 70:690.2]

Inverter. Equipment that is used to change voltage level or waveform, or both, of electrical energy. Commonly, an inverter [also known as a power conditioning unit (PCU) or power conversion system (PCS)] is a device that changes dc input to an ac output. Inverters may also function as battery chargers that use alternating current from another source and convert it into direct current for charging batteries. [NFPA 70:690.2]

Inverter Input Circuit. Conductors between the inverter and the battery in stand-alone systems or the conductors between the inverter and the PV output circuits for electrical production and distribution network. [NFPA 70:690.2]

Inverter Output Circuit. Conductors between the inverter and an ac panelboard for stand-alone systems or the conductors between the inverter and the service equipment or another electric power production source, such as a utility, for electrical production and distribution network. [NFPA 70:690.2]

Irradiation, Instantaneous. The quantity of solar radiation incident on a unit surface area in unit time, measured in British thermal unit per square foot hour [Btu/(ft²•h)] (kW/m²).

Irradiation, Integrated Average. The solar radiation incident on a unit surface area during a specified time period divided by the duration of that time period.

212.0

– J –

Joint, Brazed. A joint obtained by joining of metal parts with alloys that melt at temperatures exceeding 840°F (449°C), but less than the melting temperature of the parts to be joined.

Joint, Compression. A multipiece joint with cup-shaped threaded nuts that, when tightened, compress tapered sleeves so that they form a tight joint on the periphery of the tubing they connect.

Joint, Flanged. One made by bolting together a pair of flanged ends.

Joint, Flared. A metal-to-metal compression joint in which a conical spread is made on the end of a tube that is compressed by a flare nut against a mating flare.

Joint, Mechanical. General form for gastight or liquid-tight joints obtained by the joining of parts through a positive holding mechanical construction.

Joint, Soldered. A joint obtained by the joining of metal parts with metallic mixtures or alloys that melt at a temperature up to and including 840°F (449°C).

Joint, Welded. A gastight joint obtained by the joining of metal parts in the plastic molten state.

213.0

– K –

No definitions.

214.0

– L –

Labeled. Equipment or materials bearing a label of a listing agency (accredited conformity assessment body). See Listed (Third-Party Certified).

Langelier Saturation Index. A formula used to measure water balance or mineral saturation control of pool, spa, or hot tub water. Total alkalinity, calcium hardness, pH, water temperature, and total dissolved solids are measured, given a factor, and calculated to determine whether water has a tendency to be corrosive or scale forming.

Langley (cal_{th}/cm²). A unit of measurement of insolation, equal to 4.184 E+04 joules per square meter (J/m²).

Listed (Third Party Certified). Equipment or materials included in a list published by a listing agency (accredited conformity assessment body) that maintains periodic inspection on current production of listed equipment or material and whose listing states either that the equipment or material complies with approved standards or has been tested and found suitable for use in a specified manner.

Listing Agency. An agency accredited by an independent and authoritative conformity assessment body to operate a material and product listing and labeling (certification) system and that is accepted by the Authority Having Jurisdiction, which is in the business of listing or labeling. The system includes initial and ongoing product testing, a periodic inspection on current production of listed (certified) products, and that makes available a published report of such listing in which specific information is included that the material or product is in accordance with applicable standards and found safe for use in a specific manner.

DEFINITIONS

Load. The heat output of the storage during discharge. The load is defined as the product of the mass, specific thermal capacity and temperature increase of the water as it passes the solar hot water system.

→ **Low Hazard.** See Pollution.

215.0 – M –

→ **May.** A permissive term.

Mechanical Code. The mechanical code that is adopted by the jurisdiction. Where a mechanical code is not adopted or where the content of the mechanical code adopted by the jurisdictions is not applicable, then mechanical code shall mean the Uniform Mechanical Code (UMC) promulgated by the International Association of Plumbing and Mechanical Officials (IAPMO).

Module. A complete, environmentally protected unit consisting of solar cells, optics, and other components, exclusive of tracker, designed to generate dc power where exposed to sunlight. [NFPA 70:690.2]

Monopole Subarray. A PV subarray that has two conductors in the output circuit, one positive and one negative. Two monopole PV subarrays are used to form a bipolar PV array. [NFPA 70:690.2]

Multimode Inverter. Equipment having the capabilities of both the utility-interactive inverter and the stand-alone inverter.

216.0 – N –

Noncombustible Material. As applied to building construction material, means a material that in the form in which it is used is either one of the following:

- (1) A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat. Materials that are reported as passing ASTM E136 are considered noncombustible material.
- (2) Material having a structural base of noncombustible material as defined in 1 above, with a surfacing material not over 1/8 of an inch (3.2 mm) thick that has a flame-spread index not higher than 50.

Noncombustible does not apply to surface finish materials. Material required to be noncombustible for reduced clearances to flues, heating appliances, or other sources of high temperature shall refer to material in accordance with 1 above. No material shall be classed as noncombustible that is subject to increase in combustibility or flame-spread index beyond the limits herein established, through the effects of age, moisture, or other atmospheric condition.

Nuisance. Includes, but is not limited to:

- (1) A public nuisance known at common law or in equity jurisprudence.
- (2) Where a work regulated by this code is dangerous to human life or detrimental to health and property.
- (3) Inadequate or unsafe water supply or sewage disposal system.

