

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF HAWAII

----In the Matter of----

PUBLIC UTILITIES COMMISSION

Instituting a Proceeding to
Investigate the Issues and
Requirements of Adopting or
Establishing Standards for Solar
Water Heater Systems as Mandated
by Act 204, Session Laws of
Hawaii (2008).

DOCKET NO. 2008-0249

BIV. OF CONSUMER ADVOCACY
DEPT. OF COMMERCE AND
CONSUMER AFFAIRS
STATE OF HAWAII

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ORDER INITIATING INVESTIGATION TO ADOPT OR
ESTABLISH STANDARDS FOR SOLAR WATER HEATER SYSTEMS

PUBLIC UTILITIES
COMMISSION

2008 SEP 26 A 8:34

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_____)	

ORDER INITIATING INVESTIGATION TO ADOPT OR
ESTABLISH STANDARDS FOR SOLAR WATER HEATER SYSTEMS

By this Order, the commission initiates this investigation to examine the issues and requirements of adopting or establishing standards for solar water heater systems as mandated by Act 204, Session Laws of Hawaii (2008) ("Act 204"), Section 3. This investigation is initiated pursuant to Act 204, Hawaii Revised Statutes ("HRS") §§ 269-6 and 269-7, and Hawaii Administrative Rules ("HAR") § 6-61-71.

I.

Background

The stated purpose of Act 204 is "to increase the use of renewable energy to protect our environment, reduce pollution, make housing more affordable, and enhance Hawaii's local economy by:

- (1) Requiring the installation of solar water heater systems, comparable renewable energy systems, or demand gas water heaters in all new residential development projects constructed after January 1, 2010; and
- (2) Restricting the solar thermal energy system tax credit available for single-family residential properties to those properties for which building permits were issued prior to January 1, 2010."¹

Section 3 of Act 204 specifically directs the commission to "adopt or establish by rule, tariff, or order, standards for solar water heater systems to include, but not be limited to, specifications for the performance, materials, components, durability, longevity, proper sizing, installation, and quality to promote the objectives of [HRS] section 269-124."² The commission must act in compliance with Act 204, Section 3 by July 1, 2009, or as soon as reasonably practicable.

II.

Discussion

A.

Investigation

The commission is authorized to initiate this investigation pursuant to several statutes. First, the commission is granted broad regulatory authority in HRS § 269-7, which provides, in relevant part:

¹See Act 204, Section 1.

²Id. Section 3.

- (a) The public utilities commission and each commissioner shall have the power to examine into the condition of each public utility, the manner in which it is operated with reference to the safety or accommodation of the public, the safety, working hours, and wages of its employees, the fares and rates charged by it, . . . and all matters of every nature affecting the relations and transactions between it and the public or persons or corporations.

.

- (c) Any investigation may be made by the commission on its own motion, and shall be made when requested by the public utility to be investigated, or by any person upon a sworn written complaint to the commission, setting forth any prima facie cause of complaint.

Similarly, in HRS § 269-6, the commission is broadly vested with "general supervision . . . over all public utilities[.]"⁴

Finally, as discussed above, the commission is expressly authorized to "adopt or establish" standards for solar water heater systems under Section 3 of Act 204.

B.

Named Parties

Since all regulated electric utilities in Hawaii will be impacted by the outcome of this investigation, the commission will name HAWAIIAN ELECTRIC COMPANY, INC. ("HECO"), HAWAII ELECTRIC LIGHT COMPANY, INC. ("HELCO"), MAUI ELECTRIC COMPANY,

³HRS §§ 269-7(a) and (c) (emphases added).

⁴See also HAR § 6-61-71 (setting forth the commission's investigatory authority).

LIMITED ("MECO"),⁵ and KAUAI ISLAND UTILITY COOPERATIVE ("KIUC") as parties to this docket. The DEPARTMENT OF COMMERCE AND CONSUMER AFFAIRS, DIVISION OF CONSUMER ADVOCACY ("Consumer Advocate"), who is statutorily mandated to represent, protect, and advance the interests of all consumers of utility service and is an ex officio party to any proceeding before the commission, is also designated as a party to this docket.⁶

In addition, the commission will provide a copy of this order to the counties and representatives of the solar water heating and building industries, as the commission anticipates that some of these entities may want to intervene or participate in the instant proceeding. If these entities are interested in participating in this proceeding, they may file a motion to intervene or to participate without intervention in accordance with the requirements of HAR Chapter 6-61, Subchapter 4.

C.

Preliminary Issues

Upon preliminary review of existing standards for solar water heater systems, the commission has identified two distinct standards to utilize as possible models to fulfill the commission's mandate under Section 3 of Act 204. The Solar Rating and Certification Corporation ("SRCC"), which

⁵HECO, HELCO, and MECO hereafter collectively referred to as the "HECO Companies."

⁶See HRS § 269-51 and HAR § 6-61-62.

was first incorporated in 1980, appears to have established nationally recognized standards for solar water heating systems, SRCC Document OG-300 "Operating Guidelines and Minimum Standards for Certifying Solar Water Heating Systems", the June 2008 version of which is attached to this Order as PUC Exhibit I ("OG-300"). SRCC's OG-300 and its standards regarding solar collectors, OG-100, are purported to be utilized in numerous states including, but not limited to, Arizona, Georgia, California, Oregon, Nevada, and Wisconsin. Additionally, SRCC's OG-100 standard is currently utilized by the HECO Companies and KIUC.

Nevertheless, in Hawaii, the prevailing standard appears to be HECO's "Residential Solar Water Heating System Standards and Specifications", a copy of which and its accompanying addendums, tables, and diagrams is attached to this Order as PUC Exhibit II (collectively, the "RSWHS Standards").⁷ The commission understands that the HECO Companies and KIUC have had incentive programs to encourage use of solar water heaters for approximately 10 years, and that those who install such devices under the RSWHS Standards and requirements would be eligible for a rebate based upon each respective program.

Recognizing the above, the commission sets forth the following preliminary issues for consideration in this docket:

1. Between OG-300 and the RSWHS Standards, which is the more appropriate and

⁷During a September 16, 2008 phone conversation, a representative of KIUC indicated to commission staff that KIUC basically adopted the RSWHS Standards approximately 10 years ago and incorporated its various updates throughout the years.

reasonable standard for the commission to adopt or utilize as the basis to establish standards for solar water heater systems to comply with the requirements of Section 3, Act 204, and why?

- (a) If the response to issue no. 1 is OG-300, how should it be modified to address Hawaii specific requirements, if at all?
 - (b) If the response to issue no. 1 is the RSWHS Standards, how should it be modified, if at all? Are the RSWHS Standards too stringent?
- 2. Regardless of the above, what are the standards the commission should adopt or establish to comply with the requirements of Section 3, Act 204, and why?
 - 3. Once adopted or established, what is the most reasonable and feasible method of updating the standards for solar water heating systems in Hawaii?

These are preliminary issues for consideration. During the development of the procedural order for this proceeding, the parties (and intervenors and participants, if any) shall have the opportunity to restructure these preliminary issues, or suggest other issues for resolution in this proceeding for the commission's review and consideration.

D.

Procedural Matters

Any interested individual, entity, agency, or community or business organization may file a motion to intervene or participate without intervention in this docket in compliance with the commission's rules set forth in HAR Chapter 6-61, Subchapter 4.

The parties (and intervenors and participants, if any) shall develop a stipulated protective order if necessary, and a stipulated procedural order to govern the matters of this investigation for the commission's review and approval. If the parties (and intervenors and participants, if any) are not able to stipulate, each of them shall file proposed orders for the commission's consideration. Such orders should be filed within 20 days after passage of the intervention deadline; however, if any motions to intervene or participate without intervention are filed in this proceeding, the proposed or stipulated orders should be filed within 30 days after the commission issues its order(s) addressing the filed motions.⁸

Furthermore, the parties (and intervenors and participants, if any) should be mindful of the current statutory deadline that the commission "adopt or establish" the standards for solar water heater systems no later than July 1, 2009, when proposing a procedural order (stipulated or otherwise). Thus, the commission finds it appropriate and reasonable to

⁸The commission will not approve a stipulated procedural order that allows the parties to modify the procedural order by agreement of the parties without commission approval.

require any procedural order filed in this proceeding for the commission's review and approval to have the substantive record fully completed by May 1, 2009.

The commission expects all parties (and intervenors and participants, if any) to this proceeding to participate fully in the development of the necessary procedures and issues for the orderly conduct of this investigatory proceeding, consistent with all applicable State laws and commission rules and regulations.

III.

Orders

THE COMMISSION ORDERS:

1. An investigative proceeding is initiated to examine the issues and requirements of adopting or establishing standards for solar water heater systems as mandated by Section 3 of Act 204.

2. The commission, sua sponte, designates HECO, HELCO, MECO, KIUC, and the Consumer Advocate as parties to this investigative proceeding.


3. Any individual, entity, organization, or agency desiring to intervene as a party or to participate without intervention in this proceeding shall file a motion to intervene or participate without intervention not later than 20 days from the date of this Order. Motions to intervene or participate

without intervention must comply with all applicable rules of HAR Chapter 6-61, Rules of Practice and Procedure Before the Public Utilities Commission.


4. The parties (and intervenors and participants, if any) shall develop a stipulated protective order, if necessary, and a stipulated procedural order to govern the matters of this investigation for the commission's review and approval. If the parties (and intervenors and participants, if any) are not able to stipulate, each of them shall file proposed orders for the commission's consideration. Such orders shall be filed within 20 days after passage of the intervention deadline; however, if any motions to intervene or participate without intervention are filed in this proceeding, the proposed or stipulated orders shall be filed within 30 days after the commission issues its order(s) addressing the filed motions. Additionally, any proposed or stipulated procedural order shall adhere to the timeframe established in Section II.D of this Order.

DONE at Honolulu, Hawaii SEP 26 2008.

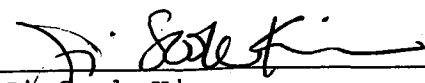
PUBLIC UTILITIES COMMISSION
OF THE STATE OF HAWAII

By 
Carlito P. Caliboso, Chairman

By 
John E. Cole, Commissioner

By 
Leslie H. Kondo, Commissioner

APPROVED AS TO FORM:


Ji Sook Kim
Commission Counsel

2008-0249.laa

PUC Exhibit I

SRCC DOCUMENT OG-300



OPERATING GUIDELINES AND MINIMUM STANDARDS FOR CERTIFYING SOLAR WATER HEATING SYSTEMS

June 2008

www.solar-rating.org

Solar Rating and Certification Corporation
c/o FSEC, 1679 Clearlake Road
Cocoa, Florida 32922-5703
(321) 638-1537 Fax (321) 638-1010

1.0 PURPOSE

The purpose of this optional solar water heating system certification and rating program is to ensure product safety, reliability and performance by giving suppliers the opportunity to submit their SWH system designs to an open-ended review in which standard practices and field experiences can be brought to suppliers' attention in order that they may produce the best possible products.

This document contains the methodology and requirements for certifying solar water heating systems based on review of a solar water heating (SWH) system's design and analytical evaluation of its components. This document also contains the methodology for rating the performance of SWH systems based on performance projections and test data of SRCC certified and rated solar collectors used in the systems.

2.0 SCOPE

This document applies to packaged domestic solar water heating systems for residential and small commercial buildings including conventional active systems, integral-collector-storage systems (ICS) and thermosyphon systems. For active systems, the solar collectors shall have been tested according to SRCC Standard 100, "Test Methods and Minimum Standards for Certifying Solar Collectors" and rated according to SRCC Document RM-1, "Methodology for Determining the Thermal Performance Ratings of Solar Collectors." For passive (ICS, self pumping, and thermosyphon systems), the solar system shall have been tested according to SRCC TM-1, "SDHW System and Component Test Protocols", or a similar test procedure approved by SRCC as specified in 6.1.2.1 of this document.

3.0 REQUIREMENTS

Certification and thermal performance ratings shall only be awarded to those solar system suppliers who explicitly follow the process established in this document. All components shall be installed in accordance with the manufacturer's instructions unless an alternate method of installation is approved by SRCC.

Installed certified solar energy systems shall comply with all codes in force at the installation site.

In order to be awarded certification, the design and analytical evaluation of components which comprise the SWH system, i.e., collectors, controls, sensors, fluids, heat exchangers, pumps, plumbing, piping and tanks, shall meet or exceed the minimum standards established in this document.

4.0 DEFINITIONS AND REFERENCES

4.1 Definitions

Accreditation - Formal evaluation and notification by the SRCC that a laboratory is qualified to perform the specific tests listed in the accreditation for the purpose of providing test data to support requests for solar equipment certification.

Accredited Laboratory - A laboratory possessing the SRCC accreditation.

Acidic/Caustic Fluids - A fluid is considered to be acidic if its pH is less than 6.7 and caustic if its pH is greater than 7.3.

Approved - Deemed acceptable in writing by authorized representative(s) of the SRCC.

Approved (component) - Evaluated on the basis of suppliers' data and application information and considered by SRCC to be suitable for use in solar energy systems. Tests are required for some components and limitations on suitable uses may be stated.

Auxiliary Heating Equipment - Equipment utilizing energy other than solar to supplement the output provided by the solar energy system.

Backflow - The reversal of the normal direction of fluid flow.

Closed Loop - Refers to systems in which the fluid in the solar loop circulates between the solar collector(s) and a heat exchanger and is not drained from the system, nor is it supplied to the load, during normal operation.

Controller - Any device which regulates the operation of the solar water heating system.

Design Life - The intended useful operation life of the system as defined by the Supplier.

Double Wall Heat Exchanger - A heat exchanger design in which a single failure of any fluid barrier will not cause a cross connection or permit back siphonage of heat transfer fluid into the potable water system. Any barrier which fails shall allow the discharge of exchanger fluid and/or potable water to the atmosphere at a location visible to the operator or owner.

Drain-Back - Refers to systems in which the fluid in the solar loop is drained from the collector into a holding tank under prescribed circumstances.

Drain-Down - Refers to systems in which the fluid in the solar collector is drained from the system under prescribed circumstances.

Drainage Slope - The designed downward slope of installed piping or other components toward drain points.

Equivalent - Those alternatives which have been officially approved by the SRCC.

Indoor Tank - A tank which is not directly exposed to weather conditions.

In-Service Conditions - The conditions to which a SWH system and its components will be exposed.

Licensee - A person or business which provides a product or service under legal agreement with another person or business.

Manual - The total documentation package to be provided by the supplier to the purchaser which describes the general operation and maintenance procedures of the system. The manual will include a parts list, a system diagram, a description of major components, and other features required by this document.

May - Action indicated is allowed.

No-Flow Condition - The condition obtained when the heat transfer fluid is not flowing through the collector array due to automatic shutdown or malfunction.

Nonpotable Water - Water containing impurities in amounts sufficient to cause disease or harmful physiological effects when taken internally by humans or domesticated animals.

Non-Toxic Fluids - Additives to the heat transfer medium which are listed on the Code of Federal Regulations, Title 21, Food and Drugs; Chapter 1, Food and Drug Administration; Part 182, Substances Generally Recognized as Safe; Part 184, Direct Food Substances Affirmed as Generally Recognized As Safe.

Owner - The person, group or organization who contracts to lease or buy the solar energy system.

Packaged - A standard system which is sold complete with collectors, tanks, pumps, controls, gauges, valves, etc., for the purpose of providing solar water heating.

Potable Water - Water free from impurities in amounts sufficient to cause disease or harmful physiological effects when taken internally by humans or domesticated animals.

Revoke - Certification withdrawn.

Seller - The solar equipment supplier or dealer who requests approval of components or a system.

Shall - The criterion is required to comply with the standard.

Should - Recommended, but not required.

Significant Deterioration - Deterioration that results either in the creation of a hazard or a debilitating decrease in performance as determined by the SRCC.

Solar Loop - The portion of the solar system which transports the heated gas or fluid to storage and back to the collector.

SRCC - The Solar Rating and Certification Corporation, Inc., the organization which is responsible for conducting the program, described herein, for certifying SWH systems.

Subsystem - A separable, functional assembly of components.

Supplemental Heating Equipment - Equipment utilizing energy other than solar to supplement the output provided by the solar energy system.

Supplier - An entity which assumes responsibility for the solar water heating system approved by the SRCC, according to the procedures described herein.

Suspend - Certification temporarily placed in inactive status pending further action as specified by the SRCC.

SWH - Solar water heating.

System (Also referred to as Solar Water Heating System, or SWH System or Solar Water Heater) - A unit or package of components designed to provide solar heated water to residential-type loads.

Toxic Fluids - Fluids which are poisonous or irritating in nature or composition.

Water Hammer - The hammering noises and severe shock that occurs in pressurized water supply systems when flow is halted abruptly.

4.2 References

The following documents are referenced in OG-300.

ANSI Z21.10.1-2004/CSA 4.1-2004 Gas Water Heaters Volume 1, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less

ANSI Z21.10.3-2004/CSA 4.3-2004 Gas Water Heaters - Volume III, Storage Water Heaters With Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous.

SRCC Standard 100, "Test Methods and Minimum Standards for Certifying Solar Collectors"

SRCC Document OG-100, "Operating Guidelines for Certifying Solar Collectors"

SRCC Document TM-1, "SDHW System and Component Test Protocols"

SRCC Document RM-1, "Methodology for Determining the Thermal Performance Ratings of Solar Collectors"

SRCC Document CS-1, "Operating Guidelines Governing Component Substitution in the SRCC Solar Collector and Solar Water Heating System Certification and Rating Programs"

SRCC Document PI-1, "Operating Guidelines Governing Product Inspections at Suppliers' Facilities in the SRCC Solar Collector and Solar Water Heating System Certification and Rating Programs"

HUD Minimum Property Standard 4930.2

ASME Boiler and Pressure Vessel Code, Division 1, Section VIII, "Rules for Construction of Pressure Vessels"

ASME Boiler and Pressure Vessel Code, Section X, "Fiber-Reinforced Plastic Pressure Vessels"

Code of Federal Regulations, Title 21, Food and Drugs, Chapter 1, Food and Drug Administration, Part 182, "Substances Generally Recognized as Safe;" Part 184, "Direct Food Substances Affirmed as Generally Recognized as Safe"

American Water Works Association, Cross Connection Control Manual

National Sanitation Foundation

Federal Hazardous Substances Act, Title 15

National Fire Protection Association (NFPA) No. 30, "Flammable and Combustible Liquid Code"

National Fire Protection Association (NFPA) No. 321, "Basic Classification of Flammable and Combustible Liquids"

National Roofing Contractors Association

U.S. Department of Energy test for water heaters (Federal Register volume 55 number 201 page 42161 – 42177, October 17, 1990)

GAMA Consumers' Directory of Certified Efficiency Ratings for Residential Heating and Water Heating Equipment, April 1994 (page 134)

National Electrical Code

TRNSYS: A Transient System Simulation Program, Solar Energy Laboratory, University of Wisconsin – Madison, Madison, WI, July 1994

5.0 CERTIFICATION GUIDELINES

5.1 Initiating the Process

The supplier shall initiate the system certification process by submitting a complete application for system certification using the forms provided by the SRCC.

5.2 Confidentiality

Any supplier who submits information to the SRCC may designate information to be kept confidential by making such a request in a plain and legible manner on the application. Certified performance ratings calculated in accordance with this document, however, may not be designated confidential, i.e., all ratings certified by SRCC shall be published.

5.3 System Identification

- A. Supplier's model name or number for the system.
- B. Collector name and model number, SRCC collector certification number, number of collectors used in the system, and collector or system performance rating, cumulative for all collectors in the system.
- C. Storage tank(s) name and model number, and volumetric capacity.
- D. Method of heat transfer to tank: direct or through a heat exchanger and model and type of heat exchanger where applicable.
- E. Pump(s) name and model number and rating where applicable.
- F. Controller name and model number, and operational type where applicable.
- G. System diagram showing components and their interconnection.

5.4 System Classification

A supplier may submit certification application(s) for basic, equivalent, or similar system(s) as given below.

5.4.1 Basic System

A system with a particular design including the plumbing arrangement and control scheme is a basic system.

5.4.2 Equivalent System

A system which has one or more components which differ from those of the basic system but which produces essentially the same performance rating is an equivalent system. Equivalent systems may include component options within the limitations in this section. However, the combination of components which results in the lowest rating will be used for determining the system's Solar Energy Factor.

- A. Collectors: Shall be in the same collector class as identified in the SRCC OG-100 Collector Program.
- B. Storage Tanks: Shall be of similar design and within $\pm 5\%$ of the same volumetric capacity.
- C. Circulating Pumps: Shall be of the same design principle, performance and durability.
- D. Controllers: Shall be of the same operational type, performance and durability.

5.4.3 Similar System

A system which has one or more components which differ from those in a basic system only in size is a similar system. There may be equivalent similar systems based on the same basic system, but the combination of components which results in the lowest rating will be used for determining the system's Solar Energy Factor.

5.5 Component Substitution

Substitution of components which were not approved as a part of either the originally certified basic system or its equivalent systems shall be submitted to SRCC to determine if the new system is eligible for certification as an equivalent system.

Certification may be reissued subject to review by the SRCC following the procedures contained in SRCC Document CS-1, "Operating Guidelines Governing Component Substitution in the SRCC Solar Collector and Solar Water Heating System Certification and Rating Programs". The analysis shall detail any and all changes and their effect on durability, safety and performance and shall clearly indicate that the new system is equal to or better in all respects than the system originally certified.

5.6 Systems Supplied by Licensees

A SWH system certified by SRCC that also is fabricated/assembled and sold by another supplier who is a licensee of the first (where fabrication/assembly entails activities which include packaging of the system), may be certified by SRCC upon (1) authorization from the original applicant to issue certification to the Licensee/Private Labeler, (2) execution by the Licensee/Private Labeler of a Solar Water Heating System Certification Program Agreement and Solar Water Heating System Certification and License, (3) submittal by the Licensee/Private Labeler of a complete system certification application, and (4) payment of requisite fees.

Private Labelers shall meet the same conditions and program requirements for certification as are required of other SRCC solar water heating system certification program participants.

