VILLAGES AT WAIPIO

OWNERS NOTIFICATION and CONSENT
FOR SOLAR DEVICE INSTALLATION

In as much as each solar collector installed at Villages at Waipio will be installed on a common element, consent by the Board of Directors is required and shall be granted prior to the installation of such device provided that the homeowner agrees to the "Solar Installation Rules and Restrictions" in writing:

The Association does require the owner to complete and submit this notification form and the "Application for Alteration Approval" to the Board of Directors prior to any solar device installation.

Owner(s) Name(s) _____

Address and Apt. Number _____

Company Performing Installation _____

Company Address _____

Company Phone Number (Date of Installation _____

Indicate the method of installation and how the device will be secured

_____

_____

(((((Additional sheets of paper may be used if necessary)))))

The installation must comply with the Association's "Guidelines on Solar Energy Devices", "Hawaiian Electric Company Standards and Specifications", as well as the manufacturer's guidelines and applicable building codes.

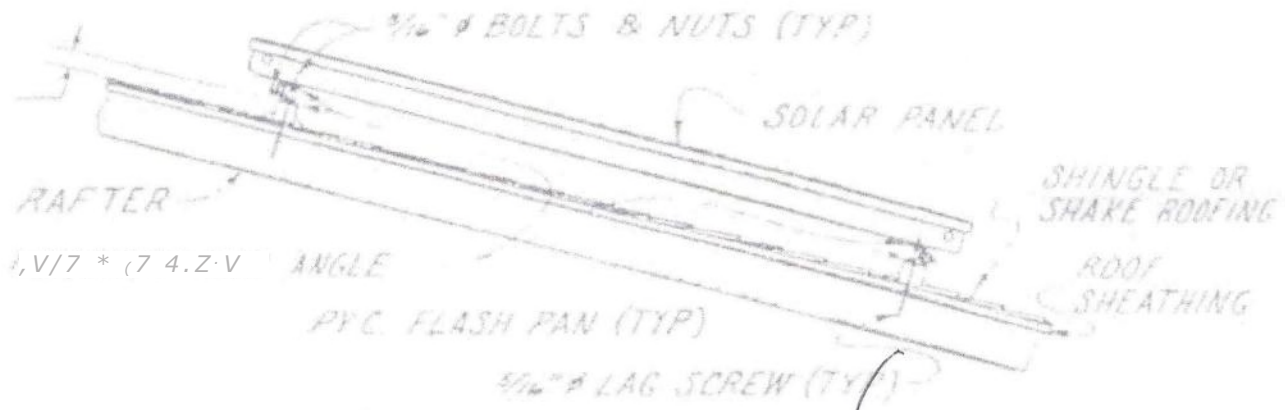
After reviewing the above terms and conditions, and those of the Villages at Waipio "Guidelines on Solar Energy Devices", please sign the following statement:

> I/We will comply with the association's **Guidelines on Solar Energy Devices.** I/We will assume liability for any personal injury or damages to Association and other residents' property or exclusive-use areas that occurs due to Solar Device installation, maintenance and use.
>
> I/We also agree to execute a recordable document formalizing the Solar agreement and binding any future purchases to the same obligation.
>
> I/We also agree to assume full responsibility for the removal/replacement of the Solar Device for the purpose of facilitating roof repairs or replacement.