217.0 – O –

Occupancy. The purpose for which a building or part thereof is used or intended to be used.

Offset. A combination of elbows or bends in a line of piping that brings one section of the pipe out of line but into a line parallel with the other section.

Open Loop System. A system where the fluid is enclosed in a piping system that is vented to the atmosphere.

Out-Gassing. As applied to thermal energy, the thermal process by which materials expel gas.

218.0 – P –

Passive Solar Systems. As used in these requirements, are solar systems that utilize elements of a building, without augmentation by mechanical components such as blowers or pumps, to provide for the collections, storage, or distribution of solar energy for heating, cooling, or both.

PE. Polyethylene.

PE-AL-PE. Polyethylene-aluminum-polyethylene.

PE-RT. Polyethylene of raised temperature.

Person. A natural person, his heirs, executor, administrators, or assigns and shall also include a firm, corporation, municipal or quasi-municipal corporation, or governmental agency. Singular includes plural, male includes female.

PEX. Cross-linked polyethylene.

PEX-AL-PEX. Cross-linked polyethylene-aluminum-cross-linked polyethylene.

pH. The log of the reciprocal of the hydrogen ion concentration of a solution, and a measure of the acidity or alkalinity of the water. It is determined by the concentration of hydrogen ions in a specific volume of water.

Photolysis. A chemical decomposition caused by radiation.

Photosynthesis. The building up of chemical compounds with the help of radiation.

Photovoltaic. Relating to electricity produced by the action of solar radiation on a solar cell.

Photovoltaic Output Circuit. Circuit conductors between the PV source circuit(s) and the inverter or dc utilization equipment. [NFPA 70:690.2]

Photovoltaic Panel. A collection of modules mechanically fastened together, wired, and designed to provide a field-installable unit. [NFPA 70:690.2]

Photovoltaic Power Source. An array or aggregate of arrays that generates dc power at system voltage and current. [NFPA 70:690.2]

Photovoltaic Source Circuit. Circuits between modules and from modules to the common connection point(s) of the dc system. [NFPA 70:690.2]

Photovoltaic System Voltage. The direct current (dc) voltage of any PV source or PV output circuit. For multiwire installations, the PV system voltage is the highest voltage between any two dc conductors. [NFPA 70:690.2]

Pipe. A cylindrical conduit or conductor conforming to the particular dimensions commonly known as “pipe size.”

Piping. The pipe or tube mains for interconnecting the various parts of a system. Piping includes pipe, tube, flanges, bolting, gaskets, valves, fittings, the pressure-containing parts of other components such as expansion joints, strainers, and devices that serve such purposes as mixing, separating, snubbing, distributing, metering, or controlling flow, pipe-supporting fixtures and structural attachments.

Plastic CC1. Plastic materials that have a burning extent of 1 inch (25.4 mm) or less where tested in nominal 0.060 of an inch (1.524 mm) thickness by ASTM D635 or in the thickness intended for use.

Plastic CC2. Plastic materials that have a burning rate of 150 inches per hour (in/h) (63.5 mm/min) or less where tested in nominal 0.060 inch (1.524 mm) thickness by ASTM D635 or in the thickness intended for use.

Plenum. An air compartment or chamber to which one or more ducts are connected and that forms part of either the conditioned air supply, circulating air, or exhaust air system, other than the occupied space being conditioned.

Plumbing Code. The plumbing code that is adopted by the jurisdiction. Where a plumbing code is not adopted or where the content of the plumbing code adopted by the jurisdiction is not applicable, then plumbing code shall mean the Uniform Plumbing Code (UPC) promulgated by the International Association of Plumbing and Mechanical Officials (IAPMO).

Pollution. An impairment of the quality of the potable water to a degree that does not create a hazard to the public health but which does adversely and unreasonably affect the aesthetic qualities of such potable water for domestic use. Also defined as Low Hazard.

Potable Water. Water that is satisfactory for drinking, culinary, and domestic purposes and that meets the requirements of the Health Authority Having Jurisdiction.

Pressure. The normal force exerted by a homogeneous liquid or gas, per unit of area, on the wall of the container.

Pressure, Residual. The pressure available at the fixture or water outlet after allowance is made for pressure drop due to friction loss, head, meter, and other losses in the system during maximum demand periods.

Pressure, Static. The pressure existing without any flow.

Pressure-Limiting Device. A pressure-responsive mechanism designed to automatically stop the operation of the pressure-imposing element at a predetermined pressure.

Pressure Test. The minimum gauge pressure to which a specific system component is subjected under test condition.

PVC. Polyvinyl Chloride.

Pyranometer. A device used to measure the total solar radiation incident upon a surface per unit time per unit area.

Pyrheliometer. A device used to measure the direct radiation on a surface normal to the sun’s rays.

219.0 – Q –

Quasi-Steady State. The state of the solar collector test where the flow rate and temperature of the fluid entering the collector are constant but the exit fluid temperature changes gradually due to the normal change in irradiation that occurs with time for clear sky conditions.

Quick-Acting Valve. A valve that closes quickly or abruptly where manually released or electrically actuated.

220.0 – R –

Radiant Heater. A heater designed to transfer heat primarily by direct radiation.

Registered Design Professional. An individual who is registered or licensed by the laws of the state to perform such design work in the jurisdiction.

Relief Valve, Vacuum. A device which automatically opens or closes for relieving a vacuum with the system, depending on whether the vacuum is above or below a predetermined value.