5.7 Application Requirements

A complete listing and description of all components used in the system shall be included with the application on forms supplied by SRCC. Test reports, suppliers' specification sheets, and supplemental drawings and/or specifications shall be provided which accurately detail their construction and function and which document the systems compliance with these minimum standards. Compliance with industrial standards and/or listing by approved agencies shall be documented.

The following minimum information shall be supplied, where applicable, on the major components of the basic system and shall be part of the system certification file:

A. Solar Collector

1. Manufacturer's name and address.
2. Model number.
3. SRCC Solar Collector Certification License Number and a copy of the SRCC Solar Collector Certification Award. (For active systems, the collector component of the system shall be SRCC tested, rated, and certified in order for the system to be eligible for certification under this document.)
4. Certification of compliance with standards concerning ultraviolet stability for glazing, sealants, gaskets, and other materials exposed to ultraviolet radiation.

B. Controller

1. Manufacturer's name and address.
2. Model number.
3. Descriptive brochure including specifications and application information.
4. Reports on safety or other certification tests, if available.
5. Operating temperature differences and tolerances, and environmental temperature limitations.
6. Statement by the manufacturer or by an independent laboratory that the unit meets all applicable provisions of the National Electrical Code.
7. Recognized third party listing agency approval file number (where applicable).

C. Storage Tanks

1. Manufacturer's name and address.
2. Model number.
3. Descriptive brochure including specifications and application information.
4. Dimensions and construction of integral heat exchanger if one is used.
5. Recognized third party listing agency approved file number (where applicable).
6. R-Value rating of tank insulation

D. Pumps

1. Manufacturer's name and address.
2. Model number.
3. Descriptive brochure including specifications and application number.
4. Materials of pump body and impeller in contact with the pumped fluid.
5. Recognized third party listing agency approved file number and description of overload protection, such as by overcurrent or overtemperature device or by impedance of windings according to the National Electrical Code.
6. Maintenance requirements.
7. Limitations on fluids used.

E. Heat Exchanger

1. Manufacturer's name and address.
2. Model number.
3. Descriptive brochure including specifications and applications information.
4. Materials in contact with heat transfer fluids on both sides of the heat exchanger.
5. Heat Exchanger effectiveness from independent test laboratory when available.

F. Other Components

1. Manufacturer's name and address.
2. Model number.
3. Descriptive brochure.
4. Appropriate approvals from recognized third party listing agencies.
5. Performance information.

Separate application forms shall be submitted for separate water heating system designs.

5.8 Review of Application

The SRCC shall review the application submitted and give written notice to the supplier of certification or denial of certification.

SRCC shall review the components, assemblies and materials in the system for compatibility.

Major system components, the contents of the supplier's manual delivered with the system, and the supplier's instructions for system installation shall be approved by SRCC. Certification shall be awarded based upon the determination by SRCC that the system successfully meets the minimum design, reliability and durability, safety, operation and servicing, installation, and manual criteria contained herein.

If the SRCC determines that the applicant does not satisfy all the criteria for certification, the SRCC shall give the applicant written notice containing a statement of reasons for the denial. An applicant denied certification may file within thirty (30) days a written request for review with the SRCC. The SRCC shall appoint a review board which will consider the evidence on file. The SRCC shall, based upon the recommendation of the review board, affirm, modify or reverse the initial decision and shall inform the applicant of the review board's recommendations.

5.9 Labeling

The supplier of a certified solar system shall identify that system as certified by means of a label. Certification label specifications shall be provided by the SRCC upon approval of the application for certification. An approved certification label shall be permanently and conspicuously affixed to all production units of the certified solar system within sixty (60) days from receipt of notice of certification. In addition, the supplier shall be required to include a Certification Award as provided by SRCC with every certified solar system shipped, sold, or offered for sale and/or on display.

The SRCC registered certification trademark may be used in advertising, in catalogs and sales promotion material by the supplier of a certified system provided clear reference is made as to which system(s) certification applies.

5.10 Periodic Verification of SRCC Certification

Each SWH system model which has been granted SRCC certification and an SRCC thermal performance rating shall be recertified every five (5) years, for as long as that system is manufactured.

5.10.1 Verification of Supplier Compliance with Certification

Each SWH system which has been granted SRCC certification and an SRCC thermal performance rating shall be subject to periodic verification and review in accordance with SRCC Document PI-1, "Operating Guidelines Governing Product Inspections at Suppliers' Facilities in the SRCC Solar Collector and Solar Water Heating System Certification and Rating Programs."

5.10.2 Field Verification

System installations will be inspected in accordance with procedures established by SRCC. Systems found to be installed in non-compliance with the requirements of this document are liable to have their certification revoked by SRCC.

5.11 Suspending, Revoking, or Terminating Certification and/or Program Agreement

5.11.1 Supplier Initiated

The supplier of a certified SWH system may voluntarily terminate certification by giving written notification to the SRCC.

5.11.2 SRCC Initiated

The SRCC may revoke or suspend certification of a SWH system or may terminate the Program Agreement in the event of:

1. Misrepresentation of material fact in an application for certification.

2. Misrepresentation that a certification of a particular model applies to other models which have not been officially certified. This includes the use of components other than those listed with the original certification application.
3. Component changes not approved by the SRCC.
4. Claiming continued certification for a solar water heating system which, after certification, has been changed or modified without the written approval of the SRCC.
5. Failure to comply with a condition of certification or labeling.
6. Failure to meet the rectification criteria as stated in Section 5.10.
7. Failure to comply with the conditions and terms of the System Program Agreement and/or System Certification and License.
8. Failure to pay fees as established by the SRCC Board of Directors.

The SRCC shall determine if suspension or revocation of a previously granted certification or the termination of a participant's Program Agreement is warranted. If so, the SRCC shall give the program participant confidential written notice containing a statement of reasons for the proposed action and those steps, if any, available to the program participant to avoid the proposed action. Where applicable, specific instructions of steps which shall be taken to correct the cause(s) for revoking or suspending certification shall also be contained in the notice.

The program participant may contest the reason(s) for the proposed revocation, suspension or termination by filing with the SRCC a written request for review within thirty (30) days of receipt of the written notice. In the event of a request for review, the SRCC Board of Directors shall conduct an independent review of the evidence on file and the reasons for contention. The SRCC shall, based upon the recommendation of the review report, affirm, modify, or reverse the proposed revocation, suspension or termination and shall so inform the program participant of the review board's recommendations. If a written request for review is not received by SRCC within thirty (30) days of the program participant's receipt of the written notice, the proposed action of the SRCC shall become final and conclusive.

In the event of revocation, suspension or termination in accordance with the preceding paragraph, notice to such effect shall be made pursuant to Paragraph 5 of the Solar Water Heating System Certification Program Agreement. In the event of revocation, suspension, or termination, the right to the use of the Official Seal and SRCC ratings by the program participant shall, consistent with the action to be taken, cease and be concluded immediately. If the program participant fails to discontinue use of the Official Seal and all references to SRCC certification and/or ratings, SRCC shall have the right to an immediate temporary and/or permanent injunction restraining the system supplier from any and all further use of, or reference to, the Official Seal, certification and/or ratings.

6.0 CERTIFICATION CRITERIA

6.1 Design Criteria

6.1.1 Overall System Design Criteria

6.1.1.1 Operating Limits

Means shall be provided to protect the SWH system within the design limits of temperature and pressure.

6.1.1.2 Solar Loop Isolation

Isolation/bypass valves must be installed to allow the system owner to bypass the solar storage tank in the case of a two-tank system, or to shut off the cold water supply to the solar tank in a one-tank system. All isolation valves shall be labeled with their normal operating position indicated.

6.1.1.3 Thermal Expansion

The system design, components and subassemblies shall include adequate provisions for the thermal contraction and expansion of heat transfer fluids, thermal storage fluids and system components that will occur over the design temperature range.

6.1.1.4 Auxiliary Water Heating Equipment

A backup system shall be provided such that the combined system will provide the same degree of reliability and performance as a conventional system.

Auxiliary (nonsolar) water heating equipment shall be compatible with the solar system heat output, temperatures, flow rates and fluid types. Auxiliary equipment shall be listed and labeled by a recognized third party listing agency.

6.1.1.5 Back Thermosyphon Prevention

Means shall be provided to prevent undesired escape of thermal energy from storage through thermosyphoning action.

6.1.1.6 Fluid System Sizing

Pumps, piping, fans, ducts and other components shall be sized to carry the heat transfer fluid at design flow rates without significant operational impairment, erosion or corrosion. Consideration should be given to minimizing pressure drops and vibrations. The SRCC rating will be determined for 4.9 meter (16 ft.) head and 7.6 meter (25 ft.) pipe runs to and from the collector array.

6.1.1.7 Blank

6.1.1.8 Vacuum-Induced Pressure Protection

All components of the solar energy system shall be protected against the maximum vacuum which could occur within the system.

6.1.1.9 Thermal Shock Protection

The system shall be able to withstand any thermal shock caused by an electric power failure.

6.1.1.10 Different Metallic Materials

All metals used in the storage system which come into contact with the heat transfer fluid shall be in accordance with Tables S-515-2.3.2 or S-515-2.3.3 of HUD Minimum Property Standard 4930.2. Documentation shall be provided to demonstrate that material usages not covered in these tables meet the intent of S-515-1.4 and S-515-7.4

6.1.1.11 Airborne Pollutants

Solar components and materials that are exposed to airborne pollutants such as ozone, salt spray, SO₂ or NO_x shall not be adversely affected by these factors to the extent that their function will be significantly impaired during their design life.

6.1.1.12 Effects Of Decomposition Products

Chemical decomposition products that are expelled from solar components under in-service conditions shall not cause the degradation of solar components or building elements to the extent that would significantly impair their ability to perform their intended function over their design life.

6.1.2 Collector Design Criteria

6.1.2.1 Collectors

The collector component(s) shall be tested in accordance with either SRCC Standard 100, "Test Methods and Minimum Standards for Certifying Solar Collectors," SRCC TM-1, "SDHW System and Component Test Protocols," or a similar test procedure approved by SRCC provided that the alternate test procedure includes the durability tests specified in Section IV of SRCC Standard 100 and the collector component of the system meets the collector standards specified in Section VI of SRCC Standard 100.

6.1.2.2 Protection From Ultraviolet Radiation

Ultraviolet radiation shall not significantly alter the performance of any component or subcomponent of the system.

6.1.2.3 Blank

6.1.2.4 Collector Flow Rate/Distribution

In multiple collector arrays, the instantaneous flow rate variations between collectors shall not exceed 10% of the array average flow.

When an array of collectors is connected by manifolds to form a parallel flow configuration, provision shall be incorporated in the manifold and/or collectors to maintain the proper design flow rate of the heat transfer fluid through each collector.

6.1.2.5 Blank

6.1.2.6 Blank

6.1.2.7 Collector Circulation Control

The collector subsystem control shall be designed to be compatible with control requirements of the system.

6.1.3 Tank and Heat Exchanger Design Criteria

6.1.3.1 Tank Design Requirements

Both pressurized and non-pressurized tanks shall meet the requirements set by a nationally accepted standard setting organization.

Non-pressurized tanks shall be vented to atmospheric pressure.

Non-Fiberglass hot water storage tanks shall comply with ASME Boiler and Pressure Vessel Code, Division 1, Section VIII, "Rules for Construction of Pressure Vessels" unless they fall into one of the classes of vessels exempted in Part U-1(c).

Fiber-reinforced plastic pressure vessels shall comply with ASME Boiler and Pressure Vessel Code, Section X, "Fiber-Reinforced Plastic Pressure Vessels" unless they fall into one of the classes of vessels exempted in Part RG-121.

Gas water heaters shall comply with ANSI Z21.10.1-2004/CSA 4.1-2004 'Gas Water Heaters Volume 1, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less' or ANSI Z21.10.3-2004/CSA 4.3-2004 'Gas Water Heaters - Volume III, Storage Water Heaters With Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous'.

6.1.3.2 Tank Insulation

Except where required by system design or constrained by safety considerations tank insulation shall have a minimum of $R-2.1 \text{ }^{\circ}\text{K}\cdot\text{m}^2/\text{W}$ ($R-12 \text{ }^{\circ}\text{F}\cdot\text{ft}^2\cdot\text{hr}/\text{Btu}$). An exterior insulation blanket may be used to satisfy this requirement.

6.1.3.3 Waterproofing

Underground and above ground unsheltered storage tanks shall be waterproofed to prevent water seepage.

6.1.3.4 Expansion Tanks

Expansion tanks shall be sized in accordance with ASHRAE recommendations.

6.1.3.5 Blank

6.1.3.6 Heat Exchanger

When toxic fluids are used as the heat transfer medium, a double wall heat exchanger shall be used. The heat exchanger design shall be such that any failure of a barrier material shall allow the discharge of exchanger fluid and/or potable water to the atmosphere. The discharge location shall be visible to the operator or owner of the system and be located so that no hazards are created by such discharge.

A single wall heat exchanger may be used when in compliance with both of the following:

1. Heat transfer medium is taken from a potable water source or is distilled water suitable for domestic use. Any additives shall be listed in the Code of Federal Regulations, Title 21, Food and Drugs, Chapter 1, Food and Drug Administration, Part 182, "Substances Generally Recognized as Safe," Part 184, "Direct Food Substances Affirmed as Generally Recognized as Safe."
2. Operating pressure within the heat exchanger shall be less than the normal minimum operating pressure of the potable water system.

6.1.4 Blank

6.1.5 Pumps and Controls Design Criteria

6.1.5.1 Blank

6.1.5.2 Control System Override

The control subsystem shall include such provision for bypass, adjustment or override controls as are required to facilitate installation, startup, operation, shutdown and maintenance of the system. Safety controls shall not have provision for bypass or override. All switches and their function shall be labeled and easily accessible.

6.1.5.3 Wiring Identification

Control circuit wiring and terminals shall be identified in accordance with Chapter 2 of the National Electrical Code.

6.1.5.4 Temperature Rating

Wiring under insulation shall be rated for expected increased temperature conditions.

6.1.5.5 Control Lines and Sensors

All wires and connections, sensors, pneumatic lines, hydraulic lines or other means for transmitting sensor outputs to control devices shall be sufficiently protected from degradation or from introducing false signals as a result of environmental or system operating conditions.

6.1.5.6 Temperature Control

The system shall be equipped with a means for automatically limiting the temperature of the hot water at the fixtures to a selectable temperature. The range of selectability shall be at least 10°C (18°F) and shall include a set point of 50°C (122°F).

6.1.6 Plumbing and Piping Design Criteria

6.1.6.1 Protection From Foreign Substances

The entire heat transport system shall be protected to prevent contamination by foreign substances that could impair the flow and quality of the heat transfer fluid beyond acceptable limits.

6.1.6.2 Blank

6.1.6.3 Insulation

All interconnecting hot water piping and the final 1.5 meters (5.0 feet) of metallic cold water supply pipe leading to the system, or the length of piping which is accessible if less than 1.5 meters, shall be insulated with $R-0.46 \text{ }^{\circ}\text{K m}^2/\text{W}$ ($R-2.6 \text{ }^{\circ}\text{F-ft}^2\text{-hr /Btu}$) or greater insulation.

All exterior piping insulation shall be protected from ultraviolet radiation and moisture damage.

6.1.6.4 Blank

6.1.6.5 Water Shut-Off

The SWH system shall be valved to provide for shut-off from the service water supply without interrupting normal cold water service to the residence.

6.1.6.6 Service Connections

Suitable connections shall be provided at readily accessible locations for filling, draining and flushing liquid systems.

6.1.6.7 Filters

Filters, if included, shall be designed and located so that they can be cleaned or replaced with minimum disruption to the system and adjacent equipment.

6.1.6.8 Blank

6.1.6.9 Blank

6.1.6.10 Coupling Hoses

Coupling hoses shall be tested in accordance with the current version of ASTM D750, ASTM D471, and ASTM D1149.

6.1.6.11 Piping System

The piping system shall be provided with valves which can be closed for the purpose of isolating the solar hot water supply system from the auxiliary hot water heater, thereby permitting operation of the auxiliary hot water heater when the solar hot water system is inoperative or being serviced.

6.2 Reliability and Durability Criteria

6.2.1 Stagnation

The system shall be able to withstand prolonged periods of stagnation (high solar flux, no hot water demand) without significant system deterioration and with no maintenance. This includes conditions during loss of electric power to the system.

6.2.2 Solar Degradation

Components or materials shall not be affected by exposure to sunlight to an extent that will significantly deteriorate their function during their design life.

6.2.3 Operation Conditions

Collectors, tanks, pumps, valves, regulating orifices, pressure regulators, heat exchangers, piping, hoses and other components shall be capable of operating within design pressures and design temperature ranges and withstanding environmental extremes anticipated in actual service without significantly reducing system design life.

6.2.4 Incompatible Materials

Incompatible materials shall be isolated or treated to prevent degradation to the extent that their function could be significantly impaired under in-service conditions.

6.2.5 Freeze Protection

Protection from freeze damage under the most severe environmental conditions that can be expected in actual use shall be provided for all system components containing heat transfer liquids. The Supplier of each system shall specify the limit ("Freeze Tolerance Limit") to the system's tolerance of freezing weather conditions. Systems installed in a location which has no record of an ambient air temperature below 5°C (41°F) may be exempted from the requirements of this paragraph except the specification of a freeze tolerance limit.

For systems that rely on manual intervention for freeze protection, the Supplier shall specify the system's freeze tolerance limit based on exposure for 18 hours to a constant atmospheric temperature. SRCC will evaluate the system design to determine the reasonableness of the specified limit.

For solar systems where the collector fluid is water, a minimum of two freeze protection mechanisms shall be provided on each system. Manual intervention (draining, changing valve positions, etc.) is suitable as one mechanism. At least one freeze protection mechanism, in addition to manual intervention, shall be designed to protect components from freeze damage, even in the event of power failure. The thermal mass of a system can be considered to be a limited form of freeze protection.

A system in which components and/or piping are subject to damage by freezing shall have the proper fittings, pipe slope and collector design to allow for manual gravity draining and air filling of the affected components and piping. Pipe slope for gravity draining shall have a minimum 2 cm vertical drop for each meter of horizontal length (1/4 inch per foot). This also applies to any header pipes or absorber plate riser tubes internal to the collector.

At the time of installation, a conspicuously placed label explaining how the system is protected from freezing and what actions the homeowner should take shall be attached to the system. For systems which rely on manual intervention for freeze protection, this label shall indicate the minimum ambient temperature conditions (Freeze Tolerance Limit) below which owner action is recommended and the procedure to be followed.

6.2.6 Protection From Leaks

All potable water sections of a solar water heating system shall not leak when tested in accordance with the codes in force at the installation site. All non-potable sections of a solar water heating system shall be tested for leaks in accordance with the supplier's instructions.

6.2.7 Fluid Compatibility

Fluids in contact with SWH system materials shall not corrode or otherwise adversely affect system materials to the extent that their function will be significantly impaired during the design life.

6.2.8 Deterioration Of Fluids

Except when allowed by the system design, fluids shall not freeze, give rise to excessive precipitation or otherwise lose their homogeneity, boil or develop excessive vapor pressure, change absorptivity, or change pH, viscosity or thermal properties beyond design ranges when exposed to their maximum and minimum service temperatures and pressures during their design life.

6.2.9 Thermal Storage System

Materials comprising the thermal storage system shall not cause corrosive wear which would result in premature failure or degradation in performance greater than that specified within the system.

6.2.10 Buried Components

Solar components and materials that are intended to be buried in soils shall be protected from degradation under in-service conditions to insure that their function shall not be impaired.

6.2.11 Deterioration Protection

Gaskets, sealants, and coupling hoses shall not be adversely affected by contact with fluids or the environment to an extent that will significantly impair their ability to function (See 6.1.6.10).

6.2.12 Water Hammer

When a liquid is used as the transfer fluid and quick-closing valves are employed in the design, the piping system shall be able to control or withstand the effects of water hammer.

6.2.13 Sound And Vibration Control

Piping and associated fittings shall be designed to carry the heat transfer fluid at design flow rates without excessive noise or vibrations which could be annoying or induce mechanical stress levels high enough to cause damage.

Pumps and compressors, or other components involving moving parts, shall be balanced or mounted in such a manner that they do not induce excessive noise or vibration that could be annoying or cause damage.

6.3 Safety Criteria

6.3.1 Blank

6.3.2 Protection Of Electrical Components

Overload and overcurrent protection of electrically operated components shall be consistent with the maximum current rating of the device and with the provisions of Article 240, Chapter 2 of the National Electrical Code.

6.3.3 Blank

6.3.4 System Failure Prevention

The control subsystem shall be so designed that, in the event of a power failure or a failure of any of the system components, the temperatures or pressures developed in the SWH system shall not damage the system, or the building, or endanger its occupants.

6.3.5 High Temperature Control

Means shall be provided to limit tank temperatures to a value not to exceed the tank supplier's specified high temperature limit. The pressure/temperature relief valve shall not be used for this purpose under normal operating conditions.

6.3.6 Protection Against Auto-Ignition Of Combustibles

Combustible materials used in solar equipment shall not be exposed to elevated temperatures which could cause ignition.

6.3.7 Fluid Safety Labeling

Labels shall mark all drain and fill valves in the SWH system. Each label shall identify the fluid in that loop. The location of fluid handling instructions shall be referenced. The label shall list the heat exchanger type and heat transfer fluid class as defined by the American Water Works Association, Cross Connection Control Manual. The label shall include a warning that fluid may be discharged at high temperature and/or pressure. The label shall contain the following warning:

“No other fluid shall be used that would change the original classification of this system. Unauthorized alterations to this system could result in a hazardous health condition.”

6.3.8 Contamination Of Potable Water

Materials which come in direct contact with potable water shall not adversely affect the taste, odor or physical quality and appearance of the water and shall meet the standards of the National Sanitation Foundation.

6.3.9 Entrapped Air

Suitable means air or gas removal from all high points in the piping system and any other location where air is most likely to accumulate shall be provided. The method of removal shall be appropriate for the system type as follows:

- Automatic for open loop (direct) circulating systems using potable water as the heat transfer fluid,
- Manual or automatic for closed loop (indirect) systems,
- Not required for integral collector storage (ICS) and open loop thermosiphon systems.

6.3.10 Backflow

Means shall be provided to prevent backflow of non-potable fluids into the potable water system.