Rock Storage. A bin, basement, or other container filled with rock to act as an energy reservoir for a solar system.

221.0 – S –

Selective Surface. A special coating applied to solar collectors, having high absorption and low emission factors.

Shall. Indicates a mandatory requirement.

Size. See Diameter.

Solar Cell. The basic PV device that generates electricity where exposed to light. [NFPA 70:690.2]

Solar Collector. A device used to absorb energy from the sun.

Solar Constant. The average amount of solar radiation reaching the earth’s atmosphere per unit time [about 2 langleys per minute [1395 J/(m²•s)]].

Solar Energy System. A configuration of equipment and components to collect, convey, store, and convert the sun’s energy for a purpose.

Solar Energy System Components. Any appliance, assembly, device, equipment, or piping used in the conversion of solar energy into thermal energy for service water heating, pool water heating, space heating and cooling, and electrical service.

Solar Thermal System. A complete assembly of subsystems which convert solar energy into thermal energy and utilize this energy for service water heating, pool water heating, space heating and cooling purposes.

Stand-Alone System. A solar PV system that supplies power independently of an electrical production and distribution network. [NFPA 70:690.2]

Standard. A document, the main text of which contains only mandatory provisions using the word “shall” to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code.

DEFINITIONS

adoption into law. Nonmandatory provisions shall be located in an appendix, footnote, or fine print note and are not to be considered a part of the requirements of a standard.

Standard Air. Air weighing 0.075 of a pound per cubic foot (lb/ft³) (1.201 kg/m³) and is equivalent in density to dry air at a temperature of 70°F (21°C) and standard barometric pressure of 29.92 of a inch Hg. (101.32 kPa).

Storage Tank. See Thermal Storage.

Storage Temperature. Temperature of the storage medium.

Stored Energy. Accumulated energy that is available for use.

Stratified. State where thermal stratification is inside the storage.

Subarray. An electrical subset of a PV array. [NFPA 70:690.2]

Supports. Supports, hangers, and anchors are devices for properly supporting and securing pipe, fixtures, and equipment.

222.0 – T –

Termination, Duct. The final or intended end-portion of a duct system that is designed and functions to fulfill the obligations of the system in a satisfactory manner. [NFPA 96:3.3.19]

Thermal Storage. A tank or vessel used in a solar thermal, hydronic, or geothermal system, in which thermal energy is stored.

Thermal Stratification. State where the local storage temperature is a function of the vertical storage height, with the temperature decreasing from top to bottom.

Thermosiphon. The natural circulation of fluids due to temperature differential.

Tilt Angle. The angle above horizontal of a plane surface.

Time Constant. The time required for the fluid leaving a solar collector to attain 63.2 percent of its steady state value following a step change in insolation or inlet fluid temperature.

Total Alkalinity. The sum of all alkaline minerals in the water that is primarily in bicarbonate form, but also as sodium, calcium, magnesium, potassium carbonates, and hydroxides. It is a measure of the water's ability to resist changes in pH.

Total Dissolved Solids (TDS). A measure (by electrical conductivity) of the amount of soluble matter that is present in the water.

Total Incident Irradiation. The total solar radiant energy incident upon a unit surface area during a specified time period, expressed in British thermal unit per square foot (Btu/ft²) (J/m²).

Transfer System. The intermediate piping, ducts, or both between the various components of the solar system.

Transfer Time. Time period during which energy is transferred through the connections for charge (x=C) or discharge

(x=D). The transfer time is calculated over one of more test sequences, excluding time periods used for conditioning at the beginning of the test sequences.

Trickling Collector. A solar collector in which fluids free flow over the collector surface.

223.0 – U –

No definitions.

224.0 – V –

Valve, Pressure-Relief. A pressure-actuated valve held closed by a spring or other means and designed to automatically relieve pressure in excess of its setting.

Venetian Blind Collector. A solar collector in which movable vanes are employed to absorb or reject energy.

225.0 – W –

Water-Distribution Pipe. In a building or premises, a pipe that conveys potable water from the building supply pipe to the plumbing fixtures and other water outlets.

Water Supply System. The building supply pipe, the water-distribution pipes, and the necessary connecting pipes, fittings, control valves, backflow prevention devices, and all appurtenances carrying or supplying potable water in or adjacent to the building or premises.

Water Well. An excavation that is drilled, cored, bored, washed, driven, dug, jetted, or otherwise constructed for the purposes of extracting groundwater, using the geothermal properties of the earth, or injecting water into an aquifer or subsurface reservoir.

226.0 – X –

No definitions.

227.0 – Y –

No definitions.

228.0 – Z –

No definitions.

CHAPTER 3

GENERAL REGULATIONS

301.0 General.

301.1 Applicability. This chapter shall govern the general requirements for the installation, design, construction, and repair of a solar energy, hydronic, or geothermal system.

302.0 Materials – Standards and Alternates.

302.1 Minimum Standards. Pipe, pipe fittings, appliances, appurtenances, equipment, material, and devices used shall be listed or labeled (third party certified) by a listing agency (accredited conformity assessment body) and shall comply with the approved applicable recognized standards referenced in this code, and shall be free from defects. Unless otherwise provided for in this code, materials, appurtenances, or devices used or entering into the construction of a system, or parts thereof, shall be submitted to the Authority Having Jurisdiction for approval.

302.1.1 Marking. Each length of pipe and each pipe fitting, material, and device used shall have cast, stamped, or indelibly marked on it the manufacturer's mark or name, which shall readily identify the manufacturer to the end user of the product. Where required by the approved standard that applies, the product shall be marked with the weight and the quality of the product. Materials and devices used or entering into the construction of a system, or parts thereof, shall be marked and identified in a manner satisfactory to the Authority Having Jurisdiction. Such marking shall be done by the manufacturer. Field markings shall not be acceptable.

Exception: Markings shall not be required on nipples created from cutting and threading of approved pipe.

302.1.2 Standards. Standards listed or referred to in this chapter or other chapters cover materials that will conform to the requirements of this code, where used in accordance with the limitations imposed in this or other chapters thereof and their listing. Where a standard covers materials of various grades, weights, quality, or configurations, the portion of the listed standard that is applicable shall be used. Design and materials for special conditions or materials not provided for herein shall be permitted to be used by special permission of the Authority Having Jurisdiction after the Authority Having Jurisdiction has been satisfied as to their adequacy. A list of accepted material standard are referenced in Table 1001.1.

302.1.3 Existing Buildings. In existing buildings or premises in which system installations are to be altered, repaired, or renovated, the Authority Having Jurisdiction has discretionary powers to permit deviation from the provisions of this code, provided that such proposal to deviate is first submitted for proper determination in order that health and safety requirements, as they pertain to the system, shall be observed.

302.2 Alternate Materials and Methods of Construction Equivalency. Nothing in this code is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire-resistance, effectiveness, durability, and safety over those prescribed by this code. Technical documentation shall be submitted to the Authority Having Jurisdiction to demonstrate equivalency. The Authority Having Jurisdiction shall have the authority to approve or disapprove the system, method, or device for the intended purpose.

However, the exercise of this discretionary approval by the Authority Having Jurisdiction shall have no effect beyond the jurisdictional boundaries of said Authority Having Jurisdiction. An alternate material or method of construction so approved shall not be considered as in accordance with the requirements, intent, or both of this code for a purpose other than that granted by the Authority Having Jurisdiction where the submitted data does not prove equivalency.

302.2.1 Testing. The Authority Having Jurisdiction shall have the authority to require tests, as proof of equivalency.

302.2.1.1 Tests. Tests shall be made in accordance with approved or applicable standards, by an approved testing agency at the expense of the applicant. In the absence of such standards, the Authority Having Jurisdiction shall have the authority to specify the test procedure.

302.2.1.2 Request by Authority Having Jurisdiction. The Authority Having Jurisdiction shall have the authority to require tests to be made or repeated where there is reason to believe that a material or device no longer is in accordance with the requirements on which its approval was based.

302.3 Flood Hazard Areas. Systems shall be located above the elevation in accordance with the building code for utilities and attendant equipment or the elevation of the lowest floor, whichever is higher.

Exception: Systems shall be permitted to be located below the elevation in accordance with the building code for utilities and attendant equipment or the elevation of the lowest floor, whichever is higher, provided that the systems are designed and installed to prevent water from entering or accumulating within their components and the systems are constructed to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to such elevation.

302.3.1 Coastal High Hazard Areas. Systems in buildings located in coastal high hazard areas shall be in accordance with the requirements of Section 302.3, and systems, pipes, tubing, and appurtenances shall not be mounted on or penetrate through walls that are intended to breakaway under flood loads in accordance with the building code.

302.3.2 Flood Resistant Materials. System components installed in flood hazard areas and below the design flood elevation shall be made of flood damage-resistant materials.

302.4 Alternative Engineered Design. An alternative engineered design shall comply with the intent of the provisions of this code and shall provide an equivalent level of quality, strength, effectiveness, fire resistance, durability, and safety. Material, equipment, or components shall be designed and installed in accordance with the manufacturer's installation instructions.

302.4.1 Permit Application. The registered design professional shall indicate on the design documents that the system, or parts thereof, is an alternative engineered design so that it is noted on the construction permit application. The permit and permanent permit records shall indicate that an alternative engineered design was part of the approved installation.

302.4.2 Technical Data. The registered design professional shall submit sufficient technical data to substantiate the proposed alternative engineered design and to prove that the performance meets the intent of this code.

302.4.3 Design Documents. The registered design professional shall provide two complete sets of signed and sealed design documents for the alternative engineered design for submittal to the Authority Having Jurisdiction. The design documents shall include floor plans of the work. Where appropriate, the design documents shall indicate location, sizing, and loading of appurtenances, equipment, appliances, and devices.

302.4.4 Design Approval. An approval of an alternative engineered design shall be at the discretion of the Authority Having Jurisdiction. The exercise of this discretionary approval by the Authority Having Jurisdiction shall have no effect beyond the jurisdictional boundaries of said Authority Having Jurisdiction. An alternative engineered design so approved shall not be considered as in accordance with the requirements, intent, or both of this code for a purpose other than that granted by the Authority Having Jurisdiction.

302.4.5 Design Review. The Authority Having Jurisdiction shall have the authority to require testing of the alternative engineered design in accordance with Section 302.2.1, including the authority to require an independent review of the design documents by a registered design professional selected by the Authority Having Jurisdiction and at the expense of the applicant.