6.3.11 Blank

6.3.12 Toxicity

The use of toxic fluids shall comply with the Federal Hazardous Substances Act, Title 15, or its equivalent, and the requirements of the health authority having jurisdiction.

6.3.13 Combustible Liquids

The storage, piping and handling of combustible liquids shall conform to the requirements of the National Fire Protection Association (NFPA) No. 30, “Flammable and Combustible Liquid Code.”

6.3.14 Liquid Flash Point

The flash point of a heat transfer fluid shall exceed by 28°C (50°F), or more, the design maximum no-flow temperature to be reached by the fluid in the collector. The flash point shall be determined by the methods described in National Fire Protection Association (NFPA) No. 321, "Basic Classification of Flammable and Combustible Liquids." In systems using a gaseous heat transfer fluid; a flammable gas shall not be used.

6.3.15 Blank

6.3.16 Pressure Relief

Each portion of the system where excessive pressures can develop shall have a pressure relief device to ensure that no section can be valved off or otherwise isolated from a relief device. Automatic pressure relief devices shall be set to open at not more than maximum design pressure.

6.3.17 Heated Components

System subassemblies which are exposed to public traffic and are maintained at elevated temperatures shall either be insulated sufficiently to keep exposed surface temperatures below 60°C (140°F) during operation, or they shall be suitably isolated. Any other exposed areas that are maintained at hazardous temperatures shall be identified with appropriate warnings.

6.4 Operation and Servicing Criteria

6.4.1 Operating Indicators

The SWH systems shall include means for an observer to determine readily that the system is operating properly and providing solar heated water.

6.4.2 Blank

6.4.3 Tanks

Fiberglass reinforced tanks shall be used within the temperature limitations established by the tank supplier. Tanks shall be labeled to show the maximum operating pressure and temperature.

6.4.4 Waste Disposal

Systems utilizing a toxic heat transfer fluid or thermal storage fluid shall provide for the catchments and harmless removal of these fluids from vents where fluid may be automatically discharged.

6.4.5 Dirt Retention And Staining

Solar systems and collectors shall be accessible for periodic cleaning if conditions are such that self-cleaning by rain is not sufficient to keep the collectors operating efficiently.

6.4.6 Maintenance And Servicing

All individual components of the system which may require periodic examination, adjustment, service and/or maintenance shall be easily and safely accessible by the owner and in accordance with the codes in force at the installation site. Individual collectors in any array shall be replaceable or repairable without disturbing any other collector in the array.

6.4.7 Permanent Maintenance Accessories

Permanent maintenance accessories such as hose bibs and drains necessary for maintenance of the system shall be provided.

6.4.8 Blank

6.5 Installation Criteria

6.5.1 Firestopping

The SWH system components shall be assembled such that firestopping shall be possible at time of installation, if required by local codes and ordinances.

6.5.2 Auxiliary System

Interconnection of the auxiliary system to the solar energy system shall be made in a manner which will not result in excessive temperature or pressure in the auxiliary system or bypassing of safety devices of the auxiliary system.

6.5.3 Space Use

Solar components should not reduce or increase humidity, temperature or thermal radiation beyond acceptable levels or interfere with required headroom or air circulation space.

6.5.4 Accessibility

The location of the solar components should not impair accessibility needed to maintain the building or site.

6.5.5 Building Penetrations

Penetrations of the building through which piping or wiring is passed shall not reduce or impair the function of the enclosure. Penetrations through walls or other surfaces shall not allow intrusion by insects and/or vermin. Required roof penetrations shall be made in accordance with applicable codes and also by practices recommended by the National Roofing Contractors Association.

6.5.6 Water Damage

Collectors and support shall be installed in such a manner that water flowing off the collector surface will not damage the building or cause premature erosion of the roof. Water tanks located in or above the living space shall be installed on a drip pan with a drain line to a waste line or outside or have other means to safely remove any excess liquid.

6.5.7 Blank

6.5.8 Structural Supports

Neither wind loading (including uplift) nor the additional weight of filled collectors shall exceed the live or dead load ratings of the building, roof, roof anchorage, foundation or soil. Collector supports shall not impose undue stresses on the collectors. The design load shall be as specified by the codes in force at the installation site and shall include an additional load due to snow accumulation for applicable locations.

6.5.9 Expansion And Contraction Of Supports

Structural supports shall be selected and installed in such a manner that thermal expansion of the collector and piping will not cause damage to the collector structural frame or the building.

6.5.10 Penetration Of Structural Members

When penetrations are required in structural members to accompany passage of solar components, those modified structural members shall comply with local building codes.

6.5.11 Protection From Thermal Deterioration

Building materials adjacent to solar equipment shall not be exposed to elevated temperatures which could accelerate their deterioration. Many non-metal roofing materials will soften in the temperature range of 60 - 80°C (140-180°F) and begin to degrade above this temperature.

6.5.12 Tilt And Azimuth

The collector shall be installed on a mount capable of maintaining tilt and azimuth to design conditions.

6.5.13 Shading Of Collector

The location and orientation of the collector shall be such that it is not shaded by external obstructions or mutual shadowing more than the specified period allowed in the design.

6.5.14 Pipe And Component Supports

Hangers shall provide adequate support and correct pitch of pipes. Hangers or supports for insulated pipes or components shall be designed to avoid compressing or damaging the insulation material.

6.5.15 Pitch Or Angle Of Piping Installation

Piping should be sloped toward drain ports with a drainage slope of no less than 2 cm vertical drop for each meter of horizontal length (1/4 inch per foot).

6.5.16 Blank

6.5.17 Underground Piping

Underground piping subject to vehicular traffic shall be installed to withstand the additional loading applied by this traffic. The trenches and backfill shall be free of sharp objects in contact with the pipe.

6.5.18 Control Sensor Installation

Control sensors and the means for transmitting sensor outputs to control devices shall be protected from environmental influence such as wind, moisture, temperature or other factors which may alter their intended sensing function.

6.5.19 Penetrations Through Fire-Rated Assemblies

Penetrations through fire-rated assemblies etc. shall not reduce the building's fire resistance required by local codes, ordinances and applicable standards.

6.5.20 Emergency Egress And Access

The design and installation of systems shall not impair emergency movement of the building occupants.

6.5.21 Rain and Snow on Collector

The location, orientation, and position of the collector relative to nearby objects and surfaces shall be such that water run-off from the collector surface is not impeded nor is excessive build-up of snow on lower portions of the collector glazing permitted to occur.

6.6 Manual Criteria

6.6.1 Provision For Manuals

A manual or manuals shall be provided with each SWH system. The manual shall contain the name and address of the system supplier, the system model name or number and shall describe the operation of the system and its components and the procedures for installation, operation and maintenance.

Manuals shall be approved by the SRCC for content as described in Sections 6.6.2 to 6.6.7. This approval shall be indicated on the manuals as follows:

"The solar energy system described by this manual, when properly installed and maintained, meets the minimum standards established by the SRCC. This certification does not imply endorsement or warranty of this product by SRCC."

6.6.2 Installation Instructions

The manual(s) shall include an explanation of physical and functional requirements of the system and its components and the general procedures for their proper installation. The instructions shall describe the interconnection requirement of the various subsystems and components and their interface requirements with the building and the site. The instructions shall be available at the installation site or from normally accessible sources.

6.6.3 Operation Instructions

The manual shall clearly describe the operation of the SWH system, explaining the function of each subsystem and component. The manual shall include a system diagram showing the components and their relationships in the typical installed system. Major components shall be described in a separate section or by enclosed descriptive material furnished by the supplier of the components.

The manual shall describe procedures for system start-up, routine maintenance and special conditional operations such as drain-down. The manual shall specify fill weights, pressure ratings and temperature ratings for servicing and routine maintenance of the system. It shall also specify temperature, pressure and flow conditions expected at various access points to allow simple operational checks and troubleshooting. The manual shall include instructions for valving off different sections of the system in emergency situations and shall include instructions for leaving the system unattended and unused for long periods of time. The manual shall indicate the minimum ambient temperature above which the system is designed not to be damaged due to freezing (Freeze Tolerance Limit). The manual shall include the statement:

"Freeze tolerance limits are based upon an assumed set of environmental conditions."

If the freezing point of the fluid in an exposed part of the system is above the freeze tolerance limit specified for the system, the following statement shall be added to the one above:

“Extended periods of cold weather, including ambient air temperatures above the specified limit, may cause freezing in exposed parts of the system. It is the owner’s responsibility to protect the system in accordance with the Supplier’s instructions if the air temperature is anticipated to approach the specified freeze tolerance limit.”

6.6.4 Maintenance Plan

The manual shall include a comprehensive plan for maintaining the specified performance of the SWH system.

The plan shall include a schedule and description of procedures for ordinary and preventive maintenance including cleaning of collector exterior surfaces. The manual shall describe minor repairs and give the projections for equipment replacement.

6.6.5 Fluid Quality

The manual shall identify the fluid(s) used in the SWH system and state whether or not the fluid(s) are toxic or hazardous. Proper procedures for handling, safe disposal, and first aid shall be provided for hazardous fluids. A technical data sheet shall be provided for each non-water fluid used in the system.

Procedures shall be described for maintaining the heat transfer fluid’s chemical composition at levels adequate to prevent unacceptable deposits on the heat transfer surfaces, corrosion of the heat transfer surfaces or loss of freeze resistance.

6.6.6 Service And Replacement Parts

The manual shall include a parts list giving a sufficient description of each part for ordering a replacement. Parts, components and equipment required for service, repair or replacement shall be commercially available or available from the system or subsystem supplier. All options (make and model), allowed by the Participant holding the OG-300 certification, for the following components must be listed on the same page of both the installation and operation manuals: solar collector, solar storage tank, pump, controller, heat exchanger, and heat transfer fluid. The piping material(s) shall be listed. This page shall also include temperature, pressure, and/or flow conditions expected at system access points to allow simple operational checks. The manual shall include the name and address of at least one company in close geographic proximity to the purchaser that offers service on the system. An 800 telephone number maintained by the supplier that a consumer can call to get in contact with a local service agent will satisfy this requirement.

6.6.7 Hazards

The manual shall provide warning against health and safety hazards that could arise in the operation and maintenance of the system and shall fully describe the precautions that shall be taken to avoid these hazards. For collector(s) that are not grounded via the plumbing components, a warning label shall be affixed to the system and the manual should recommend lightning protection.

6.6.8 Warranty Coverage

The manual shall provide a full description of the warranty coverage on the system. In addition, the manual shall describe what actions the purchaser shall undertake to obtain warranty coverage.

6.7 Blank

7.0 PERFORMANCE RATING

7.1 Determination of Thermal Performance Rating

A thermal performance rating shall be based upon component tests completed in accordance with Section 6.1.2.1 of this document in conjunction with a computer program. The computer program shall be based on the TRNSYS computer code version 13.1 or later or an approved equivalent code. The test data will provide performance parameters for the solar collectors and any other components as deemed necessary. The computer program will use these performance parameters along with accepted engineering practices and the conditions presented in section 7.3 of this document to model the balance of the system and calculate the performance ratings.

The performance rating is presented as a Solar Energy Factor (SEF) defined as the energy delivered by the system divided by the electrical and/or gas energy put into the system:

$$SEF = Q_{DEL} / (Q_{AUX} + Q_{PAR})$$

Where:

Q_{DEL} = Daily energy delivered to the hot water load MJ (Btu).

Q_{AUX} = Daily amount of energy used by the auxiliary water heater or backup element, MJ(Btu).

Q_{PAR} = Daily amounts of energy used to power pumps, controllers, shutters, trackers, or any other item needed to operate the SWH system, MJ(Btu). Parasitic energy)

7.2 Blank

7.3 Rating Conditions

The following conditions shall be used for calculating the daily energy savings and the solar energy factor. These conditions are the same as those used in the U.S. Department of Energy test for water heaters (Federal Register volume 55 number 201 page 42161 - 42177, October 17, 1990) except for the following:

- a solar radiation profile has been added.
- an outdoor ambient air temperature profile has been added.
- the draw profile has been set to begin at 9:30 am solar time.
- the amount of energy to be drawn from the system was obtained from the GAMA Consumers' Directory of Certified Efficiency Ratings for Residential Heating and Water Heating Equipment, April 1994 (page 134). This amount of energy is drawn rather than the normalized volume draw specified in the DOE test.
- the performance of the systems is determined from a computer simulation as specified in Section 7.1 above rather than by the actual test specified by the DOE procedure.

Rating Conditions:

Environmental Temperature	19.7°C	(67.5°F)
Auxiliary Set Temperature	57.2°C	(135°F)
Water Mains Temperature	14.4°C	(58°F)
Draw Type	energy	
Number of Draws	6-one at the beginning of each hour starting at 9:30am	
Total Energy Draw	43.302 MJ	(41,045 Btu)
Approximate Volume Draw	243 l	(64.3 gal)
Draw Rate	0.189 l/s	(3.0 gpm)

The outdoor ambient temperature, solar radiation, and incident angle profiles are defined as follows:

Solar Time (hour)	Ambient Temperature		Solar Radiation		Incident Angle
	(°C)	(°F)	(W-hr/m ²)	(Btu/hr-ft ²)	
0 - 1	13	55.4	0	0	--
1 - 2	12	53.6	0	0	--
2 - 3	11	51.8	0	0	--
3 - 4	10	50.0	0	0	--
4 - 5	9	48.2	0	0	--
5 - 8	8	46.4	0	0	--
8 - 9	8	46.4	315	100	60
9 - 10	11	51.8	470	150	45
10 - 11	13	55.4	570	180	30
11 - 12	15	59.0	660	210	15
12 - 13	17	62.6	700	220	0
13 - 14	19	66.2	660	210	15
14 - 17	21	69.8	570	180	30
15 - 16	21	69.8	470	150	45
16 - 17	21	69.8	315	100	60
17 - 18	20	68.0	0	0	--
18 - 19	19	66.2	0	0	--
19 - 20	18	64.4	0	0	--
20 - 21	17	62.6	0	0	--
21 - 22	16	60.8	0	0	--
22 - 23	15	59.0	0	0	--
23 - 24	14	57.2	0	0	--

8.0 PROCEDURE FOR THE CHALLENGE OF EXISTING SRCC CERTIFICATION

This section addresses the function of the SRCC to ensure that products being produced and marketed conform to the SRCC requirements. In addition, it addresses the procedures for handling the challenges to SRCC certification of a product by an interested party or by the SRCC.

Under the provisions of this section, the SRCC, or its designated representative, may conduct periodic inspections of manufacturing facilities and/or field inspections of certified installed systems for the purpose of ascertaining if the certified product conforms to the product description on file with SRCC. (As used in this section, the phrase "product description" shall be understood to mean the description provided to SRCC by the Supplier for certification as it relates to all aspects of the material, specifications, parts design, and construction techniques of the product.) This action may be taken at the SRCC's request or as the result of a formal challenge by an interested third party.

If a site-inspection initiated either by the SRCC or the challenge by an interested third party documents a change in product description not previously approved by SRCC, the SRCC representative will be given access to the Suppliers premises to permit the inspection of any current production unit or units designated by SRCC.

NOTE: Additional details on site inspections and program enforcement require further development by the Standards Committee.

9.0 AGREEMENT FOR CERTIFYING AND LABELING SWH SYSTEMS

An agreement (known as the Solar Water Heating System Certification Program Agreement and Solar Water Heating System Certification and License) between the Solar Rating and Certification Corporation and a supplier is required for certification of a solar water heating system meeting the requirements of SRCC Document OG-300, "Operating Guidelines and Minimum Standards for Certifying Solar Water Heating Systems". The System Certification Program Agreement shall be renewed annually in order to continue participation in the program. The Certification and License shall be executed with each grant of system model certification and rating. These agreements are governed by the SRCC Board of Directors and shall accompany this document as a separate addendum.

10.0 SOLAR WATER HEATING SYSTEM CERTIFICATION PROGRAM FEES

The costs of participating in the SRCC Solar Water Heating System Certification and Rating Program are governed by the SRCC Board of Directors and shall accompany this document as a separate addendum.

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PUC Exhibit II

EXHIBIT A

Residential Solar Water Heating System Standards and Specifications

- 1) Solar System Standards and Specifications (09/19/07) with Addendums 1-3
- 2) Figures 1-3. Forced Circulation System Design (07/12/99)
- 3) Form1. System Sizing Verification (01/06)
- 4) Chart 1. Orientation Factors for Solar Installations (01/23/96)
- 5) Tables 1-5. Residential Solar Water Heating System (09/12/06)
- 6) Table 6. Flat Plate Solar Collector BTU/Day Output (03/09/07)
- 7) Table 7. Minimum Thermosiphon System Tank Supports, Support Anchoring Fasteners and Tank Mounting Brackets (06/01/99)
- 8) Accepted Products List (08/07) HEWH RNC & REWH Accepted Product List (06/07 Update)



Hawaiian Electric Co., Inc.

PO Box 2750

Honolulu, HI 96840-0001

July 17, 2003
[fn:SSA07173]

TO: All Participating Contractors and Product Suppliers

FROM: Ron Richmond, REWH Program Technical Advisor

SUBJECT: **Addendum No. 1 to the HECO Solar Standards and Specifications dated September 21, 2002**

Effective July 17, 2003 the **HECO** Residential Solar Water Heating System Standards and Specifications dated September 21, 2002 are amended as follows.

Part I – GENERAL

1.06.1. Water Storage. The minimum water storage for the combined capacity of the primary and any additional tanks in retrofit systems and owner builder new construction shall be ~~number of residents~~ equal to or greater than the required storage as determined on Form 1 but not less than the Minimum Storage listed in Table 1. The minimum water storage for the combined capacity of the primary and any additional tanks in systems for new construction, rental, and military family housing units shall be based on the number of bedrooms as listed in Table 1.

Lined through language signifies deleted language. Underlined language signifies new language.

Please note that separate approvals are required by the HELCO and MECO Programs.



Hawaiian Electric Co., Inc.

PO Box 2750

Honolulu, HI 96840-0001

February 27, 2004

[fn:SSA02274]

TO: All Participating Contractors and Product Suppliers

FROM: Ron Richmond, REWH Program Technical Advisor

SUBJECT: Addendum No. 2 to the HECO Solar Standards and Specifications dated September 21, 2002

Effective February 27, 2004 the HECO Residential Solar Water Heating System Standards and Specifications dated September 21, 2002 are amended as follows.

Part II – PRODUCTS

2.01. All products shall be accepted for use in the Program by the Company prior to system installation. Specific product catalog data; equipment test data/approval, where applicable; local Building Department approval, where applicable; manufacturer's written installation instructions; and detailed manufacturer's written product warranty statements shall be submitted only by Participating Contractors or local product suppliers to Company for product acceptance consideration. Accepted products shall be listed on an Accepted Products List. The acceptance, rejection, or de-listing of any product from the Accepted Products List shall be within the sole discretion of the Company.

Underlined language signifies new language.

Please note that separate approvals are required by the HELCO and MECO Programs.

ENERGY SOLUTIONS™

FOR THE HOME

December 2, 2004
[Ven12024b]

TO: All HECO Participating Contractors and Product Suppliers

FROM: Ron Richmond (543-4784)

SUBJECT: Addendum No. 3 to the HECO Accepted Solar Standards and Specifications dated September 21, 2002

Effective immediately, Section 2.16.1 of the HECO Residential Solar Water Heating System Standards and Specifications dated September 21, 2002 is replaced in its entirety with the following language.

2.16.1. Ball Valves. Ball valves shall be provided to isolate major system components such as tanks, collectors and circulating pumps. Factory supplied pump isolation flanges *listed on the Accepted Products List* are acceptable to isolate the pump in lieu of ball valves. *A ball valve or pump isolation flange is not required between the tank and pump as long as the pump remains above the top of the tank.*

(Note: New language is in bold, italics print.)

Please place this addendum in front of your master HECO Standards and Specifications document file and be sure to notify your entire staff of the change.

These changes are independent of the HELCO and MECO programs.

Ron Richmond



Hawaiian Electric Company, Inc.

P.O. Box 3920 • Honolulu, Hawaii 96812-3920

Telephone (808) 537-5577

RESIDENTIAL SOLAR WATER HEATING SYSTEM STANDARDS AND SPECIFICATIONS

September 19, 2007
(supercedes prior versions)

PART I - GENERAL

1.01. PROGRAM CONTRACT. The terms and conditions of the Customer Efficiency Program Contract, in their entirety, are hereby incorporated into these Program Standards and Specifications.

1.02. OTHER DOCUMENTS. Program figures, forms, tables, charts, approvals, Accepted Products List, and Policies and Procedures referred to herein are hereby incorporated into these Program Standards and Specifications.

1.03. SYSTEMS. Solar systems installed under the Company Customer Efficiency Residential Efficient Water Heating Program shall conform to applicable local building, plumbing and electrical codes, these Standards and Specifications, and other program requirements described in this document and shall be approved by Company prior to system installation. Where discrepancies, if any, exist between local codes and these Standards and Specifications, local codes shall govern.

1.04. SYSTEM DESIGN. Systems shall be designed specifically for residential water heating. Systems shall be of forced circulation or thermosiphon design which contain potable water. Systems may consist of single or multiple tanks and/or collectors. Multiple tank systems shall have the tanks connected in series. Multiple collector systems shall have the collectors connected in parallel. Single and multiple collectors shall be plumbed in a reverse return (i.e. opposite-end) method to achieve balanced flow through collectors. The solar return collector connection shall be at the highest point on each collector. Systems shall be designed to prevent back-siphoning. Acceptable system designs for forced circulation systems are bottom-return, side-return and top-return. Side-return and top-return system designs shall incorporate check valves and heat loops. Multiple tank bottom-return system designs shall incorporate swing check valves. Forced circulation system component sequence shall conform to Figure 1 for bottom-return systems; to Figure 2 for side-return systems; to Figure 3 for top-return systems; or as approved by Company prior to installation. Thermosiphon system designs shall conform to the manufacturer's recommendations. System mounting method shall conformed to the mounting method as approved by Company prior to system installation. Systems installed in areas which experience freezing conditions shall incorporate appropriate freeze protection measures.

1.05. SYSTEM PERFORMANCE. Systems shall be designed to provide a minimum of 90% of the annual average water heating load, except as provided for in Section 1.06.4 of these Standards and Specifications; to provide consistency of performance over the life of the system; and to achieve a minimum 15 year useful life.