302.4.6 Inspection and Testing. The alternative engineered design shall be tested and inspected in accordance with the submitted testing and inspection plan and the requirements of this code.

304.0 Accessibility for Service.

304.1 General. Appliances shall be located with respect to building construction and other equipment so as to permit access to the appliance. Sufficient clearance shall be maintained to permit cleaning of heating surfaces; the replacement of filters, blowers, motors, burners, controls, and vent connections; the lubrication of moving parts where necessary; the adjustment and cleaning of burners and pilots; and the proper functioning of explosion vents, where provided. For attic installation, the passageway and servicing area adjacent to the appliance shall be floored. [NFPA 54:9.2.1]

Unless otherwise specified, not less than 30 inches (762 mm) in depth, width, and height of working space shall be provided.

Exception: A platform shall not be required for unit heaters or room heaters.

304.2 Access to Equipment and Appliances on Roofs. Equipment and appliances located on roofs or other elevated locations shall be accessible. [NFPA 54:9.4.3.1]

304.2.1 Access. Buildings exceeding 15 feet (4572 mm) in height shall have an inside means of access to the roof, unless other means acceptable to the Authority Having Jurisdiction are used.

Exception: In Group R occupancies of less than 6 dwelling units and Group U occupancies.

304.2.2 Access Type. The inside means of access shall be a permanent, or foldaway inside stairway or ladder, terminating in an enclosure, scuttle, or trap door. Such scuttles or trap doors shall be not less than 22 inches by 24 inches (559 mm by 610 mm) in size, shall open easily and safely under all conditions, especially snow; and shall be constructed so as to permit access from the roof side unless deliberately locked on the inside.

Not less than 6 feet (1829 mm) of clearance shall be between the access opening and the edge of the roof or similar hazard, or rigidly fixed rails or guards not less than 42 inches (1067 mm) in height shall be provided on the exposed side. Where parapets or other building structures are utilized in lieu of guards or rails, they shall be not less than 42 inches (1067 mm) in height. [NFPA 54:9.4.3.3]

304.2.3 Permanent Ladders. Permanent ladders required by Section 304.2.2 shall be constructed in accordance with the following:

- (1) Side railings shall extend not less than 30 inches (762 mm) above the roof or parapet wall.
- (2) Landings shall not exceed 18 feet (5486 mm) apart measured from the finished grade.
- (3) Width shall be not less than 14 inches (356 mm) on center.
- (4) Rungs spacing shall not exceed 12 inches (305 mm) on center and each rung shall be capable of supporting a 300 pound (136.1 kg) load.
- (5) Toe space shall be not less than 6 inches (152 mm).

303.0 Iron Pipe Size (IPS) Pipe.

303.1 General. Iron, steel, brass, and copper pipe shall be standard-weight iron pipe size (IPS) pipe.

304.2.4 Permanent Lighting. Permanent lighting shall be provided at the roof access. The switch for such lighting shall be located inside the building near the access means leading to the roof. [NFPA 54:9.4.3.4]

304.2.5 Sloped Roof. Where equipment or appliances that require service are installed on a roof having a slope of 4 units vertical in 12 units horizontal (33 percent slope) or more, a level platform of not less than 30 inches by 30 inches (762 mm by 762 mm) shall be provided at the service side of the equipment or appliance.

» **304.3 Appliances in Attics and Under-Floor Spaces.** An attic or under floor space in which an appliance is installed shall be accessible through an opening and passageway not less than the largest component of the appliance, and not less than 22 inches by 30 inches (559 mm by 762 mm).

» **304.3.1 Length of Passageway.** Where the height of the passageway is less than 6 feet (1829 mm), the distance from the passageway access to the appliance shall not exceed 20 feet (6096 mm) measured along the centerline of the passageway. [NFPA 54:9.5.1.1]

» **304.3.2 Width of Passageway.** The passageway shall be unobstructed and shall have solid flooring not less than 24 inches (610 mm) wide from the entrance opening to the appliance. [NFPA 54:9.5.1.2]

» **304.3.3 Work Platform.** A level working platform not less than 30 inches by 30 inches (762 mm by 762 mm) shall be provided in front of the service side of the appliance. [NFPA 54:9.5.2]

Exception: A working platform need not be provided where the furnace is capable of being serviced from the required access opening. The furnace service side shall not exceed 12 inches (305 mm) from the access opening.

» **304.3.4 Lighting and Convenience Outlet.** A permanent 120-volt receptacle outlet and a lighting fixture shall be installed near the appliance. The switch controlling the lighting fixture shall be located at the entrance to the passageway. [NFPA 54:9.5.3]

304.4 Equipment and Appliances on Roofs. Equipment and appliances on roofs shall be designed or enclosed so as to withstand climatic conditions in the area in which they are installed. Where enclosures are provided, each enclosure shall permit easy entry and movement, shall be of reasonable height, and shall have not less than a 30 inch (762 mm) clearance between the entire service access panel(s) of the equipment and appliance and the wall of the enclosure. [NFPA 54:9.4.1.1]

304.4.1 Load Capacity. Roofs on which equipment and appliances are to be installed shall be capable of supporting the additional load or shall be reinforced to support the additional load. [NFPA 54:9.4.1.2]

304.4.2 Fasteners. Access locks, screws, and bolts shall be of corrosion resistant material. [NFPA 54:9.4.1.3]

304.4.3 Installation of Equipment and Appliances on Roofs. Equipment and appliances shall be installed in accordance with the manufacturer's installation instructions. [NFPA 54:9.4.2.1]

304.4.4 Clearance. Equipment and appliances shall be installed on a well-drained surface of the roof. Not less than 6 feet (1829 mm) of clearance shall be between a part of the equipment or appliance and the edge of a roof or similar hazard, or rigidly fixed rails, guards, parapets, or other building structures not less than 42 inches (1067 mm) in height shall be provided on the exposed side. Clearance requirements shall not apply to solar equipment.