1.06. SYSTEM SIZING. Systems shall be sized to yield an acceptable solar fraction. Solar fraction, expressed as a percentage, is the contribution by the solar system to the average daily water heating requirements. Solar fraction is a function of the actual system hot water storage, design finish tank temperature, daily BTU requirement to achieve design finish tank temperature, and daily collector output as determined by collector tilt, orientation and sunshine zone.

1.06.1. Water Storage. The minimum water storage for the combined capacity of the primary and any additional tanks in retrofit systems and owner builder new construction shall be number of residents as determined on Form 1 but not less than the Minimum Storage listed in Table 1. The minimum water storage for the combined capacity of the primary and any additional tanks in systems for new construction, rental, and military family housing units shall be based on the number of bedrooms as listed in Table 1.

1.06.2. Tank Temperature. Tank temperature rise for system sizing shall be 55 degrees F. to a finish tank temperature of 130 degrees F.

1.06.3. Daily BTU Requirement. The daily BTU requirement shall be determined by multiplying the total actual system storage in gallons as determined in Form 1 by 8.33 lbs. per gallon and by 55 BTU per pound for a 55 degrees F. temperature rise. Table 2 lists the daily BTU requirements for common nominal size residential heaters and storage tanks.

1.06.4. Solar Fraction. The system design solar fraction shall be not less than 90% and not more than 110% of the total actual system storage BTU requirement. The solar fraction shall be determined by dividing the total adjusted collector BTU output per day by the total actual system storage BTU requirement per day as provided on Form 1. In sizing retrofit systems based on the number of residents, when the required storage equals the actual storage as determined on Form 1, the design solar fraction shall be not less than 95% and not more than 110% of the total actual system storage BTU requirement.

1.07. COLLECTOR TILT. Collectors shall be tilted not less than 14 degrees or more than 60 degrees from the horizontal. Forced circulation system collectors mounted on roofs whose pitch is less than 14 degrees shall be tilted to no less than 20 degrees and no more than 30 degrees. Thermosiphon system collectors mounted on roofs whose pitch is less than 14 degrees shall be tilted to no less than 20 degrees and no more than 30 degrees. Collectors mounted on roofs whose tilt is above 35 degrees shall have their output rating derated by percentages listed in Table 3. Collector tilt factors shall be determined by rounding collector tilt to the nearest 5 degrees.

1.08. COLLECTOR ORIENTATION. Collectors shall be oriented between South of due East and South of due West. Collectors oriented East of 135 degrees true or West of 225 degrees true shall have their output rating derated by the percentages shown on Chart 1. Orientation Factors for Solar Installations (Compass Rose Diagram). Chart 1 shows allowable collector orientations and orientation factors corrected for magnetic deviation.

1.09. COLLECTOR SHADING. Collectors shall not be shaded by any permanent obstacle at any portion of the time after 9:00 a.m. or before 3:00 p.m. on December 21 or any other day of the year, except by prior Company approval.

PART II - PRODUCTS

2.01. GENERAL. All products shall be accepted for use in the Program by the Company prior to system installation. Specific product catalog data; equipment test data/approval, where applicable; local Building Department approval, where applicable; manufacturer's written installation instructions; and detailed manufacturer's written product warranty statements shall be submitted only by Participating Contractors or local product suppliers to Company for product acceptance consideration. Accepted products shall be listed on an Accepted Products List.

2.02. COLLECTOR RATINGS. Collectors shall be of the liquid type and shall have a current Solar Rating & Certification Corporation OG-100 rating and certification. OG-100 Category C data for clear day, mildly cloudy and cloudy days sky conditions shall be correlated to the Oahu Sunshine Map at 500, 400, and 300 cal. per sq. cm. per day and interpolated linearly at 450 and 350 cal. per sq. cm. per day. Table 6 lists accepted collectors and their output ratings for each sunshine zone. The sunshine zone closest to the collector installation site shall be used to determine collector output. Sites equidistant between two zones may be considered to be in either zone. Sites in the 300 zone shall be considered to be in a 350 zone for system sizing purposes.

2.03. COLLECTOR MATERIALS. For flat plate collectors, collector frame material shall be aluminum, stainless steel, copper or approved equal. Collector glazing shall be low-iron tempered solar glass. Collector waterways shall be of Type M minimum copper tube. Other collector materials are acceptable, subject to prior Company approval.

2.04 COLLECTOR/SYSTEM MOUNTING BRACKETS. Collector/system mounting brackets which secure the collector/system to the support structure or directly to the roof structural member shall be designed specifically for the equipment to be bracketed and shall be fabricated by an established manufacturer.

2.05. COLLECTOR/SYSTEM LEG SETS. Collector/system leg sets which secure the collector/system to the support structure or directly to the roof structural member shall be designed specifically for the equipment to be supported and shall be fabricated by an established manufacturer.

2.06. COLLECTOR/SYSTEM SUPPORT STRUCTURE. Collector/system support structure shall be of structurally sound material. The material shall be of non-corrosive metal channel or similar sections of approved material and finish which are compatible with the collector, collector mounting brackets, collector leg supports and leg set cross braces. Acceptable support structure materials are extruded aluminum solar strut, channel and double T, isolated galvanized steel and UV resistant plastic. Unless otherwise approved by Company prior to system installation, solar strut shall be 1 5/8" x 1 5/8" x 1/8" in size, channel and double T shall be 3" x 1" x 1/8" in size, and angle aluminum shall be 2" x 2" x 3/16" in size. Wood or wood products are not acceptable.

2.07. TANKS. Tanks shall be designed specifically as residential water heaters or water storage tanks. New tanks shall be warranted by the manufacturer for at least 5 years and shall be listed in the Company Accepted Products List or in the Company List of Accepted High-Efficiency Electric Water Heaters List. Where use of high-efficiency electric water heaters are not practical, the new tank shall be listed in the Gas Appliance Manufacturers Association Consumers' Directory of Certified Efficiency Ratings. Incorporation of existing water heaters and/or storage tanks into the solar system shall be accepted at the sole discretion of the Company. In single tank systems, the tank shall be equipped with an internal thermostat and heating element rated at not more than 4500 Watts. In single tank systems, the lower element, if any, shall be disabled at the upper element. In multiple tank systems, the tank which directly supplies the hot water load shall have an internal thermostat and heating element of an approved rating and the lower element, if any, shall not be disabled.

2.08. PUMP. Pumps shall be of a circulating type. The pump shall be designed to attain the manufacturer's recommended collector flow rate for the total number of system collectors and the total developed head of the solar lines. AC powered pumps shall be compatible with the pump controller. DC powered pumps shall be compatible with the photovoltaic module. Pump isoflanges are not acceptable in lieu of ball valves.

2.09. CONTROLLER. Controller shall automatically control the operation of the circulating pump so that optimum system performance is attained. The controller shall be compatible with the circulating pump. Controller sensors shall be thermistors, which conform to the manufacturer's specifications for the controller.

2.10. PHOTOVOLTAIC MODULE. Photovoltaic modules used to power DC pumps shall be compatible with the pump's performance rating and power requirements.

2.11. TIME SWITCHES. All systems shall have time switches, which control the operation of the auxiliary heating system. Acceptable time switches are electric, electronic and spring-loaded mechanical switches. Electric and electronic time switches shall have a manual override feature.

2.12. ELECTRICAL CONDUCTOR. Electrical conductors exposed to direct sunlight shall have sunlight resistant insulation. Conductors interconnecting the photovoltaic module and DC circulating pump shall not have more than a 3% voltage drop over the one way distance between the pump and module. Refer to Table 5 for conductor sizes based on one way distances.

2.13. PIPING. Piping shall be copper tubing Type M minimum. Solar supply and return pipe shall be sized to attain the manufacturer's recommended collector flow rate for the total number of system collectors and pump size. The pipe size for forced circulation systems with not over 120 sq. ft. of collector area and not over 120 feet total round trip distance shall be 1/2-inch minimum. The pipe size for forced circulation systems with collector area over 120 sq. ft. and/or over 120 feet total round trip distance shall be approved by Company prior to system installation. The pipe size for water heater/storage tank supply, distribution, multiple tank interconnections and overflow lines shall be 3/4-inch minimum. The hot and cold supply lines to a thermosiphon system shall have a pipe size of 3/4" minimum. Water heater flex connectors are not acceptable.

2.14. FITTINGS. Fittings shall be bronze, brass, or wrought copper approved for potable water distribution. Factory installed galvanized tank nipples are acceptable.

2.15. PIPE SUPPORTS, BLOCKS AND SPACERS. Pipe supports shall be copper, stainless steel or other approved material. Rooftop piping support blocks or spacers, when used, shall be 2" x 4" painted wolmanized wood blocks, UV resistant non-metallic spacers, solar strut or equal.

2.16. VALVES. Valves shall be bronze or brass.

2.16.1. Ball Valves. Ball valves shall be provided to isolate major system components such as tanks, collectors and circulating pumps. Factory supplied pump isolation flanges are acceptable to isolate the pump in lieu of ball valves.

2.16.2. Check Valves. Check valves shall be provided with side-return, top-return and multiple tank, bottom-return forced circulation systems or where back siphoning may occur. Check valves shall be of the swing check type.

2.16.3. Flush Out Valves. Flush out valves shall be provided to allow for storage tank and collector draining and periodic flushing. Acceptable valves are hose bibs and boiler drains.

2.16.4. Pressure Relief Valve. A pressure relief valve shall be provided at the collector(s). The pressure setting shall be non-adjustable and rated at 125 or 150 PSI. The valve lever shall be stainless steel and the valve pin shall be brass.

2.16.5. Temperature & Pressure Relief Valve. A temperature & pressure relief valve shall be provided for single or multiple pressurized water storage tank systems provided that the location complies with local code requirements. The temperature and pressure relief settings shall be non-adjustable and rated at 210 degrees F. and 150 PSI, respectfully.

2.17. UNIONS. Unions shall be bronze or brass. Unions shall be used to connect dissimilar piping materials. Dielectric unions connecting corrosion causing dissimilar metals are acceptable.

2.18. TEMPERATURE MEASURING DEVICE. A temperature-measuring device shall be provided to measure the temperature of the storage tank, which directly supplies the hot water load. Acceptable temperature measuring devices are temperature gauges and electronic temperature devices.

2.19 FASTENING HARDWARE. All fastening hardware, including, but not limited to, strut-nut sets, through-bolt sets, lag-bolt sets, and hanger-bolt sets, shall be stainless steel Series 300 minimum or other approved material.

2.19.1. Strut-Nut Sets. Strut-nut sets shall consist of one strut nut, bolt, and flat or lock washer each. The size, length and quantity of strut-nut sets shall be that recommended by the manufacturer or one strut-nut set per collector mounting bracket with a minimum bolt diameter and length of 5/16" by 3/4", whichever is greater.

2.19.2. Through-Bolt Sets. Through-bolt sets shall consist of one bolt, nut, flat or fender washer and lock washer each. The size, length and quantity of through-bolt sets shall be that recommended by the manufacturer or one through-bolt set per collector mounting bracket with a minimum bolt diameter and length of 5/16" by 3/4", whichever is greater.

2.19.3. Lag-Bolt Sets. Lag-bolt sets shall consist of one lag bolt and one flat or fender washer. Lag bolt diameter shall be that recommended by the manufacturer or 5/16" minimum, whichever is greater. Lag bolts shall be of sufficient length to penetrate a minimum of 1 3/4" into the roof structural member. The number of anchoring lag bolts shall be that recommended by the manufacturer or that listed in Table 4, whichever is greater, or as approved by Company prior to installation.

2.19.4. Hanger-Bolt Sets. Hanger-bolt sets shall consist of one hanger bolt, and lock washer each and two nuts and flat or fender washer each. Hanger bolt diameter shall be that recommended by the manufacturer or 3/8" minimum, whichever is greater. Hanger bolts shall be of sufficient length to penetrate a minimum of 1 3/4" into the roof structural member. The number of anchoring hanger bolts shall be that recommended by the manufacturer or that listed in Table 4, whichever is greater, or as approved by Company prior to installation.

2.20. INSULATION. Piping insulation shall be flexible and elastomeric with a minimum wall thickness of 1/2" and a minimum design temperature of 220 degrees F.

2.21. SOLDER. Solder shall be lead free.

2.22. FLASHING. Flashing, when used, shall be designed to positively seal roof penetrations resulting from the solar system installation. Acceptable flashing materials are lead, copper, aluminum or other approved material. Lead shall not be used where water supplying a catchment system contacts the flashing.

2.23. OTHER PRODUCTS. Neoprene, EPDM spacers or other approved material shall separate corrosion causing dissimilar metals. Minor component products not otherwise listed in these standards and specifications may be used provided that their use does not detract from overall system performance.

2.24. PRODUCT WARRANTIES. Manufacturer warranties shall apply to all products. Contractors and/or vendors who unilaterally extend manufacturer product warranties shall provide the Company with a copy of the warranty and shall provide the solar system purchaser with a written statement approved by the Company that the extension is not guaranteed by the Company.

2.25. ASBESTOS PROHIBITION. No materials containing asbestos shall be used in any product.

PART III - EXECUTION

3.01. GENERAL. Solar system installations shall result in fully operational systems. Solar systems shall be installed by licensed solar water heating contractors approved by Company. All required governmental permits shall be issued prior to system installation. Installations shall be in accordance with applicable governmental codes and Company's Residential Solar Water Heating Standards and Specifications or manufacturer's recommendations where they meet or exceed these Standards and Specifications. Systems shall be installed in a professional, workmanlike manner using Company accepted products.

3.02. COLLECTORS/SYSTEMS. Solar collectors/systems, mounting brackets, leg sets, support structure and support structure anchoring fasteners shall be attached to form a secure mechanical bond between adjoining components and the roof structural members.

3.02.1. Collectors/Systems. In multiple collector systems, collectors shall be installed with the same tilt and orientation or as approved by Company prior to system installation. Solar collectors/systems shall be mounted in a stand-off method with a minimum of 2 inches between the roof and the bottom edge of the collectors/system, except where the collectors are integrated into the roof.

3.02.2. Mounting Brackets. Mounting brackets shall secure flush mounted collectors directly to the collector support structure or the roof structural members. Unless otherwise provided by the collector manufacturer, a minimum of four brackets per collector shall secure each flush mounted collector. For mounting brackets which require penetration of the collector box, the number of fasteners attaching each bracket to the collector shall equal the number of holes in the bracket, unless otherwise provided by the collector manufacturer. Collector box penetrations by mounting bracket fasteners shall be positively sealed to prevent moisture infiltration. Brackets attached directly to roof structural members shall be secured with a minimum required diameter anchoring fastener. Brackets attached to support structures shall be secured with lock-nut sets on "solar strut" and with through-bolt sets on channel.

3.02.3. Mounting Flanges. Fastening of collectors with mounting flanges directly to the support structure through the mounting flange is acceptable provided that collector manufacturer documentation of the acceptability of this mounting method is submitted to the Company prior to installation. When collectors with mounting flanges are fastened directly to the support structure through the mounting flange, collectors shall be secured with strut-nut sets or

through-bolt sets. These bolt-sets shall be through-bolted to the support structure in accordance with the collector manufacturer's recommendations, or secured with a minimum of four bolt-sets of the size and length described for mounting brackets per collector, whichever is greater.

3.02.4. Leg Sets. Leg sets shall secure tilted collectors directly to the collector support structure or the roof structural members. The type, number, location and installation method of leg sets shall be in accordance with the collector manufacturer's recommendations. Unless otherwise provided by the collector manufacturer, each tilted collector shall be supported by a minimum of two leg sets. For leg set brackets which require penetration of the collector box, the number of fasteners attaching the collector leg sets to the collector shall equal the number of holes in the leg set bracket, unless otherwise provided by the collector manufacturer. Collector box penetrations by leg set bracket fasteners shall be positively sealed to prevent moisture infiltration. Leg sets shall be secured to the support structure with strut-nut sets on "solar strut" and with through-bolt sets on channel. Leg sets which are 4 feet or longer in length shall be cross-braced diagonally. Cross braces shall be through bolted to the leg sets.

3.02.5. Support Structure. Collector/system support structures shall be anchored by fasteners firmly secured to the roof structural members. Support structure runners, when used, shall be located no farther in than 24" from the shorter ends of the collector(s). Anchor fasteners along each runner shall be located no farther from the edge of outer most collector than one-half the collector width and no farther than 4 feet apart. Collector/ system support structures and anchoring fastener size and spacing for roof structural members greater than 4 feet apart shall be approved by Company prior to system installation. Collector/system support structure anchoring fasteners shall not be exposed on the interior side of roof structural members. Support structures installed parallel to the roof ridge shall provide sufficient clearance from the roof covering to allow for adequate water and debris shed.

3.03. TANKS. Water heaters and/or storage tanks shall be plumbed so that the attached equipment, cover plates and warning labels are visible and accessible. Attached equipment shall be defined as pump, controller, time switch, piping and any other components attached or connected to the tank. All pressurized tanks shall be equipped with a securely attached temperature and pressure relief valve. Piping connections to the tank shall be made with brass or bronze fittings. The tank combination temperature and pressure relief valve drain line shall be securely attached to the temperature and pressure relief valve and shall terminate no more than 2' nor less than 6" above the ground and pointing downward or as otherwise approved by Company. Adjustable auxiliary heating thermostats shall be set at 120 degrees F.

3.03.1. Ground Mounted Tanks. Vertical and horizontal ground mounted tanks shall be set level on concrete or other approved base extending not less than three (3) inches above the adjoining ground level. Cement bricks placed between the tank and the supporting base shall support tanks. Cement bricks shall be whole and of a nominal minimum size of 2" high, 3" wide and 7" long. A minimum of three bricks evenly spaced shall be used to support vertical tanks. Bricks are not required for tanks with non-metallic bottoms. Horizontal tanks shall be supported in accordance with the tank manufacturer's recommendations or as approved by Company prior to system installation. Acceptable leveling devices are manufactured plastic shims, or other approved material. In side-return, top-return single and multiple tank systems, the solar return line shall be plumbed with a heat loop which extends to within 12 inches of the bottom of the tank. Required swing check valves shall be installed horizontally on the solar return line at the bottom of the heat loop. In bottom-return multiple tank systems, the required swing check valve shall be installed horizontally at the solar return line connection to the tank drain port. Nipples replacing manufacturer supplied tank drain valve shall be of sufficient length to allow adequate access to tank sensor. All contractor installed flush out valves shall have thread caps with hose washer securely attached to the valve.

3.03.2. Roof Mounted Tanks. Roof mounted thermosiphon system tanks shall be supported by the number of tank supports, support fasteners and tank mounting brackets recommended by the manufacturer or those which correspond to the tank length ranges shown on Table 7 Minimum Thermosiphon System Tank Supports, Support Anchoring Fasteners and Tank Mounting Brackets, whichever is greater. The number of supports and fasteners are based on roof structural member spacing of 24" on center or less. The number of tank supports and support fasteners for roof structural members with spacing greater than 24" shall be approved by Company prior to system installation. The length of tank supports shall be not less than the tank diameter or width and shall conform to Section 2.06. Collector/System Support Structure of these Standards and Specifications. Each tank support shall be installed parallel to and directly over a roof structural member. Each tank support shall be securely attached to the roof structural member with a minimum of 2 anchoring fasteners per support, which shall be located no farther than 4" from the ends of each support. Tank mounting brackets shall be located on and secured to opposite sides of each tank support. Tank mounting brackets shall be secured to the tank supports with strut nut sets on "solar strut", with through-bolt sets on channel, and with lag bolt-sets on approved plastic lumber.

3.04. CONTROLLERS. Pump controllers shall be installed in accordance with manufacturer's recommendations. The top of the controller shall not be higher than 6 ft. 7 in. above the floor/ground level and shall not be located behind the tank. Controller sensors shall be attached at the hottest and coldest points in the solar piping loop by

stainless steel clamps. Collector sensors shall be attached no farther than 6" from the collector header connection to the solar return line. Tank sensors shall be attached no farther than 12" from the coldest point at the tank on the solar supply line. Attachment of the tank sensor to factory provided tank sensor stud is permitted. Controller sensor attachment shall form a positive mechanical bond between the sensor and the sensing point to optimize heat transfer to the sensor. The sensor shall be clamped on its flanged end. Clamping of sensors over the sensor "barrel" end is unacceptable. Sensors shall be connected to sensor wire with all plastic wire nuts. Wire nuts shall be sealed with silicon and wrapped with electrician's tape. Sensor wiring shall be secured in a workmanlike manner.

3.05. TIME SWITCHES. Time switches shall be installed in accordance with manufacturer's recommendations. The top of the time switch shall not be higher than 6 ft. 7 in. above the floor/ground level and shall not be located behind the tank. Time switches shall be set so that tank thermostats are not energized during the solar day (i.e. between 9:00 AM and 3:00 PM). Recommended automatic time switch settings are 4 PM "on", 5 PM "off". Multiple automatic time switch settings, exclusive of the solar day, are acceptable. At a minimum, electric time switches shall have at least one "off" tab securely affixed to the face of the timing mechanism and electronic time switches shall be programmed to turn off within 24 hours of being turned on. Time switch wiring shall be secured in a workmanlike manner.

3.06. PHOTOVOLTAIC MODULES. Photovoltaic modules shall be securely installed with approved support structure materials in the same tilt and orientation as the system collectors. Module location shall conform to Section 1.09 Collector Shading. Wire nuts used to interconnect module and pump shall be all plastic and shall be sealed with silicon and wrapped with electrician's tape.

3.07 PIPING, FITTINGS AND VALVES. Solder joints shall be sanded, fluxed and soldered with approved solder. Threaded fittings and valves shall be wrapped with Teflon or equal tape and/or joint sealant. Piping shall be plumb and level where practical. Vertical piping shall be supported at each story or at maximum intervals of 10 feet. Horizontal piping shall be supported at approximately 6-foot intervals. Pipe supports shall not penetrate piping insulation. Rooftop piping shall be raised off the roof by blocks or spacers. Blocks/spacers shall be placed at approximately 6-foot intervals on straight runs and not more than 2 feet of each side of an angular joint. Piping shall be attached to blocks/spacers with acceptable pipe supports. Blocks/spacers shall be adhered to the roof. Roof penetration shall not be made to attach blocks/spacers to the roof. Valves, including hose bibs and boiler drains, shall be installed in the sequence shown on the Company accepted system schematic.