304.4.5 Electrical Power. Equipment and appliances requiring an external source of electrical power for its operation shall be provided with the following:

- (1) A readily accessible electrical disconnecting means within sight of the equipment and appliance that will completely de-energize the equipment and appliance.
- (2) A 120-VAC grounding-type receptacle outlet on the roof adjacent to the equipment and appliance. The receptacle outlet shall be on the supply side of the disconnect switch. [NFPA 54:9.4.2.3]

304.4.6 Platform or Walkway. Where water stands on the roof at the equipment, and appliance or in the passageways to the equipment and appliance, or where the roof is of a design having a water seal, an approved platform, walkway, or both shall be provided above the waterline. Such platforms or walkways shall be located adjacent to the equipment and appliance and control panels so that the equipment and appliance is capable of being safely serviced where water stands on the roof. [NFPA 54:9.4.2.4]

305.0 Installation.

305.1 Listed Appliances. Except as otherwise provided in this code, the installation of appliances regulated by this code shall be in accordance with the conditions of the listing. The appliance installer shall leave the manufacturer's installation and operating instructions attached to the appliance. Clearances of listed appliances from combustible materials shall be as specified in the listing or on the rating plate.

305.2 Dissimilar Metals. Except for necessary valves, where intermembering or mixing of dissimilar metals occur, the point of connection shall be confined to exposed or accessible locations. <<

The Authority Having Jurisdiction shall be permitted to require the use of an approved dielectric insulator on the piping connections of an open loop system.

305.3 Direction of Flow. Valves, pipes, and fittings shall be installed in correct relationship to the direction of flow. <<

305.4 Changes in Direction. Changes in direction shall be made by the approved use of fittings, except that changes in direction in copper tubing shall be made by brazing. <<

with bends provided that such bends are made with bending equipment that does not deform or create a loss in the cross-sectional area of the tubing.

»» **305.5 Improper Location.** Piping or equipment shall not be located as to interfere with the normal use thereof or with the normal operation and use of windows, doors, or other required facilities.

305.6 Insulation. Piping, tubing, and fittings shall be insulated where located in areas capable of reaching a surface temperature below the dew point of the surrounding air and located in spaces or areas where condensation is capable of creating a hazard for the building occupants or damage to the structure.

305.7 Drainage Pan. Where a water heater, boiler, or thermal storage tank is located in an attic, or in or on an attic-ceiling assembly, floor-ceiling assembly, or floor subfloor assembly where damage results from a leaking water heater, boiler, or tank, a watertight pan of corrosion-resistant materials shall be installed beneath the water heater, boiler, or tank, with not less than $\frac{3}{4}$ of an inch (20 mm) diameter drain to an approved location. Such pan shall be not less than $1\frac{1}{2}$ inches (38 mm) in depth.

305.8 Anchorage. Appliances and equipment designed to be fixed in position shall be securely fastened in place in accordance with the manufacturer's installation instructions. The supports shall be designed and constructed to sustain vertical and horizontal loads within the stress limitations specified in the building code.

»» **305.9 Structural Design Loads.** System components, including building components and attachments, shall be designed and constructed to withstand the following loads in accordance with the building code:

- (1) Dead loads
- (2) Live loads
- (3) Snow loads
- (4) Wind loads
- (5) Seismic loads
- (6) Flood loads
- (7) Expansion and contraction loads resulting from temperature changes

»» **305.10 Location.** Except as otherwise provided in this code, no system, or parts thereof shall be located in a lot other than the lot that is the site of the building, structure, or premises served by such facilities.

»» **305.11 Ownership.** No subdivision, sale, or transfer of ownership of existing property shall be made in such manner that the area, clearance, and access requirements of this code are decreased.

»» **306.0 Workmanship.**

»» **306.1 Engineering Practices.** Design, construction, and workmanship shall comply with accepted engineering practices and shall be of such character as to secure the results sought to be obtained by this code.

306.2 Concealing Imperfections. It is unlawful to conceal cracks, holes, or other imperfections in materials by welding, brazing, or soldering or by using therein or thereon a paint, wax, tar, solvent cement, or other leak-sealing or repair agent. <<

306.3 Burred Ends. Burred ends of pipe and tubing shall be reamed to the full bore of the pipe or tube, and chips shall be removed. <<

306.4 Installation Practices. A system shall be installed in a manner that is in accordance with this code, applicable standards, and the manufacturer's installation instructions. <<

306.4.1 On-Site. The installer shall leave the manufacturer's installation and operating instructions with the system owner. <<

307.0 Labeling.

307.1 Fuel-Burning Appliances. Fuel-burning heating appliances shall bear a permanent and legible factory applied nameplate on which shall appear:

- (1) The name or trademark of the manufacturer.
- (2) The approved fuel input rating of the appliance, expressed in Btu/h (kW).
- (3) The model number or equivalent.
- (4) The serial number.
- (5) Instructions for the lighting, operation, and shutdown of the appliance.
- (6) The type of fuel approved for use with the appliance.
- (7) The symbol of an approved agency certifying compliance of the equipment with recognized standards.
- (8) Required clearances from combustible surfaces on which or adjacent to which it is permitted to be mounted.