3.08. PIPING INSULATION. Insulation shall be installed on all new hot water piping, including solar supply and return lines and on accessible existing hot and cold water supply pipe for a minimum of 6 feet leading to the system. Insulation is not required on

the cold water supply line to thermosiphon systems. The tank temperature & pressure relief overflow line and collector pressure relief overflow line, where present, shall be insulated to within the 12" of the end of exposed pipe. Insulation butt joints shall be sealed in accordance with manufacturer's recommendations. Packing of insulation butt joints in attics and within walls, in lieu of sealing, is acceptable. Abutment of valves, unions and tees with pipe insulation is acceptable. Insulation shall in no way restrict the operation of any valve. Collector headers and interconnections shall be insulated. Collector headers and interconnections insulation may be slit and ny-tied without sealing. The entire circumference of rooftop exposed insulation shall be UV protected. Acceptable UV protection is latex based paint or other approved product. UV protection of insulation on exterior vertical piping is acceptable.

3.09. ROOF/WALL/CEILING PENETRATIONS. Roof penetrations shall be detailed on system mounting detail drawings and shall be positively sealed in accordance with standard roofing practices. Flashing installed on metal roofs shall be compatible with the roofing material. Exterior/interior wall penetrations shall be made watertight. Ceiling penetrations shall be sealed.

3.10. TEMPERATURE MEASURING DEVICE. In forced circulation systems, the temperature-measuring device shall be installed at the hot water outlet port on the tank, which directly supplies the domestic hot water load. In thermosiphon systems, the temperature-measuring device shall be installed only on an accessible hot water supply after the storage tank and before any hot water fixture; the device shall not be required on inaccessible hot water supply lines.

3.11. OTHER PRODUCTS. Minor component products not otherwise listed in these standards and specifications shall be installed in a professional, workmanlike manner in accordance with manufacturer's recommendations.

3.12. SYSTEM WARRANTY. Contractors shall provide full labor warranty for one (1) year from the date of Company acceptance for each system installed. Contractors and/or vendors who unilaterally extend manufacturer product warranties shall provide the Company with a copy of the warranty and shall provide the solar system purchaser with a written statement approved by the Company that the extension is not guaranteed by the Company.

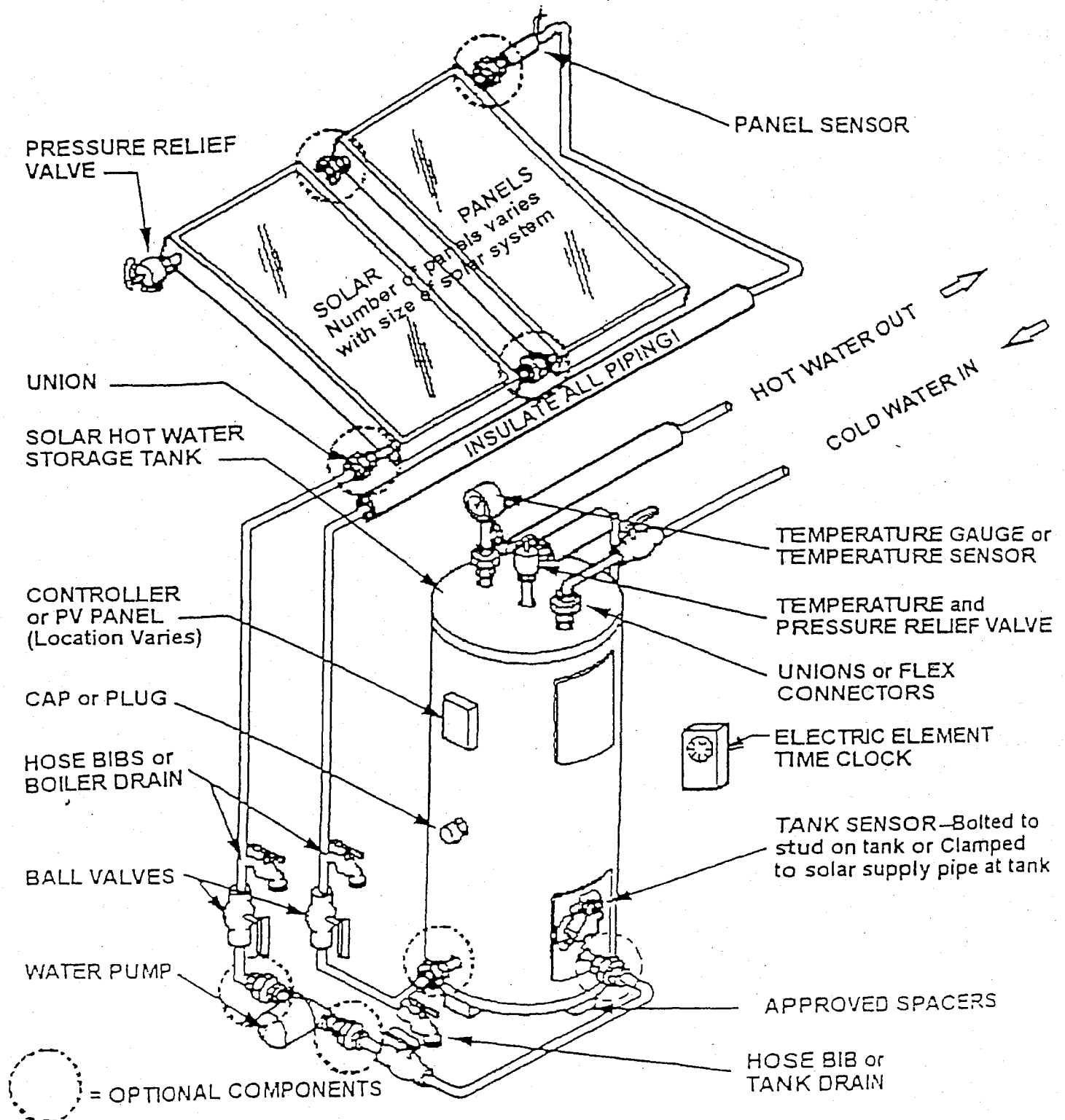


Hawaiian Electric Co., Inc.

PO Box 2750

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FIGURE 1.
BOTTOM-RETURN RESIDENTIAL FORCED CIRCULATION SYSTEM DESIGN



(Effective 7/12/99)

Reference: HECO Residential Solar Water Heating System
Standards and Specifications Section 1.04. System Design

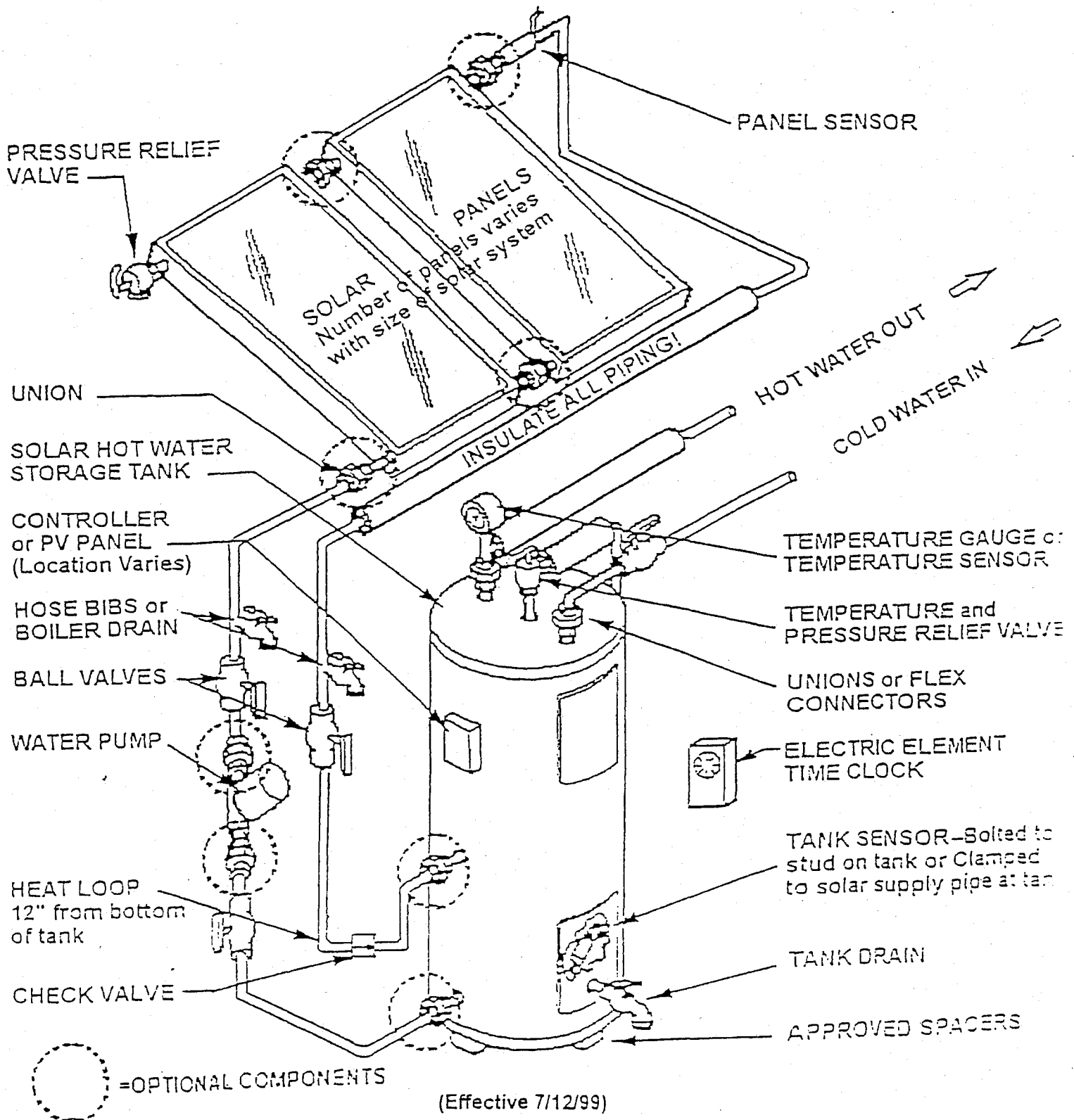


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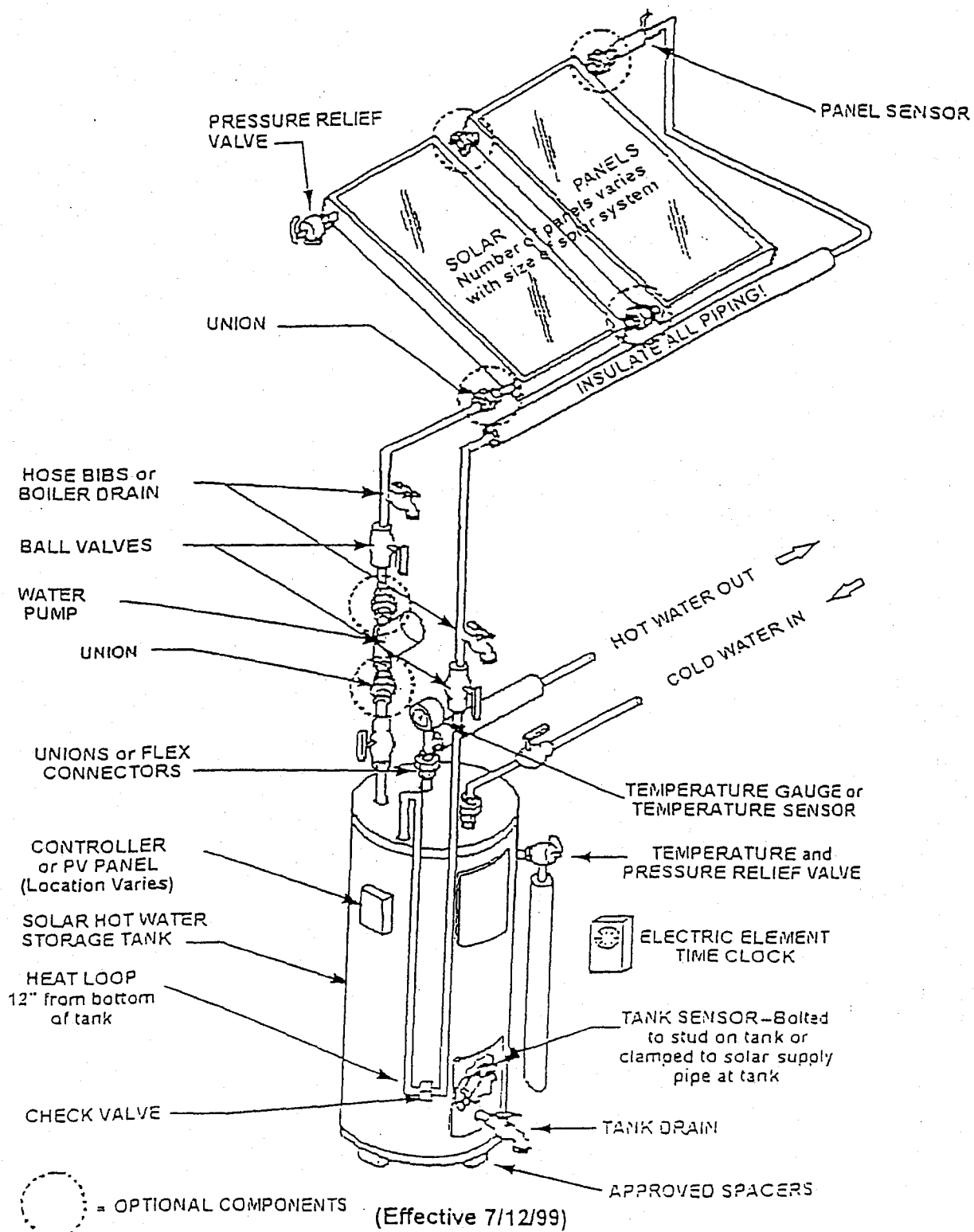
FIGURE 2.
SIDE-RETURN RESIDENTIAL FORCED CIRCULATION SYSTEM DESIGN



Reference: HECO Residential Solar Water Heating System
Standards and Specifications Section 1.04. System Design



FIGURE 3.
TOP-RETURN RESIDENTIAL FORCED CIRCULATION SYSTEM DESIGN



Reference: HECO Residential Solar Water Heating System Standards and Specifications Section 1.04. System Design

Form 1. Residential Solar System Sizing Verification

Customer _____ Contractor _____
 Authorization No(s) _____ Phone _____
 Subcontractor(s) Used ☐ Yes ☐ No Contact _____
 If yes, Name & License No. _____ Centralized Dual System ☐ Yes ☐ No
 Collector Access: One Story / Two Story / Other Tank Access: Locked / Unlocked

SYSTEM DATA

			Accepted	Denied
1	Installation Reason	Burnout / Retrofit / New Construction		
2	Previous Water Heater Type	Electric / Heat Pump / Solar / None		
3	System Type	Active / Passive		
4	Neighborhood / Community			
5	Sunshine Zone	300 350 400 450 500		
6	Collector Manufacturer			
7	Collector Model No.			
8	Collector Size	3' x 7' 3' x 8' 4' x 6' 4' x 8' 4' x 10'		
9	Absorber Coating	chrome / paint		
10	Collector Orientation	deg.		
11	Collector Orientation Factor	%		
12	Collector Mounting Method	flush / side tilt / end tilt		
13	Collector Tilt	deg.		
14	Collector Tilt Factor	%		
15	Actual Hot Water Storage	gal.		
16	Back-Up Heating Type	Electric / Gas / Heat Pump		
17	Pump Type	AC / DC / None		
18	System Solar Fraction	%		

HOT WATER STORAGE SIZING

	gal/day	Line
1. Hot Water Use (No. of Residents ____ x 20 gal./person/day) OR New Construction, Rental, Military (from Table 1) No. of Bedrooms ____	_____	1
2. Total No. of Additional Showers/Day (____ x 10 gal.)	_____	2
3. Tub Bath Hot Water Use (No. of Tub Baths Taken/Week ____ x 20 ÷ 7 days)	_____	3
4. Clothes Washing Hot or Warm Water Use (No. of Loads/Week ____ x 18 ÷ 7 days)	_____	4
5. Required Storage (add Lines 1, 2, 3, 4) or Table 1 minimum whichever is greater	_____	5
6. Actual System Storage (from Table 2)	_____	6
7. Tank #1	_____	7
8. Tank #2	_____	8
9. Tank #3	_____	9
10. Total Actual Sys. Storage/BTU's/Day (add Lines 7, 8, 9)	_____	10

COLLECTOR OUTPUT SIZING

11. Collector Rated BTU Output/Panel/Day/Sky Condition (from Table 6)	_____	11
12. Number of Collectors	_____	12
13. Total Collector BTU Output/Day (Multiply Lines 11 & 12)	_____	13
14. Off-Orientation BTU's Required/Day (Multiply Chart 1 Factor & Line 13)	_____	14
15. Off-Tilt BTU's Required/Day (Multiply Table 3 Factor & Line 13)	_____	15
16. Total Adjusted Collector BTU Output/Day (Subtract Lines 14 & 15 from Line 13)	_____	16

SOLAR FRACTION

17. Percent Solar Fraction (Divide Line 16 by Line 10 BTU/day value) _____ % 17

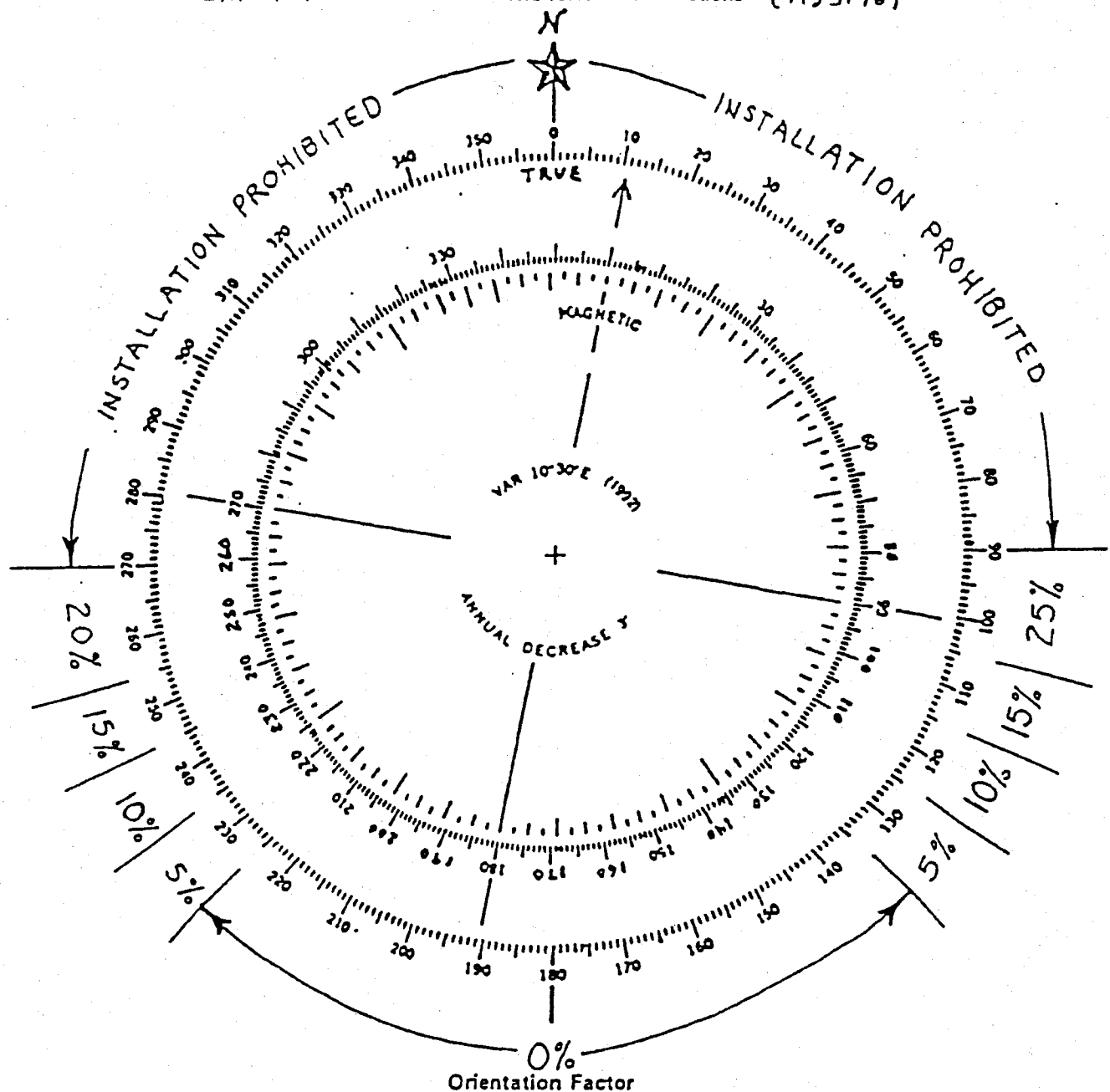
INSPECTOR ACTION

Inspector	Present	Date	System	Accepted	Denied
Comments					

INSTRUCTIONS: Contractor to complete all unshaded areas. Company to complete shaded areas.
 Mail blue & pink copies to HECO. Contractor to retain yellow copy.

HAWAII ELECTRIC LIGHT COMPANY
Residential Efficient Water Heating Program

CHART 1. Orientation Factors for Solar Installations (1123196)

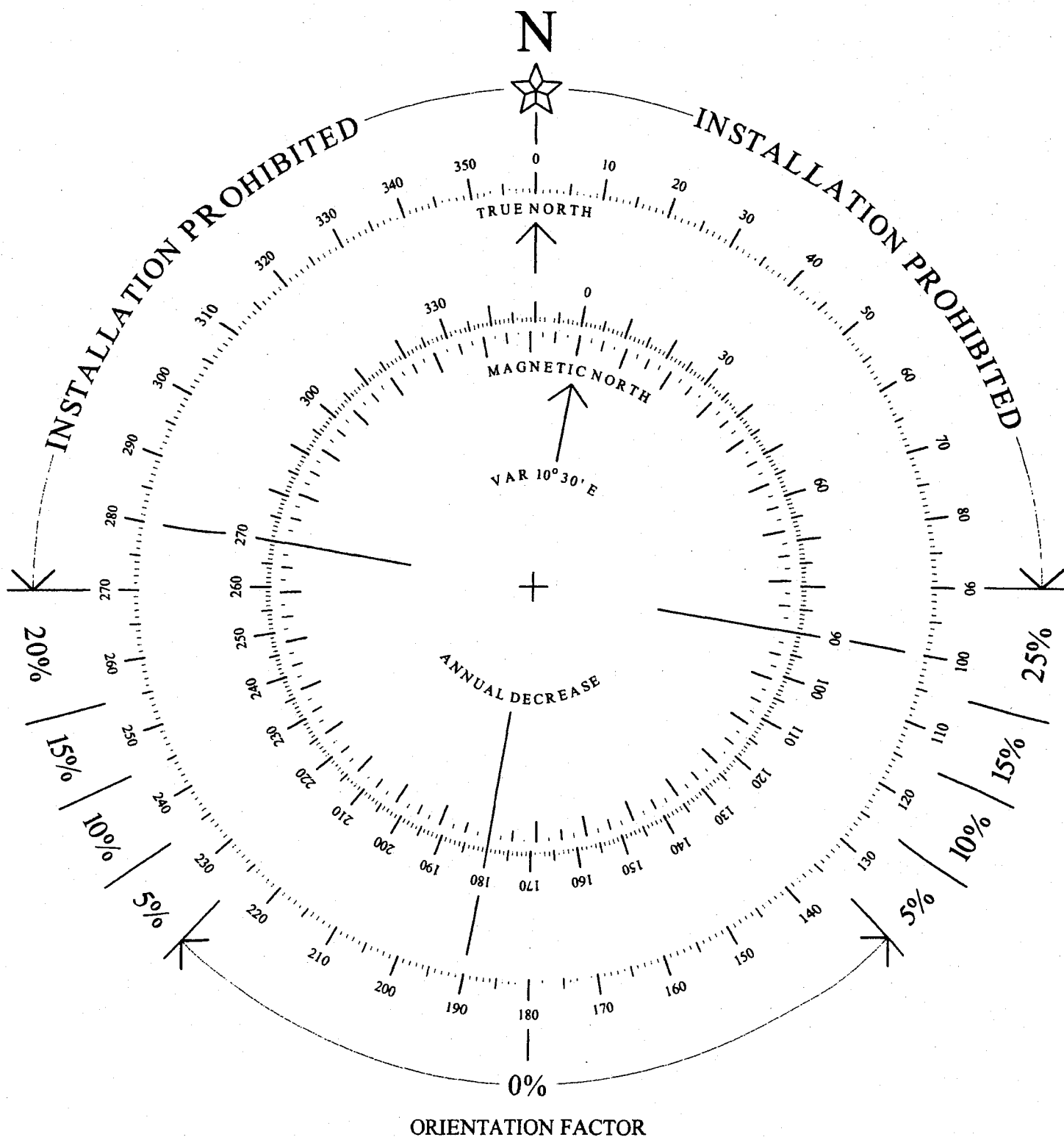


This compass rose diagram is to be used in conjunction with Table 4 and Form 1.

Steps to determine True direction of solar collector panels using the compass rose:

1. With a Magnetic compass, determine the Magnetic bearing (direction) that the long axis of the panels will sit at when installed. This bearing must be between 080° and 260° Magnetic, (090° and 270° True).
2. On the compass rose, lay a straightedge along the X at the center of the compass rose and, using the inner circle, through the Magnetic bearing (determined in step 1).
3. Read the True bearing from the outer circle. This is the True bearing which is used to determine the orientation factor, if any, which must be used on Form 1.

True compass direction can also be found on the Island of Hawaii by adding 10° to the Magnetic compass bearing. (The current magnetic variation in Hawaii is 10° East).



COMPASS ROSE DIAGRAM COURTESY OF HAWAII ELECTRIC LIGHT COMPANY

TABLES 1-5. RESIDENTIAL SOLAR WATER HEATING SYSTEM STANDARDS

[9/12/06 fn: tables 1-5]

Effective September 12, 2006
(supercedes 7/1/99)

Table 1. Minimum Water Storage for Retrofit and New Construction, Rentals, Military Family Housing

<u>RETROFIT, OWNER BUILDER</u>		<u>NEW CONSTRUCTION, RENTALS, MILITARY FAMILY HOUSING</u>	
<u>No. of Residents</u>	<u>Storage</u>	<u>No. of Bedrooms</u>	<u>Storage</u>
1 to 4	80 gals.	1-3	80 gal.
4 to 5	100 gals.	4-5	120 gal.
5 to 6	120 gals.	over 5	custom
over 6	20 per person		

Table 2
Daily BTU Requirements for Common Nominal Size Residential Heaters & Storage Tanks
at 55 Deg. Rise to Tank Temperature of 130 Deg.

<u>Nominal Storage Capacity</u>	<u>Daily BTU Requirement</u>	<u>Nominal Storage Capacity</u>	<u>Daily BTU Requirement</u>
30 gals.	13,745	70 gals.	32,071
40 gals.	18,326	80 gals.	36,652
50 gals.	22,908	90 gals.	41,234
52 gals.	23,824	100 gals.	45,815
60 gals.	27,489	115 gals.	52,687
66 gals.	30,238	120 gals.	54,978

Table 3. Tilt Factors

<u>Tilt (in deg.)</u>	<u>Add'l Collector BTU</u>	<u>Tilt (in deg.)</u>	<u>Add'l Collector BTU</u>
14	0%	50	15%
35	0%	55	20%
40	5%	60	25%
45	10%		

Table 4. Minimum Support Structure Anchors*

<u>No. of Collectors</u>	<u>Collector Size</u>	<u>No. of Anchors</u>
1	any size	4
2	3' x 7' or 3' x 8'	4
2	1 @ 3' x 8' and 1 @ 4' x 8'	4
2	4' x 6' or 4' x 8' or 4' x 10'	6
3	3' x 7' or 3' x 8'	6
3	2 @ 3' x 8' and 1 @ 4' x 8'	6
3	1 @ 3' x 8' and 2 @ 4' x 8'	6
3	4' x 6' or 4' x 8' or 4' x 10'	8
4	3' x 7' or 3' x 8'	8
4	2 @ 3' x 8' and 2 @ 4' x 8'	8
4	4' x 6' or 4' x 8' or 4' x 10'	10

* Applies to extruded aluminum sizes: 1 5/8" x 1 5/8" x 1/8" solar strut, 3" x 1" x 1/8" channel & double T, 2" x 2" x 3/16" angle.

Table 5. Minimum Conductor Size for PV Powered Pumps (One Way Distance)

<u>Module Output</u>	<u>18 AWG</u>	<u>16 AWG</u>	<u>14 AWG</u>	<u>12 AWG</u>	<u>10 AWG</u>	<u>8 AWG</u>
5 W	54 ft	109 ft	219 ft	327 ft	545 ft	>1000ft
10 W	26 ft	52 ft	104 ft	156 ft	269 ft	429 ft
20 W	n/a	26 ft	52 ft	78 ft	130 ft	208 ft
43 W	n/a	n/a	24 ft	36 ft	60 ft	96 ft

HECO Table 6. Solar Collector BTU/Day Output by Hawaii Sunshine Zone

OG-100 Protocol Format		(BTU/sq ft day)	1845	1661	1476	1292	1107
Hawaii Sunshine Zone		(Cal/sq cm/day)	500	450	400	350	300
Nom. Size	Coating	Model					
3' x 7'	Paint	AE-21E	17,528	14,707	11,808	9,299	9,299
		EP-20	17,528	15,182	12,792	10,332	10,332
		EP-21	19,373	16,605	13,776	11,365	11,365
		EPI-308CU (3' X 7')	18,450	15,656	12,792	9,815	9,815
		EPI-308SS (3' X 7')	18,450	15,656	12,792	9,815	9,815
		J Collector	20,295	17,079	13,776	10,849	10,849
		L Collector	13,838	11,861	9,840	7,232	7,232
		MSC-21E	17,528	15,182	12,792	9,815	9,815
		SSP-21	18,450	16,131	13,776	10,849	10,849
		ST-21E	17,528	15,182	12,792	9,815	9,815
		SunPro21	18,450	15,656	12,792	9,815	9,815
3' x 7'	Selective	AE-21	19,373	16,605	13,776	11,365	11,365
		Aprilus AP-10	11,070	9,489	7,872	6,716	6,716
		Bt	21,218	18,503	15,744	12,398	12,398
		EC-20	18,450	16,131	13,776	11,365	11,365
		EC-21	20,295	17,554	14,760	12,398	12,398
		K Collector	21,218	18,503	15,744	12,915	12,915
		M Collector	17,528	15,182	12,792	9,815	9,815
		MSC-21	19,373	17,079	14,760	11,882	11,882
		SSC-21	19,373	16,605	13,776	11,365	11,365
3' x 8'	Paint	AE-24E	19,373	16,605	13,776	10,849	10,849
		EP-24	22,140	19,452	16,728	13,432	13,432
		EPI-308CU (3' x 8')	20,295	17,554	14,760	11,365	11,365
		EPI-308SS (3' x 8')	20,295	17,554	14,760	11,365	11,365
		IP-24	22,140	19,452	16,728	13,432	13,432
		MSC-24E	20,295	17,554	14,760	11,365	11,365
		SP-24	22,140	19,452	16,728	13,432	13,432
		SSP-24	21,218	18,503	15,744	12,915	12,915
		SunPro24	21,218	18,028	14,760	11,365	11,365
		308P-HP	21,218	18,028	14,760	11,882	11,882
#REF!	#REF!	308C-HP	23,985	20,875	17,712	14,465	14,465
		AE-24	22,140	18,977	15,744	12,915	12,915
		EC-24	23,985	20,875	17,712	14,465	14,465
		IC-24	23,985	20,875	17,712	14,465	14,465
		MSC-24	22,140	19,452	16,728	13,432	13,432
		SC-24	23,985	20,875	17,712	14,465	14,465
		SSC-24	22,140	19,452	16,728	13,432	13,432
4' x 6'	Paint	AE-26E	21,218	18,028	14,760	11,882	11,882
		MSC-26E	21,218	18,028	14,760	11,882	11,882
4' x 6'	Selective	AE-26	23,063	19,926	16,728	13,432	13,432
		MSC-26	23,985	20,875	17,712	14,465	14,465
		SLCO-30	24,908	21,349	17,712	14,465	14,465
		SSP-32	28,598	24,670	20,664	17,048	17,048
4' x 7'	Paint	AE-28E	23,063	19,926	16,728	12,915	12,915
		MSC-28E	23,985	20,400	16,728	12,915	12,915

HECO Table 6. Solar Collector BTU/Day Output by Hawaii Sunshine Zone

OG-100 Protocol Format		(BTU/sq ft day)	1845	1661	1476	1292	1107
Hawaii Sunshine Zone		(Cal/sq cm/day)	500	450	400	350	300
Nom. Size	Coating	Model					
4' x 7'	Selective	AE-28	25,830	22,298	18,696	14,981	14,981
		Gobi 3366	27,675	24,196	20,664	17,048	17,048
		MSC-28	26,753	23,247	19,680	16,015	16,015
#REF!	#REF!	408P-HP	28,598	24,196	19,680	14,981	14,981
		AE-32E	26,753	22,773	18,696	14,465	14,465
		EP-32	29,520	25,619	21,648	17,564	17,564
		EPI-308CU (4' x 8')	28,598	24,196	19,750	16,531	16,531
		EPI-308SS (4' x 8')	28,598	24,196	19,750	16,531	16,531
		IP-32	30,443	26,094	21,648	17,564	17,564
		MSC-32E	26,753	22,773	18,696	14,981	14,981
		SLCR-30	30,443	26,568	22,632	19,114	19,114
		SP-32	29,520	25,619	21,648	17,564	17,564
		SunPro32	27,675	23,721	19,750	15,498	15,498
#REF!	#REF!	408C-HP	33,210	28,940	24,600	19,631	19,631
		AE-32	29,520	25,619	21,648	17,564	17,564
		EC-32	31,365	27,517	23,616	19,114	19,114
		Gobi 408	34,133	29,415	24,600	20,147	20,147
		IC-32	31,365	27,517	23,616	19,114	19,114
		MSC-32	29,520	25,619	21,648	17,564	17,564
		SC-32	31,365	27,517	23,616	19,114	19,114
		SLCO-32	32,288	27,991	23,616	19,114	19,114
		SLCR-32	32,288	28,466	24,600	20,147	20,147
		SSC-32	30,443	26,568	22,632	18,598	18,598
#REF!	#REF!	410P-HP	35,055	29,889	24,600	18,598	18,598
		AE-40E	33,210	28,466	23,616	18,598	18,598
		EP-40	36,900	32,261	27,552	22,214	22,214
		IP-40	37,823	32,736	27,552	22,214	22,214
		MSC-40E	33,210	28,466	23,616	18,598	18,598
		SP-40	36,900	32,261	27,552	22,214	22,214
		SSP-40	35,978	31,312	26,568	21,697	21,697
		ST-40E	32,288	27,517	22,632	17,564	17,564
		SupPro40	35,055	29,889	24,600	19,114	19,114
#REF!	#REF!	410C-HP	41,513	35,582	29,520	23,764	23,764
		AE-40	36,900	31,787	26,568	21,697	21,697
		EC-40	38,745	33,684	28,536	23,247	23,247
		Gobi 410	42,435	36,531	30,504	25,313	25,313
		IC-40	39,668	34,633	29,520	23,764	23,764
		MSC-40	38,745	33,684	28,536	23,247	23,247
		SC-40	38,745	33,684	28,536	23,247	23,247
		SLCO-40	38,745	33,684	28,536	22,730	22,730
		SLCR-40	40,590	35,582	30,504	25,313	25,313
		SSC-40	37,823	32,736	27,552	22,730	22,730

HECO Table 6. Solar Collector BTU/Day Output by Hawaii Sunshine Zone

OG-100 Protocol Format		(BTU/sq ft day)	1845	1661	1476	1292	1107
Hawaii Sunshine Zone		(Cal/sq cm/day)	500	450	400	350	300
Nom. Size	Coating	Model					
4' x 12'	Paint	412P-HP	42,435	35,582	28,536	21,697	21,697
4' x 12'	Selective	412C-HP	49,815	43,173	36,408	29,446	29,446
5' X 7'	Selective	Aprius AP-20	21,218	18,977	16,728	14,465	14,465
		Aprius AP-22	23,985	21,349	18,696	16,015	16,015
7' x 7'	Selective	Aprius AP-30	32,288	28,466	24,600	21,181	21,181
Notes:							
1. Values for the 350 and 450 Sunshine Zones are interpolated assuming a linear relationship.							
2. Values for the 300 Sunshine Zone equals the 350 Sunshine Zone per Section 2.02.							

HECO Solar Water Heating System Standards & Specifications
[06/01/99 fn:table7]

Effective June 1, 1999

**Table 7. Minimum Thermosiphon System
Tank Supports, Support Anchoring Fasteners & Tank Mounting Brackets**

<u>Tank Length</u>	<u>No. of Tank Supports¹</u>	<u>No. of Support Fasteners²</u>	<u>No. of Tank Mount Brackets³</u>
48" - 56"	2	4	4
69" - 75"	3	6	6
91" - 108"	4	8	8
120" - 130"	5	10	10
160"	6	12	12

1. Based on typical rafter/joist spacing of 24" on center or less. For rafter/joist spacing greater than 24' on center refer to Section 3.03.2. Minimum support length not less than tank diameter or width.
 2. Minimum of 2 support fasteners per support of 5/16" diameter for direct mount method. Fasteners of sufficient length to penetrate a minimum of 1 3/4" into the roof structural member.
 3. Tank mounting brackets shall be located on and secured to opposite sides of each tank support.
-

HECO SOLAR WATER HEATING SYSTEMS ACCEPTED PRODUCTS LIST

COLLECTORS				
Manufacturer	Brand Name	Model No.	Type	Absorber Coating
Alternate Energy Technologies	Alternate Energy	AE-21	Flat Plate	Black Chrome
		AE-24	Flat Plate	Black Chrome
		AE-26	Flat Plate	Black Chrome
		AE-28	Flat Plate	Black Chrome
		AE-32	Flat Plate	Black Chrome
		AE-40	Flat Plate	Black Chrome
	American Energy	AE-21E	Flat Plate	Selective Paint
		AE-24E	Flat Plate	Selective Paint
		AE-26E	Flat Plate	Selective Paint
		AE-28E	Flat Plate	Selective Paint
		AE-32E	Flat Plate	Selective Paint
		AE-40E	Flat Plate	Selective Paint
	Morning Star	MSC-21	Flat Plate	Black Chrome
		MSC-24	Flat Plate	Black Chrome
		MSC-26	Flat Plate	Black Chrome
		MSC-28	Flat Plate	Black Chrome
MSC-32		Flat Plate	Black Chrome	
MSC-40		Flat Plate	Black Chrome	
Morning Star	MSC-21E	Flat Plate	Selective Paint	
	MSC-24E	Flat Plate	Selective Paint	
	MSC-26E	Flat Plate	Selective Paint	
	MSC-28E	Flat Plate	Selective Paint	
	MSC-32E	Flat Plate	Selective Paint	
	MSC-40E	Flat Plate	Selective Paint	
Star Fire	ST-21E	Flat Plate	Selective Paint	
	ST 40E	Flat Plate	Selective Paint	
Corona		SLCO-30 (4'x6')	Flat Plate	Black Chrome
		SLCO-32 (4'x8')	Flat Plate	Black Chrome
		SLCO-40 (4'x10')	Flat Plate	Black Chrome
Chromagen		SLCR-30 (4'x6')	Flat Plate	Black Chrome
		SLCR-32 (4'x8')	Flat Plate	Black Chrome
		SLCR-40 (4'x10')	Flat Plate	Black Chrome
Heliodyne	Gobi	Gobi 3366	Flat Plate	Black Chrome
	Gobi	Gobi 408	Flat Plate	Black Chrome
	Gobi	Gobi 410	Flat Plate	Black Chrome
R & R Services	Copper Star 21	EPI-308CU (3'x7')	Flat Plate	Black Paint
	Copper Star 24	EPI-308CU (3'x8')	Flat Plate	Black Paint
	Copper Star 32	EPI-308CU (4'x8')	Flat Plate	Black Paint
	Sunlast 21	EPI-308SS (3'x7')	Flat Plate	Black Paint
	Sunlast 24	EPI-308SS (3'x8')	Flat Plate	Black Paint
	Sunlast 32	EPI-308SS (4'x8')	Flat Plate	Black Paint
	Sunpro 21	Sunpro 21	Flat Plate	Black Paint
	Sunpro 24	Sunpro 24	Flat Plate	Black Paint
	Sunpro 32	Sunpro 32	Flat Plate	Black Paint
	Sunpro 40	Sunpro 40	Flat Plate	Black Paint

HECO SOLAR WATER HEATING SYSTEMS ACCEPTED PRODUCTS LIST

COLLECTORS (cont.)				
Manufacturer	Brand Name	Model No.	Type	Absorber Coating
Radco Products Inc.	Radco	308C-HP	Flat Plate	Black Chrome
		408C-HP	Flat Plate	Black Chrome
		410C-HP	Flat Plate	Black Chrome
		412C-HP	Flat Plate	Black Chrome
		308P-HP	Flat Plate	Black Paint
		408P-HP	Flat Plate	Black Paint
		410P-HP	Flat Plate	Black Paint
		412-P-HP	Flat Plate	Black Paint
Solahart	Solahart	Bt Collector	Flat Plate	Selective
		J Collector	Flat Plate	Black Paint
		K Collector	Flat Plate	Black Chrome
		L Collector	Flat Plate	Black Paint
		M Collector	Flat Plate	Black Chrome
SunEarth	Empire	EC-20	Flat Plate	Black Chrome
		EC-21	Flat Plate	Black Chrome
		EC-24	Flat Plate	Black Chrome
		EC-32	Flat Plate	Black Chrome
		EC-40	Flat Plate	Black Chrome
	Empire	EP-20	Flat Plate	Black Paint
		EP-21	Flat Plate	Black Paint
		EP-24	Flat Plate	Black Paint
		EP-32	Flat Plate	Black Paint
		EP-40	Flat Plate	Black Paint
	Imperial	IC-24	Flat Plate	Black Chrome
		IC-32	Flat Plate	Black Chrome
		IC-40	Flat Plate	Black Chrome
	Imperial	IP-24	Flat Plate	Black Paint
		IP-32	Flat Plate	Black Paint
		IP-40	Flat Plate	Black Paint
	SolarStar	SSC-21	Flat Plate	Black Chrome
		SSC-24	Flat Plate	Black Chrome
		SSC-32	Flat Plate	Black Chrome
		SSC-40	Flat Plate	Black Chrome
	SolarStar	SSP-21	Flat Plate	Black Paint
		SSP-24	Flat Plate	Black Paint
		SSP-32	Flat Plate	Black Paint
		SSP-40	Flat Plate	Black Paint
	SunWise	SC-24	Flat Plate	Black Chrome
		SC-32	Flat Plate	Black Chrome
		SC-40	Flat Plate	Black Chrome
	SunWise	SP-24	Flat Plate	Black Paint
		SP-32	Flat Plate	Black Paint
		SP-40	Flat Plate	Black Paint