307.2 Electric Heating Appliances. Electric heating appliances shall bear a permanent and legible factory applied nameplate on which shall appear:

- (1) The name or trademark of the manufacturer.
- (2) The model number or equivalent.
- (3) The serial number.
- (4) The electrical rating in volts, amperes (or watts), and, for other than single phase, the number of phases.
- (5) The output rating in Btu/h (kW).
- (6) The electrical rating in volts, amperes, or watts of each field-replaceable electrical component.
- (7) The symbol of an approved agency certifying compliance of equipment with recognized standards.
- (8) Required clearances from combustible surfaces on which or adjacent to which it is permitted to be mounted.

An appliance shall be accompanied by clear and complete installation instructions, including required clearances from combustibles other than mounting or adjacent surfaces, and temperature rating of field-installed wiring connections exceeding 140°F (60°C).

307.3 Heat Pump and Electric Cooling Appliances. Heat pumps and electric cooling appliances shall bear a permanent and legible factory-applied nameplate on which shall appear:

- (1) The name or trademark of the manufacturer.
- (2) The model number or equivalent.
- (3) The serial number.
- (4) The amount and type of refrigerant.
- (5) The factory test pressures or pressures applied.
- (6) The electrical rating in volts, amperes, and, for other than single phase, the number of phases.
- (7) The output rating in Btu/h (kW).
- (8) The electrical rating in volts, amperes, or watts of each field replaceable electrical component.
- (9) The symbol of an approved agency certifying compliance of the equipment with recognized standards.
- (10) Required clearances from combustible surfaces on which or adjacent to which it is permitted to be mounted.

An appliance shall be accompanied by clear and complete installation instructions, including required clearances from combustible other than mounting or adjacent surfaces, and temperature rating of field-installed wiring connections exceeding 140°F (60°C).

307.4 Absorption Units. Absorption units shall bear a permanent and legible factory-applied nameplate on which shall appear:

- (1) The name or trademark of the manufacturer.
- (2) The model number or equivalent.
- (3) The serial number.
- (4) The amount and type of refrigerant.
- (5) Hourly rating in Btu/h (kW).
- (6) The type of fuel approved for use with the unit.
- (7) Cooling capacity Btu/h (kW).
- (8) Required clearances from combustible surfaces on which or adjacent to which it is permitted to be mounted.
- (9) The symbol of an approved agency certifying compliance of the equipment with recognized standards.

308.0 Condensate Wastes and Control.

308.1 Condensate Disposal. Condensate from air washers, air-cooling coils, condensing appliances, and the overflow from evaporative coolers and similar water supplied equipment or similar air-conditioning equipment shall be collected and discharged to an approved plumbing fixture or disposal area. Where discharged into the drainage system, equipment shall drain by means of an indirect waste pipe. The waste pipe shall have a slope of not less than $\frac{1}{8}$ inch per foot (10.4 mm/m) or 1 percent slope and shall be of approved corrosion-resistant material not smaller than the outlet size in accordance with Section 308.3 or Section 308.4 for air-cooling coils or condensing appliances, respectively. Condensate or wastewater shall not drain over a public way.

308.1.1 Condensate Pumps. Where approved by the Authority Having Jurisdiction, condensate pumps shall be installed in accordance with the manufacturer's installation instructions. Pump discharge shall rise vertically to a point where it is possible to connect to a gravity condensate drain and discharged to an approved

disposal point. Each condensing unit shall be provided with a separate sump and interlocked with the equipment to prevent the equipment from operating during a failure. Separate pumps shall be permitted to connect to a single gravity indirect waste where equipped with check valves and approved by the Authority Having Jurisdiction.

308.2 Condensate Control. Where an equipment or appliance is installed in a space where damage is capable of resulting from condensate overflow, other than damage to replaceable lay-in ceiling tiles, a drain line shall be provided and shall be drained in accordance with Section 308.1. An additional protection method for condensate overflow shall be provided in accordance with one of the following:

- (1) A water level detecting device that will shut off the equipment or appliance in the event the primary drain is blocked.
- (2) An additional watertight pan of corrosion-resistant material, with a separate drain line, installed beneath the cooling coil, unit, or appliance to catch the overflow condensate due to a clogged primary condensate drain.
- (3) An additional drain line at a level that is higher than the primary drain line connection of the drain pan.
- (4) An additional watertight pan of corrosion-resistant material with a water level detection device installed beneath the cooling coil, unit, or the appliance to catch the overflow condensate due to a clogged primary condensate drain and to shut off the equipment.

The additional pan or the additional drain line connection shall be provided with a drain pipe of not less than $\frac{3}{4}$ of an inch (20 mm) nominal pipe size, discharging at a point that is readily observed.

308.2.1 Protection of Appurtenances. Where insulation or appurtenances are installed where damage is capable of resulting from a condensate drain pan overflow, such installations shall occur above the rim of the drain pan with supports. Where the supports are in contact with the condensate waste, the supports shall be of approved corrosion-resistant material.