HECO SOLAR WATER HEATING SYSTEMS ACCEPTED PRODUCTS LIST

STORAGE TANKS & HEATERS				
(HECO Listed High Efficient Electric Water Heaters Are Automatically Accepted)				
Manufacturer	Brand Name	Model No.	Type	Heating Element
A.O. Smith	ProMax	SUN-80	Open Storage	yes
		SUN-120	Open Storage	yes
American	Solar Storage Tanks	SE62-80H-45S	Open Storage	yes
		SE62-119R-45S	Open Storage	yes
Bradford White	Solar Saver	MS65R6 (SS)	Open Storage	yes
		MS80R6 (SS)	Open Storage	yes
		MS120R6 (SS)	Open Storage	yes
Lochinvar Corp	SunSaver	FTA066-K	Open Storage	yes
		FTA-082-K	Open Storage	yes
		FTA-120-K	Open Storage	yes
		FTS-066	Open Storage	no
		FTS-082	Open Storage	no
		FTS-120	Open Storage	no
Radco Products Inc.	Copper SunSation	CSS-60	Heat Exchange	no
		CSS-80	Heat Exchange	no
		CSS-100	Heat Exchange	no
Rheem	Solaraide	81VR80-1	Open Storage	yes
		81VR120-1	Open Storage	yes
		81VR80-T	Open Storage	no
		81VR120-T	Open Storage	no
Richmond	Solar Model	S80-1	Open Storage	yes
		S120-1	Open Storage	yes
		S80TC-1	Open Storage	yes
		S120TC-1	Open Storage	yes
Ruud	Solar Servant	RSPER80-1	Open Storage	yes
		RSPER120-1	Open Storage	yes
		RSPER80-T	Open Storage	no
		RSPER120-T	Open Storage	no
	Solar Servant TC	RSTCR80-1	Open Storage	yes
		RSTCR120-1	Open Storage	yes
		RSTCR80-T	Open Storage	no
		RSTCR120-T	Open Storage	no
Solahart Industries	Solahart	150 J	Closed Storage	yes
		180 J	Closed Storage	yes
		220 J	Closed Storage	yes
		300 J	Closed Storage	yes
		440 J	Closed Storage	yes

HECO SOLAR WATER HEATING SYSTEMS ACCEPTED PRODUCTS LIST

STORAGE TANKS & HEATERS (cont.)		Model No.	Type	Heating Element
(HECO Listed High Efficient Electric Water Heaters Are Automatically Accepted)				
		150 K	Closed Storage	yes
Manufacturer	Brand Name	180 K	Closed Storage	yes
		220 K	Closed Storage	yes
Solahart Industries	Solahart	300 K	Closed Storage	yes
		440 K	Closed Storage	yes
		150 KBCXII	Closed Storage	yes
		180 KBCXII	Closed Storage	yes
		220 KBCXII	Closed Storage	yes
Solahart Industries	Solahart	300 KBCXII	Closed Storage	yes
		440 KBCXII	Closed Storage	yes
		150 L	Open Storage	yes
		180 L	Open Storage	yes
		220 L	Open Storage	yes
	Solahart	300 L	Open Storage	yes
		440 L	Open Storage	yes
		150 LX	Open Storage	yes
		180 LX	Open Storage	yes
		220 LX	Open Storage	yes
	Solahart	300 LX	Open Storage	yes
		440 LX	Open Storage	yes
		252 SL	Open Storage	yes
		303 SL	Open Storage	yes
	Solahart	270SL2USA	Closed Storage	yes
		340SL4USA	Closed Storage	yes
		430SL4USA	Closed Storage	yes
Solar Edwards	Edwards	DES125 (42 gal.)	Open Storage	yes
		DES250 (80 gal.)	Open Storage	yes
		DES 350 (92 gal.)	Open Storage	yes
	Edwards	L180 (48 gal.)	Open Storage	yes
		L305 (80 gal.)	Open Storage	yes
		L440 (116 gal.)	Open Storage	yes
		L600 (160 gal.)	Open Storage	yes
State Industries	State	SBV-66-10TS	Open Storage	yes
		SBV-82-10TS	Open Storage	yes
		OST-66-E	Open Storage	yes
		OST-80-E	Open Storage	yes
		OST-120-E	Open Storage	yes

HECO SOLAR WATER HEATING SYSTEMS ACCEPTED PRODUCTS LIST

CIRCULATING PUMPS				
Manufacturer	Brand Name	Model No.	Type	
Bell & Gossett	Bronze Fox	NBF-8S/LS	AC	
		NBF-9U/LW	AC	
		NBF-10S/LW	AC	
		NBF-12U/LW	AC	
		NBF-12F/LW	AC	
		NBF-18S	AC	
		NBF-22U	AC	
		NBF-22U	AC	
Grundfos	Grundfos	UM15-10B5	AC	
		UM15-10B7	AC	
		UP15-18SU	AC	
		UP15-42SU	AC	
		UP15-18SF	AC	
		UP15-42SF	AC	
		UP15-18B5	AC	
		UP15-42B5	AC	
		UP15-18B7	AC	
		UP15-42B7	AC	
		UP25-64SU	AC	
		UP25-64SF	AC	
		UP26-96BF	AC	
		UP26-99BF	AC	
		UP43-75BF	AC	
Hartell	Brushless	MD-10-HEH	DC	
Hartell	Brush	MD-3-DCL	DC	
		MD-10-DCH	DC	
Ivan Labs Inc.	El Sid	2W2RD331200	DC	
		2W2RD341500	DC	
		2W2RD31730	DC	
Laing	ecocirc solar	720 B	DC	
	ecocirc solar	090 B	DC	
March Manufacturing	March	809	AC/DC	
		809HS	AC/DC	
		815	AC	
		821	AC	
		830	AC	
Taco	Taco	#006B	AC	
		#006-BC7-1IFC	AC	
		#006-BC7-IFC	AC	
		#007B	AC	
		#008B	AC	
		#009B	AC	
		#010B	AC	

HECO SOLAR WATER HEATING SYSTEMS ACCEPTED PRODUCTS LIST

PUMP CONTROLLERS			
Manufacturer	Brand Name	Model No.	Type
Heliotrope Thermal	Delta-T	DTT-84	AC
		DTT-94	AC
Goldline Controls	Goldline	GL-30	AC
		GL-30-LCO	AC
Sun Earth	Sun Earth	SETR 0301 U	AC
PHOTOVOLTAIC MODULES			
Manufacturer	Brand Name	Model No.	Type
Alternative Energy Engineering		AE-5G	DC
		AE-10G	DC
		AE-20G	DC
BP Solar, Inc.	BP Solar	BP SX 10	DC
		BP SX 20	DC
Shell Solar	Shell Solar	ST5	DC
		ST10	DC
		ST20	
SunWize	SunWize	OEM10	DC
		OEM20	DC
Yingli Solar	Yingli Solar	YL10	DC
		YL20	DC
TIME SWITCHES			
Manufacturer	Brand Name	Model No.	Type
BRK Electronics Inc.	BRK Electronics	TS212	AC
		TS212M	AC
		TS212R	AC
	First Alert	TS212RP	AC
Intermatic Inc.	Intermatic	WH40	AC
		EH10	AC
		EH40	AC
		T104	AC
M.H. Rhodes	Marktime	72133 AB	AC
Paragon Electric		4004-71	AC
		4014-71P	AC
		EC-4005	AC
		P104	AC
		P104P	AC
		P104PC	AC
		P104-S	AC
P104P-S	AC		

HECO SOLAR WATER HEATING SYSTEMS ACCEPTED PRODUCTS LIST

TIME SWITCHES (Cont.)				
Manufacturer	Brand Name	Model No.	Type	
Solahart	Solar Optimiser	TEK 414	DC	
		TEK 415	AC	
PIPING INSULATION				
Manufacturer	Brand Name	Model No.	Type	
Aeroflex International	Aerocel	AC5812	1/2" wall min.	
		AC7812	1/2" wall min.	
Aramcell LLC	AP Armaflex	AP Armaflex	1/2" wall min.	
Bridging China Int'l	Solar Flex	MMAC 05812	1/2" wall min.	
		MMAC 07812	1/2" wall min.	
Mueller Industries	Streamline	CT-98	1/2" wall min.	
Nomaco K-Flex	FlexTherm	Pipe Insulation	1/2" wall min.	
	Insul-Tube	Insul-Tube 180	1/2" wall min.	
VALVES				
Manufacturer	Brand Name	Model No.	Type	Description
American Valve	American Valve	M100	Bronze	Ball Valve
		M100S	Bronze	Ball Valve
Arrowhead Brass	Arrowhead Brass	220	Brass	Boiler Drain
		221	Brass	Boiler Drain
		222	Brass	Boiler Drain
		223	Brass	Boiler Drain
	Arrowhead Brass	251	Brass	Hose Bib
253		Brass	Hose Bib	
351		Brass	Hose Bib	
353		Brass	Hose Bib	
B&K Industries	B&K Industries	107-403HC	Brass	Ball Valve
		107-404HC	Brass	Ball Valve
		107-453HC	Brass	Ball Valve
		107-454HC	Brass	Ball Valve
	B&K Industries	101-003	Brass	Swing Check Valve
101-004		Brass	Swing Check Valve	
101-503		Brass	Swing Check Valve	
101-504		Brass	Swing Check Valve	
	B&K Industries	102-003	Brass	Boiler Drain
102-004		Brass	Boiler Drain	
102-003HC		Brass	Boiler Drain	
102-004HC		Brass	Boiler Drain	

HECO SOLAR WATER HEATING SYSTEMS ACCEPTED PRODUCTS LIST

VALVES (cont.)				
Manufacturer	Brand Name	Model No.	Type	Description
	B&K Industries	103-023HC	Brass	Hose Bibb
		103-024HC	Brass	Hose Bibb
	ProLine	101-203	Bronze	Swing Check "Y"
		101-204	Bronze	Swing Check "Y"
		101-703	Bronze	Swing Check "Y"
		101-704	Bronze	Swing Check "Y"
	ProLine	102-703	Brass	Boiler Drain
		102-704	Brass	Boiler Drain
Cash Acme	Cash Acme	#8316	Bronze	Temp./ Press. Relief
Erie Mfg. Company	Motortrol	#0654C0307GB00	Electric	Motorized Check Valve
Familian Northwest Inc	FNW Valve	FV 12 420	Brass	Ball Valve
		FV 34 420	Brass	Ball Valve
		FV 12 421	Brass	Ball Valve
		FV 34 421	Brass	Ball Valve
Grundfos	Grundfos	519852	Bronze	Flange Isolation Valve
Guardian	Guardian	16-202-125	Bronze	Press. Relief
Hammond Valve	Hammond	#8201	Brass	Ball Valve
		#8211	Brass	Ball Valve
Mueller Industries	Streamline	M420012	Brass / Bronze	Boiler Drain
		M420034	Brass / Bronze	Boiler Drain
		S210012	Brass / Bronze	Ball Valve
		S210034	Brass / Bronze	Ball Valve
Nibco Inc.	Nibco	S-413	Bronze	Check Valve
		T-413	Bronze	Check Valve
		T-580	Bronze	Ball Valve
		T-585	Bronze	Ball Valve
Premier	Premier	#252259	Brass	Ball Valve
Red-White Valve Corp.	Red-White	#247	Bronze	Check Valve
		5044F	Brass	Ball Valve
		5049F	Brass	Ball Valve
Solar Edwards	RMC	HT575	Brass	Temp. / Press. Relief
		HT748	Brass	Temp. / Press. Relief
SunEarth	SunEarth	B-6001-Y111	Bronze	Ball Valve
Taco	Taco	258-2	Bronze	Isolation Valve

HECO SOLAR WATER HEATING SYSTEMS ACCEPTED PRODUCTS LIST

VALVES (cont.)				
Manufacturer	Brand Name	Model No.	Type	Description
Watts Regulator	Watts	No. 3L-Z9	Bronze	Press. Relief
		No. 53L	Bronze	Press. Relief
		FBV-1	Brass	Ball Valve
		FBVS-1	Brass	Ball Valve
	Blue Ribbon	No. 100XL	Bronze	Temp./ Press. Relief
		Series CVY	Brass	Check Valves
		Series CVYS	Brass	Check Valves
		Series B-6000	Bronze	Ball Valve
		Series B-6001	Bronze	Ball Valve
		WBV	Brass	
		WBVS	Brass	
Zurn/Wilkins	Zurn/Wilkins	TP1100A	Bronze	Temp./ Press. Relief
TEMPERATURE GAUGES				
Manufacturer	Brand Name	Model No.	Type	
Clifton Industrial	Clifton	I3-2-06-03	Bi-Metal	
		I3-2-06-04	Bi-Metal	
		A4-2-06-03	Bi-Metal	
		A4-2-06-04	Bi-Metal	
		#71226	Bi-Metal	
Heliotrope General	Two-Temp	Two-Temp	Electronic	
	Quadra-Temp	Quadra-Temp	Electronic	
Goldline Controls	Goldline	TD-GL	Electronic	
Grainger	Taylor	9940-10	Digital Panel Thermometer	
Letro Products, Inc.	Letro	SL2DW	Bi-Metal	
		SL2DW3	Bi-Metal	
Pasco	Pasco	1449	Bi-Metal	
		1449-C	Bi-Metal	
		1450	Bi-Metal	
		1450-W	Bi-Metal	
		1455	Bi-Metal	
		1457	Bi-Metal	
Winter's Thermogauges		T100	Industrial 9IT	
		T174	Bi-Metal	
		T30040	Bi-Metal	
		T30060	Bi-Metal	
		T31060	Bi-Metal	



ENERGY\$OLUTIONS

FOR THE HOME

Hawaiian Electric • Giving you the power

Date: July 28, 2008

To: All HECO Participating Contractors and Product Suppliers

From: Bryan Law, 543-4784 *Bryan Law*

Subject: Addendum No. 2 to the HECO Solar Water Heating Systems Accepted Products List dated February 1, 2008

Effective immediately the following solar collectors are added to the HECO Residential Solar Water Heating System Accepted Products List and S&S Table 6 dated February 1, 2008. Use of these products prior to the date of this Addendum is acceptable.

Hawaii Sunshine Zone Btu Ratings								
<u>Supplier</u>	<u>Collector Model #</u>	<u>Nominal Size</u>	<u>500</u>	<u>450</u>	<u>400</u>	<u>350</u>	<u>Type</u>	<u>Coating</u>
Solene	SLCO-32P	4 x 8	24,908	20,875	16,728	12,915	Flat Plate	Black Paint
Solene	SLCO-40P	4 x 10	29,520	25,145	20,664	16,015	Flat Plate	Black Paint
Heliodyne	Gobi 336 013	4 x 7	23,985	20,875	17,712	14,465	Flat Plate	Black Chrome
Heliodyne	Gobi 406 001	4 x 7	25,830	22,773	19,680	16,015	Flat Plate	Selective
Heliodyne	Gobi 406 002	4 x 7	23,985	20,400	16,728	12,915	Flat Plate	Black Paint
Heliodyne	Gobi 408 001	4 x 8	31,365	27,517	23,616	19,114	Flat Plate	Selective
Heliodyne	Gobi 408 002	4 x 8	29,520	25,145	20,664	16,015	Flat Plate	Black Paint
Heliodyne	Gobi 408 013	4 x 8	29,520	25,145	20,664	16,531	Flat Plate	Black Chrome
Heliodyne	Gobi 410 001	4 x 10	39,668	34,633	29,520	24,280	Flat Plate	Selective
Heliodyne	Gobi 410 002	4 x 10	36,900	31,787	26,568	20,664	Flat Plate	Black Paint
Heliodyne	Gobi 410 013	4 x 10	36,900	31,787	26,568	21,181	Flat Plate	Black Chrome

Please attach this addendum in front of your HECO Approved Product List and S&S Table 6 documents, and notify your staff of the change.

RESIDENTIAL NEW CONSTRUCTION AND RETROFIT PROGRAMS
LIST of ACCEPTED
HIGH-EFFICIENCY ELECTRIC WATER HEATERS
[fn:revisedAccWHList 06/07]

Electric resistance water heaters must meet the energy efficiency requirements stipulated in the following table to qualify for financial incentives under the Residential Efficient Water Heating Program. This table is based on the 1990 federal efficiency standards established by the National Appliance Energy Conservation Act ("NAECA").

Residential New Construction and Retrofit Programs High-efficiency electric water heater specifications and incentive rebate levels*			
<u>Tank Capacity</u>	<u>Efficiency Factor</u>	<u>Retrofit Rebate</u>	<u>New Construction Rebate</u>
35 gal or less	.94	\$40	\$60
36-45 gal	.93	\$40	\$60
46-64 gal	.92	\$50	\$80
65 gal	.91	\$50	\$80
66 –118 gal	.88	\$70	\$80
119 +	.83	\$70	\$80

80 + w/ load control device	.88	--	\$270**
119 + w/ load control device	.83	---	\$270**

* Specification and incentive amounts are subject to change.

** New-construction developers installing a qualifying 80+ gallon tank with a HECO-supplied load control timer qualifies participating homeowners to receive a monthly \$5 credit on their electric bills.

The financial incentive available to the purchaser of one of the qualifying high-efficiency electric water heaters depends on (1) the tank size of the water heater being purchased and (2) assuring the efficiency factor is the correct rating for the selected size tank.

The following list of high-efficiency electric water heaters is based on specifications contained in the May 2007 Gas Appliance Manufacturers Association (Gama) Consumers' Directory of Certified Efficiency Ratings for Residential Heating and Water Heating Equipment. This list may not be complete and it may be updated periodically without notice.

American Water Heater Company

Trade Names: ACE, American, American Hardware, America's Best, Apex, AquaTemp, AquaTherm, Aquamatic, Best, Best Deluxe, Champion, Craftmaster, De-Limer, Deluxe, Eagle, The Earl's Energy Conservation Water Heater, The Earl's Energy Saver Plus, Evirotemp, Four Most, Hotmaster, Hotstream King-Kleen, King-Line, Master Plumber, Nationaline, Neptune, Penguin, Premier Plus, Premier Plus Self Cleaning Prestige, ProLine and ProLine Plus, Quaker, QuickFlo, Raywall, Revere, Riveria, Sands, Sentinal, Servi-Star, Shamrock, Special Deluxe, Standard, Super Eagle, Super-Flo, Supreme, SureFire, ThoroClean, TrueTest, Tru Value, US Supply, XCL Energy Saver.

Comments:

First asterisk after letter "E" may be replaced with any number (1,3,5,6,8,9,10 or 12) signifying warranty period.

May have prefix "S"

May have prefix "LDC"

First three asterisks after model number are changes to total wattage.

May have suffix "D" or "S".

May have any combination of the following suffixes: V, M or X.

May have suffix "CO".

Model #	Energy Factor	Gallon Size	
EE*3-40R*****	0.95	40	
EE*2-50R*****	0.92	50	
E*3-60H*C***	0.93	60	discontinued, still qualifies
EE*3-50H*****	0.93	50	
EZ3-60H****C***	0.93	60	discontinued, still qualifies
E*3-50H*O***	0.93	50	
E*3-50R*C***	0.93	50	
EE*3-50R*****	0.95	50	
EZ3-50R****C***	0.93	50	
EE*2-65H*****	0.90	66	
E*3-65H*C***	0.91	66	
EE*3-65H*****	0.92	66	
EE*2-80H*****	0.90	80	
E*3-80H*C***	0.91	80	
EE*3-80H*****	0.92	80	
E*2-110R*H***	0.83	110	discontinued, still qualifies
E*2-110R*C***	0.83	110	discontinued, still qualifies
EE*2-50H*****	0.92	50	
E*2-65H***	0.90	66	
E*3-60H*O***	0.93	60	discontinued, still qualifies

Bradford White Corp

Trade Names: Bradford White, JetGlas

Comments:

The M or J prefix in the model number may be replaced with A,B,D,P, PH or R.

The "6" may be replaced with 1,2,3,4,5,7,8,9 or 10.

An additional suffix number may be added to indicate an engineering change.

The "S" may be replaced by a "D".

An additional S" may be added as a suffix to indicate screw-in elements.

-12 may be substituted for -14. -16 may be substituted for -17.

Asterisks may be replaced by letters "S" or "D" or the numbers 0,1,2,3,4,5,6,7,8 or 9.

Model #	Energy Factor	Gallon Size	
M230L**S3	0.94	30	
M230L**S5	0.94	30	
M230L**S(A)	0.94	30	New
M230L**S(B)	0.94	30	New
M2HE40S**S3	0.93	40	
M2HE40S**S5	0.93	40	
M2HE40S**S(A)	0.93	40	New
M2HE40S**S(B)	0.93	40	New
M240L**S3	0.93	40	
M240L**S5	0.93	40	
M240L**S(A)	0.93	40	New
M240L**S(B)	0.93	40	New
M250S**S2	0.92	50	
M250S**S5	0.92	50	
M250S**S(A)	0.92	50	New
M250S**S(B)	0.92	50	New
M2HE50S**S3	0.93	50	
M2HE50S**S5	0.93	50	
M2HE50S**S(A)	0.93	50	New
M2HE50S**S(B)	0.93	50	New
M2HE65R**S3	0.91	65	
M2HE65R**S5	0.91	65	
M2HE65R**S(A)	0.91	65	New
M2HE65R**S(B)	0.91	65	New
M280R**S2	0.88	80	
M2HE80R**S3	0.91	80	
M2HE80R**S5	0.91	80	
M2420R**S2	0.86	119	discontinued, still qualifies
M-III-40T***S-13	0.93	40	
M-III-50T***S-17	0.92	50	
M-III-50T***S-19	0.93	50	
M-III-65R***S-13	0.91	65	
M-III-65R***S-17	0.91	65	
M-III-80R***S-13	0.91	80	
M-II-120R***S-13	0.84	119	discontinued, still qualifies
M-II-120R***S-16	0.84	119	discontinued, still qualifies

GSW Water Heating Company**Trade Names:** John Wood, GSW, Moffat, Medal**Comments:**

All models may have a prefix number to indicate warranty period, and G, JW or SS to indicate brand.

Model #	Energy Factor	Gallon Size	
50TDE3	0.93	50	EF reduced, but still qualifies
110SDE	0.83	110	discontinued, still qualifies
66SDE	0.88	66	

Lochinvar Water Heater Corp.**Trade Name:** Energy Saver, Golden Knight, Knight**Comments:**

The model number may be further suffixed with a "K" to denote double element heater.

"K" may be replaced with one or two of the following: A,B,C,D,E,F,G,H,I,J,K,L,M,N or P to denote element wattages other than 4500.