308.3 Condensate Waste Pipe Material and Sizing. Condensate waste pipes from air-cooling coils shall be sized in accordance with the equipment capacity as specified in Table 308.3. The material of the piping shall comply with the pressure and temperature rating of the appliance or equipment, and shall be approved for use with the liquid being discharged.

TABLE 308.3
MINIMUM CONDENSATE PIPE SIZE

EQUIPMENT CAPACITY IN TONS OF REFRIGERATION	MINIMUM CONDENSATE PIPE DIAMETER (inches)
Up to 20	$\frac{3}{4}$
21 – 40	1
41 – 90	1 $\frac{1}{4}$
91 – 125	1 $\frac{1}{2}$
126 – 250	2

For SI units: 1 ton of refrigeration = 3.52 kW, 1 lb. = 0.45 kg

The size of condensate waste pipes is for one unit or a combination of units, or as recommended by the manufacturer. The capacity of waste pipes assumes a $\frac{1}{8}$ inch per foot (10.4 mm/m) or 1 percent slope, with the pipe running three quarters full at the following pipe conditions:

Outside Air – 20%		Room Air – 80%	
DB	WB	DB	WB
90°F	73°F	75°F	62.5°F

For SI units: °C = (°F-32)/1.8

Condensate drain sizing for other slopes or other conditions shall be approved by the Authority Having Jurisdiction.

308.3.1 Cleanouts. Condensate drain lines shall be configured or provided with a cleanout to permit the clearing of blockages and for maintenance without requiring the drain line to be cut.

308.4 Appliance Condensate Drains. Condensate drain lines from individual condensing appliances shall be sized as required by the manufacturer's instructions. Condensate drain lines serving more than one appliance shall be approved by the Authority Having Jurisdiction prior to installation.

308.5 Point of Discharge. Air-conditioning condensate waste pipes shall connect indirectly, except where permitted in Section 308.6, to the drainage system through an air gap or air break to trapped and vented receptors, dry wells, leach pits, or the tailpiece of plumbing fixtures. A condensate drain shall be trapped in accordance with the appliance manufacturer's instructions or as approved.

308.6 Condensate Waste From Air-Conditioning Coils. Where the condensate waste from air conditioning coils discharges by direct connection to a lavatory tailpiece or to an approved accessible inlet on a bathtub overflow, the connection shall be located in the area controlled by the same person controlling the air-conditioned space.

308.7 Plastic Fittings. Female plastic threaded fittings shall be used with plastic male fittings and plastic male threads.

»» 309.0 Safety Requirements.

»» **309.1 Welding.** Welding shall be done by approved welders in accordance with nationally recognized standards. Such welding shall be subject to the approval of the Authority Having Jurisdiction.

»» **309.2 Spark or Flame.** Equipment that generates a glow, spark, or flame capable of igniting flammable vapors shall be permitted to be installed in a residential garage provided the pilots and burners, heating elements, motors, controllers, or switches are not less than 18 inches (457 mm) above the floor level unless listed as flammable vapor ignition resistant.

»» **309.3 Hazardous Heat-Transfer Mediums.** Heat-transfer mediums that are hazardous shall not be used, except where approved by the Authority Having Jurisdiction.

309.4 Discharge. The collector, collector manifold, and manifold relief valve shall not discharge directly or indirectly into the building or toward an open flame or other source of ignition. <<

310.0 Circulators.

310.1 General. Circulators shall be listed for their intended use based on the heat transfer medium. Circulators shall be installed to allow for service and maintenance. The manufacturer's installation instructions shall be followed for correct orientation and installation. <<

310.2 Mounting. The circulator shall be installed in such a way that strain from the piping is not transferred to the circulator housing. The circulator shall be permitted to be directly connected to the piping, provided the piping is supported on each side of the circulator. Where the installation of a circulator will cause strain on the piping, the circulator shall be installed on a mounting bracket or base plate. Where means for controlling vibration of a circulator is required, an approved means for support and restraint shall be provided. <<

310.3 Sizing. The selection and sizing of a circulator shall be based on the following:

- (1) Loop or system head pressure, feet of head (m)
- (2) Capacity, gallons per minute (L/s)
- (3) Maximum and minimum velocity, feet per second (m/s)
- (4) Maximum and minimum temperature, °F (°C)
- (5) Maximum working pressure, pounds-force per square inch (kPa)
- (6) Fluid type

310.4 Drainback Systems. For drainback solar thermal systems, a circulator without a check valve shall be installed.

310.5 Pumps Used in Parallel. A check valve shall be installed downstream of each circulator installed in parallel. Circulators with integral check valves shall be permitted.

310.6 Cavitation. Systems, which utilize circulators, shall be designed such that the pressure of the system is more than the vapor pressure of the liquid it conveys.

310.7 Materials. Circulating pumps shall be constructed of materials that are compatible with the heat transfer medium. <<

310.8 Operation. Over-temperature protection shall be provided for circulating pumps. The temperature set point of the pump shall comply with the manufacturer's instructions. The pumps shall automatically turn off when the system is not in operation. <<

311.0 Safety Devices.

311.1 General. Solar thermal system components containing pressurized fluids shall be protected against pressures exceeding the design limitations with a pressure relief valve. Hydronic or geothermal system components containing pressurized fluids shall be protected against pressures and temperatures exceeding design limitations with a pressure and temperature relief valve. Each section of the system in which <<