Model #	Energy Factor	Gallon Size	
ETA040KK-3	0.93	40	
STA040KK-3	0.93	40	
ETA052KK-3	0.93	50	
STA052KK-3	0.93	50	
ETA066KK-3	0.91	65	
STA066KK-3	0.91	65	
ETA082KK-3	0.91	80	
STA082KK-3	0.91	80	
LTA041KK	0.93	40	
XTA041KK	0.93	40	
LTA051KK	0.93	50	
XTA051KK	0.93	50	
LTA065KK	0.91	65	
XTA065KK	0.91	65	
LTA081KK	0.91	80	
XTA081KK	0.91	80	
LTA120KK	0.84	119	discontinued, still qualifies
XTA120KK	0.84	119	discontinued, still qualifies

Marathon Water Heater Company

Trade Name: Marathon

Model #	Energy Factor	Gallon Size
MR-30230B	0.94	30
MR30238B	0.94	30
MR30245B	0.94	30
MR40230B	0.94	40
MR40238B	0.94	40
MSR50230B	0.94	50
MSR50238B	0.94	50
MR40245B	0.94	40
MSR50245B	0.94	50
MR50230B	0.94	50
MR50238B	0.94	50
MR50245B	0.94	50
MR75230B	0.92	75
MR75238B	0.92	75
MR75245B	0.92	75
MR85230B	0.92	85
MR85238B	0.92	85
MRE85238B	0.92	85
MR85245B	0.92	85
MR105230B	0.91	105
MR105238B	0.91	105
MR105245B	0.91	105
UCON30238B	0.94	30
UCON30245B	0.94	30
UCON40238B	0.94	40
UCONS50238B	0.94	50
UCON40245B	0.94	40
UCONS50245B	0.94	50
UCON50238B	0.94	50
UCON50245B	0.94	50
UCON75238B	0.92	75
UCON75245B	0.92	75
UCON85238B	0.92	85
UCON85245B	0.92	85
UCON105238B	0.91	105
UCON105245B	0.91	105

Maytag

Trade Name: Maytag

Comments:

(*) indicates 8 or 9 for warranty.

(**) indicates X or 12 for warranty

Model #	Energy Factor	Gallon Size	
HE2**40S	0.93	40	discontinued, still qualifies
HE3**40S	0.93	40	discontinued, still qualifies
HE2**50PC**	0.93	50	discontinued, still qualifies
HE2**50T	0.93	50	discontinued, still qualifies
HE3**50T	0.93	50	discontinued, still qualifies
HX622ERTW	0.88	66	discontinued, still qualifies
HE2**82PC**	0.91	82	discontinued, still qualifies
HE2**82T	0.91	80	discontinued, still qualifies
HE3**82T	0.91	80	discontinued, still qualifies
HR66DJRT	0.88	66	discontinued, still qualifies
HRE21240S	0.95	40	discontinued, still qualifies
HR**30DERT	0.95	30	
HRE21250PC	0.95	50	
HRE212-50T	0.95	50	discontinued, still qualifies
HR**40-DERT	0.93	40	discontinued, still qualifies
HRE212-50S	0.95	50	discontinued, still qualifies
HR**40-DERS	0.93	40	discontinued, still qualifies
HRE212-82PC	0.95	80	
HRE212-82T	0.95	80	discontinued, still qualifies
HR**52-DERT	0.93	50	discontinued, still qualifies
HR**52-DERS	0.93	50	discontinued, still qualifies
HRE29-66T	0.88	66	
HR677DJRT	0.88	66	discontinued, still qualifies
HR**66-DERT	0.93	66	discontinued, still qualifies
HR**82-DERT	0.93	80	discontinued, still qualifies
HM340SHMSE3	0.93	40	discontinued, still qualifies
HM352SHMSE3	0.93	40	
HM352SHMSE3	0.95	50	
#HR6-30-DERT	0.95	30	New
HRT-40-DERT	0.93	40	New
HRX-40-DERT	0.93	40	New
HRT-40-DERS	0.93	40	New
HRX-40-DERS	0.93	40	New
HR6-52-DERT	0.93	50	New
HRX-52-DERT	0.93	50	New
HR6-66-DERT	0.93	66	New
HRX-66-DERT	0.93	66	New
HRT-82-DERT	0.93	80	New
HRX-82-DERT	0.93	80	New

Reliance Water Heater Company

Trade Names: Ace, Ambassador, Barnett, Century, Crosley, Energy Stretcher, Freedom, Freedom/Nipsco, Hardware House, Master Plumber/True Value, Mission, Nationaline, Patriot, Penfield, President, Regency, Reliance, Sentry, Superior, The Plumbery, Thermo-King, Top Line.

Comments:

The following prefix may be added to the Reliance water heater line to reflect private brand names: A,C,N,RE,SW,UP,BS,IN and MN.

The prefix (**) may be replaced by 1 through 15 for warranty changes

All model numbers may have one or more of the following suffixes: B,E,G,J,K,M,NC,R,V,W,X or Y

First digit of suffix may be replaced by 1 to denote a single element model.

Model #	Energy Factor	Gallon Size	
LT522LRTW***	0.92	50	
6522OCTJW***	0.93	50	
**662ARTW	0.88	66	
**662ERTW	0.88	66	
**662ORTW	0.88	66	
6662OCTJW***	0.91	66	
LT822LRTW	0.89	80	
6822OCTW***	0.91	80	
#9 30 DKRT	0.95	30	
6 40 SHMS	0.93	40	
9 40 DKRT	0.93	40	
6 40 DOCT	0.93	40	
9 40 DKRS	0.93	40	
12 40 DARS	0.95	40	
9 50 DKRS	0.93	50	
**52 DKRS	0.93	50	
9 80 DKRT	0.93	80	
**50 DKRT	0.93	55	
6 50 DOCT	0.93	55	
LT 50 DLRS	0.95	50	
**50 DARS	0.95	50	
**50 DART	0.95	55	
LT 50 DLRT	0.95	55	
6 66 DORT	0.88	66	
9 66 DKRT	0.92	66	
6 66 DOCT	0.92	66	
LT 80 DLRT	0.95	80	
12 80 DART	0.95	80	
**80 DOCT	0.93	80	
**40 DOLS	0.93	40	discontinued, still qualifies

Rheem Mfg Company
Trade Name: General Electric

Comments:

The "*" denotes change to wattage and may be replaced by the following alphanumeric: A, or KC00.

Model #	Energy Factor	Gallon Size	
PE40M09*	0.93	40	
SE40M12*	0.94	40	EF change qualifies
SE50M12AA01	0.92	50	discontinued, still qualifies
GE50T6EA	0.93	50	discontinued, still qualifies
SE50T12AA01	0.93	50	discontinued, still qualifies
PE65T0A	0.94	65	discontinued, still qualifies
SE80T12AA01	0.94	80	discontinued, still qualifies
PE50M09*	0.93	50	
PEM5012*	0.93	50	discontinued, still qualifies
PE50T09*	0.93	50	
SE50T12*	0.94	50	
PE65T09*	0.92	65	
GE40T06*	0.93	40	
GE30T06*	0.92	30	EF change but qualifies
PE30S00*	0.92	30	EF change but qualifies
SE80T12*	0.92	80	
SE40M12*	0.94	40	
GE50T06*	0.94	50	
GE80T06*	0.86	80	discontinued, still qualifies
SE50M12*	0.93	50	
PE65T09AAH00	0.89	65	discontinued, still qualifies
SE80T12AAH00	0.86	80	discontinued, still qualifies

Trade Name: Hotpoint

Model #	Energy Factor	Gallon Size	
HE30M01*	0.82	80	EF lowered, but qualifies

Trade Name: Professional (previously named Hotpoint)

Model #	Energy Factor	Gallon Size	
RHEPRO40-2T	0.93	40	discontinued, still qualifies
RHEMPRO52-2	0.92	50	discontinued, still qualifies
RHEPRO62-2	0.92	50	discontinued, still qualifies
RHEPRO62-2T	0.93	50	discontinued, still qualifies
RHEPRO66-2	0.94	65	discontinued, still qualifies
RHEPRO66-2T	0.94	65	discontinued, still qualifies
RHEPRO80-2	0.90	80	discontinued, still qualifies
RHEPRO80-2T	0.94	80	discontinued, still qualifies
RHE PRO40-*A	0.94	40	
RHEM PRO52-*A	0.93	50	
RHE PRO52-*A	0.94	50	
RHE PRO66-*A	0.92	65	
RHEM PRO30-*A	0.90	30	Lower EF, but qualifies
RHE PRO80-*A	0.92	80	
RHEPRO40-*T	0.93	40	discontinued, still qualifies
RHEMPRO52-*	0.92	50	discontinued, still qualifies
RHEPRO62-*	0.92	50	discontinued, still qualifies
RHEPRO62-*T	0.93	50	discontinued, still qualifies
RHEPRO66-*	0.94	65	discontinued, still qualifies
RHEPRO66-*T	0.94	65	discontinued, still qualifies
RHEPRO80-*	0.90	80	discontinued, still qualifies
RHEPRO8-*T	0.94	80	discontinued, still qualifies

Trade Name: Rheem**Comments:**

The first "" denotes the warranty period and may be replaced by the following letters: V,I,J,K,X, or a dash.

The second "" denotes the single or double element model and may be replaced by the following alphanumerics: S, D, 1 or 2.

Model #	Energy Factor	Gallon Size	
72"40-*	0.93	40	
82"R40- [*] T	0.93	40	discontinued, still qualifies
82M"R52-*	0.92	50	discontinued, still qualifies
82"R52-*	0.92	50	discontinued, still qualifies
82"R52- [*] T	0.93	50	discontinued, still qualifies
82"R66-*	0.91	65	discontinued, still qualifies
82"R66- [*] T	0.91	65	discontinued, still qualifies
82"R80-*	0.90	80	discontinued, still qualifies
82"R80- [*] T	0.91	80	discontinued, still qualifies
81"120"1-B	0.86	119	discontinued, still qualifies
83VR40-*	0.94	40	EF change still qualifies
83MVR52-*	0.93	50	
83VR52-*	0.93	50	
83"R52-*	0.94	50	
83VR66-*	0.91	65	
83"R66-*	0.92	65	
83VR80-*	0.92	80	EF change still qualifies
82V120-2	0.86	119	discontinued, still qualifies
83"R40-*	0.94	40	
83M"R52-*	0.93	50	
83"R52R [*]	0.94	50	discontinued, still qualifies
82"R40- [*] T	0.93	40	discontinued, still qualifies
82M"R52-*	0.92	50	discontinued, still qualifies
82"R52-*	0.92	50	discontinued, still qualifies
82"R52- [*] T	0.93	50	discontinued, still qualifies
82"R66-*	0.91	65	discontinued, still qualifies
82"R66- [*] T	0.91	65	discontinued, still qualifies
82"R80-*	0.90	80	discontinued, still qualifies
82"R80- [*] T	0.91	80	discontinued, still qualifies
81"120"1-B	0.86	119	discontinued, still qualifies

Trade Name: Rheem-Ruud Light Duty Electric

Model #	Energy Factor	Gallon Size	
ELD80	0.88	80	discontinued, still qualifies
ELD40-B	0.94	40	
ELD52-B	0.94	50	
ELD66-B	0.92	65	
ELDS30-B	0.90	80	EF change but qualifies
ELD80-B	0.92	80	

Trade Name: Vanguard

Model #	Energy Factor	Gallon Size	
1PZ84	0.93	40	discontinued, still qualifies
1PZ85	0.93	50	discontinued, still qualifies
1PZ86	0.91	80	discontinued, still qualifies
1PZ82	0.86	119	discontinued, still qualifies
3WA67	0.92	80	EF Changed, but qualified
3WA70	0.94	40	
3WA73	0.94	50	
3WA76	0.92	80	

Richmond Water Heaters

Trade Name: Richmond

Comments:

The first "" denotes the warranty period and may be replaced by the following letters: V, I, K or X.

The second "" denotes the single or double element model and may be replaced by the following numbers: 1 or 2

Model #	Energy Factor	Gallon Size	
RMEM*R40-TI	0.93	40	
9EMR40-	0.93	40	
*EM40-	0.94	40	discontinued, still qualifies
*EMR40-	0.94	40	
RMEM*R50-TI	0.92	50	
RME*R50-TI	0.93	50	
9EMR50-	0.92	50	
*EMR50-	0.93	50	
9ER50-	0.93	50	
*ER50-	0.94	50	
RME*R65-TI	0.91	65	
9ER66-	0.91	65	
*ER66-	0.92	65	
RME*R80-2	0.88	80	discontinued, still qualifies
RME*R80-TI	0.91	80	
RME*R80-	0.88	80	
9ER80-	0.88	80	Lower E.F. but qualifies
*ER80-	0.92	80	
8V420-2T-B	0.86	119	discontinued, still qualifies
6E420-2	0.86	119	discontinued, still qualifies
T2V40-2	0.93	40	

Trade Name: Richmond Light Duty Electric

Model #	Energy Factor	Gallon Size	
TELD80	0.88	80	
TELD40-B	0.94	40	
TELD52-B	0.94	50	
TELD66-B	0.92	65	
TELD530-B	0.90	30	EF change still qualifies
TELD80-B	0.92	80	
TELD120-B	0.86	119	discontinued, still qualifies

Ruud Water Heater Division**Trade Name: Professional**

Model #	Energy Factor	Gallon Size	
RUEPRO40-*T	0.93	40	
RUE PRO40-*A	0.94	40	
RUEMPRO52-*	0.92	50	
RUEPRO52-*	0.92	50	
RUEM PRO52-*A	0.93	50	
RUEPRO52-*T	0.93	50	
RUE PRO52-*A	0.94	50	
RUEPRO66-*	0.91	65	
RUEPRO66-*T	0.91	65	
RUE PRO66-*A	0.92	65	
RUEPRO80-*	0.90	80	
RUEPRO80-*T	0.91	80	
RUEM PRO30-*A	0.90	30	EF Change, still qualifies
RUE PRO80-*A	0.92	80	

Trade Name: Ruud**Comments:**

The first "" denotes the warranty period and may be replaced by the following letters: V,I, J,P,X or M.

The second "" denotes the single or double element model and may be replaced by the following numbers: 1 or 2

Model #	Energy Factor	Gallon Size	
E*R40-*T	0.93	40	
E3R-40-	0.94	40	
EM*R52-*	0.92	50	
E*R52-*	0.92	50	
E*R52-*T	0.93	50	
PE3MR-52-*	0.93	50	
E*R66-*	0.91	65	
E*R66-*T	0.91	65	
E3R-66-	0.92	65	
E*R80-*	0.90	80	
E*R80-*T	0.91	80	
PE2M-30-*	0.90	30	EF Change, still qualifies
E3R-80-	0.92	80	
*E120-*T-B	0.85	119	discontinued, still qualifies
PE2-120-2	0.85	119	discontinued, still qualifies
E3R-52-	0.94	50	

Sears, Roebuck and Company

Trade Name: Kenmore

Model #	Energy Factor	Gallon Size	
153.320492HT	0.93	40	
153.320493HT	0.93	40	
153.321512HT	0.92	50	
153.321513 HT	0.92	50	
153.320592 HT	0.93	50	
153.320593 HT	0.93	50	
153.320692 HT	0.91	66	
153.320693 HT	0.91	66	
153.320892 HT	0.91	80	
153.320893 HT	0.91	80	
153.321340	0.95	30	E. F. change still qualifies
153.321341	0.95	30	
153.329360	0.95	30	
153.329361	0.95	30	
153.329460	0.93	40	
153.329461	0.93	40	
153.321440	0.95	40	
153.321441	0.95	40	
153.313640	0.93	50	
153.326660	0.93	50	
153.326661	0.93	50	
153.329560	0.93	55	
153.329561	0.93	55	
153.321540	0.95	55	
153.321541	0.95	55	
153.321640	0.95	66	
153.321641	0.95	66	
153.329660	0.92	66	
153.329661	0.92	66	
153.321840	0.95	80	
153.321841	0.95	80	
153.329860	0.93	80	EF change still qualifies
153.329861	0.93	80	EF change still qualifies
153.329262	0.93	38	New

A.O. Smith Water Products Co.

Trade Names: National, A.O. Smith, Glascote, Perma-Glas

Model #	Energy Factor	Gallon Size	
EEH-52	0.92	50	
EEH-52-920	0.92	50	
PEH-52	0.92	50	
PEH-52-920	0.92	50	
EEH-52-930	0.93	50	
PEH-52-930	0.93	50	
EEH-66	0.95	66	
PEH-66	0.95	66	
EC-80T	0.89	80	discontinued, still qualifies
PES-80T	0.89	80	
EEH-80	0.92	80	discontinued, still qualifies
PEH-80	0.92	80	discontinued, still qualifies
EC-120	0.83	119	discontinued, still qualifies
EES-120	0.83	119	discontinued, still qualifies
PES-120	0.83	119	discontinued, still qualifies
EC-120T	0.85	119	discontinued, still qualifies
EES-120T	0.85	119	discontinued, still qualifies
PES-120T	0.85	119	discontinued, still qualifies
PEC-120	0.83	119	discontinued, still qualifies
PXHS-40	0.95	40	
ECRT-40	0.93	40	
PXHT-40	0.95	40	
ECRT-52	0.93	50	
PXHT-52	0.95	50	
ECRS-50	0.93	50	
PXHS-52	0.95	50	discontinued, still qualifies
ECT-66	0.88	66	
PXHT-66	0.95	66	
ECRT-66	0.92	66	
PXHT-80	0.95	80	
ECRT-80	0.93	80	
PXHS-50	0.95	50	
ESM-40	0.93	40	
ESM-50	0.95	50	

State Industries

Trade Name: State

Comments:

(**) indicates 1 through 15 or X for warranty.

All models may have one or more of the following suffixes: B,E,G,J,K,M,NC,R,V,W,X or Y.

First digit of suffix may be replaced by 1 to denote a single element model.

Model #	Energy Factor	Gallon Size	
P**622OCTJW**	0.90	60	EF changed, but still qualifies
P**662OCTJW**	0.94	66	discontinued, still qualifies
P**822OCTJW**	0.87	80	EF changed, but still qualifies
ES6 40 DOCT	0.93	40	
EPX 40 DXRT	0.95	40	
IN1 50 DHMT	0.92	50	
SCV 50 DHMT	0.92	50	
ES**52 DOCT	0.93	50	
EP**52 DXRT	0.95	50	
ES**50 DOCS	0.93	50	
EP**50 DXRS	0.95	50	
ES**66 DOCT	0.92	66	
ES**66 DORT	0.88	66	
IN1 66 DORTE4	0.88	66	
IN1 66 DORTE5	0.88	66	
EP**66 DXRT	0.95	66	
EP**66 DOCT	0.92	66	discontinued, still qualifies
EP**80 DXRT	0.95	80	
ESX 40 DOCT	0.93	40	New
ES**80 DOCT	0.93	80	
**50 DLRS	0.95	50	
**50 DLRT	0.95	55	
**50 DART	0.95	55	
**80 DLRT	0.95	80	
**80 DART	0.95	80	
**40 DXRS	0.95	40	discontinued, still qualifies
IN1 52 DHMTEH	0.95	50	discontinued, still qualifies
IN1 40 DHMSE3	0.93	40	
IN1 40 DHMSE4	0.93	40	
IN1 40 SHMSE3	0.93	40	
IN1 40 SHMSE4	0.93	40	
IN1 52 DHMTE3	0.93	40	
IN1 52 DHMTE4	0.95	50	
SCI 40 DHMS	0.93	40	New
SCI 52 DHMT	0.95	50	New
SCV 40 DHMS	0.93	40	
SCV 52 DHMT	0.93	40	
EP40 DXRS	0.95	40	
IN1 52 SHMTE3	0.95	50	
IN1 52 SHMTE4	0.95	50	

U.S. Craftmaster Water Heaters

Trade Names: ACE, American Hardware, America's Best, Apex, Aqua Temp, Aqua Therm, Aquamatic, Best, Best Deluxe, Craftmaster, De-Limer, Deluxe, Eagle, The Earl's Energy Conservation Water Heater, The Earl's Energy Saver Plus, Envirotemp, Four Most, Hotmaster, Hotstream King Kleen, King-Line, Master Plumber, Nationaline, Neptune, Penquin Prestige, Pro-Line, Pro-Line Plus, Quaker, Quick-Flo, Raywall, Revere, Riviera, Sands, Sentinel, Servistar, Shamrock, Special Deluxe, Standard, Supereagle, Super Flo, Supreme, Sure-Fire, Thoro-Clean, True-Test, Tru Value, U.S. Craftmaster, U.S. Supply, XCL Energy Saver, Whirlpool

Comments:

First asterisk after first number in model number may be replaced with any letter (A,E,F,H,J or Z) signifying warranty period.

May have prefix "S"

First asterisk after model number may have "D" or "S".

Second through fourth asterisk after model number may have change to total wattage.

May have any combination of the following suffixes: V,M or X.

May have suffix "CO".

Model #	Energy Factor	Gallon Size	
EE3*40R*****	0.95	40	
E3*50H****C***	0.93	60	discontinued, still qualifies
EE2*50H*****	0.92	50	
EE3*50H*****	0.93	50	
E3*50R****C***	0.93	50	
EE3*50R*****	0.95	50	
EE2*-50R*****	0.92	50	
EE2*65H*****	0.90	66	
E3*65H****C***	0.91	66	
EE3*65H*****	0.92	66	
EE2*80H*****	0.90	80	
E3*80H****C***	0.91	80	
EE3*80H*****	0.92	80	
E2*110R****C***	0.83	110	discontinued, still qualifies
E2*110R****H***	0.83	110	discontinued, still qualifies
E3*50H****O***	0.93	50	
E2*65H*****	0.90	66	

Vaughn Manufacturing Corp.

Trade Names: Sepco, Hydrohot, D.W. Whitehead

Model #	Energy Factor	Gallon Size
M-50	0.92	50
S-50	0.92	50
S-70	0.88	70
M-80	0.91	80
M-80PS	0.90	80
S-80	0.90	80
M-100TPS	0.90	100

CERTIFICATE OF SERVICE

The foregoing order was served on the date of filing by mail, postage prepaid, and properly addressed to the following parties:

CATHERINE P. AWAKUNI
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DIVISION OF CONSUMER ADVOCACY
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PRESIDENT
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Kahului, HI 96733-6898

RANDALL HEE
PRESIDENT AND CHIEF EXECUTIVE OFFICER
KAUAI ISLAND UTILITY COOPERATIVE
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Lihue, HI 96766

THE HONORABLE MUFI HANNEMANN
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Certificate of Service

Page 2

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