_____ _____ _____
(Signature) (Print Name) (Date)

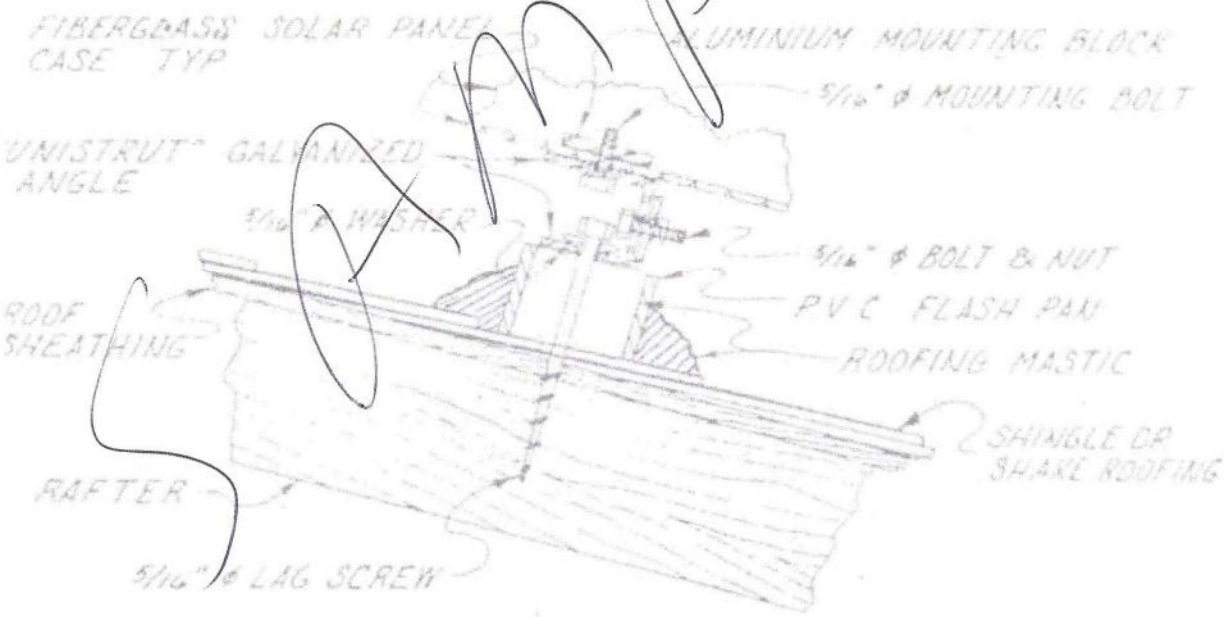
_____ _____ _____
(Signature) (Print Name) (Date)

FRONT ELEVATION
FRONT DOOR
WINDOW
Lower Roof
WINDOW
SOUTH SIDE ELEVATION
SLIDING DOOR
Lower Roof
WINDOW
Roof
12-3'x5' SOLAR PANELS FLAT MOUNTED
WINDOW
Sample



SIDE VIEW

1/2" = 1'-0"



TYPICAL MOUNTING DETAIL

3" = 1'-0"

STANDARD MOUNTING PLAN		
SCALE: AS NOTED	APPROVED: J.W.	DRAWN BY: P. BROCK
DATE: SEPT. 24, 1981		REVISED
SOLAR HOT WATER PANELS		
SLOPED ROOF MOUNT		DRAWING NUMBER: 1 OF 1

SunPro Collector Series

Manufactured in Hawaii, *for* Hawaii since 1981

Aribther Superior EPI-308

industrial Grade. DO able.
Designed for Hawaii's 'ate, the SunPro Collector is precisely asser bled under stringent y
Control management. Engineere d to me d all maior governmental and local specifications.
the Sun Pro Collector ensures a continuous pp ly of hot water for your family,

FULL 12 Year Manuf*a* urers Warranty

• atcr eitiminu
9 het hq t Fre:ght casing for ernat
mponents of am StroPra Its durable bronze
dezen coxing k.?..nsures ttif they .pretmton
tron, Hawmrs hamh chntate Stainless steel
fast ers securely attach the glazing thm to the
or frame _____ -_____•

Hi has an iron t, o r of less than .05%.
Custom manutar t• ured fo s l i t r thermal applications.

All Copper
The SunPro ury6nrrnssed
or' ducts available 0 blawao wail
a9ckness -- and 0 lubmg per square
fmt SunPro; abs,orbco boasts an
ay-copper tune ar•:,r ,i;:dti,!ihc·i 5
OD Type- •,41-a,ie
tubirq High fitiKi CapItAy

Low-Iron Glass

Hi-Temp Insulation
SunPro is fiberglass insula! rte'.
temperature resistant mat long-
i ting and eff „tent. Fawn ne
insulation can degrade or expand at high
temperatures.

EPDM Grommets
U-shaped grommets allow for easy absorber
plate removal.

skgt
ith vulcanized corners.

ring Clips
allow for flush or tilt
g any punctures to the

Aluminum Backsheet

Riveted Corner Brackets

Collector

Sun *Pro* Specifications

Model	SP21 / SP21C*	SP24 / SP24C*	SP32 / SP32C*	SP40 / SP40C*
Gross Area (ft²)	20.76	23.69	31.78	39.64
Dimensions (in)	35 x 85	35 x 97	47 x 97	47 x 121
Weight (lb)	88	97	123	170
Fluid Capacity (Gal)	1.3	1.8	2.3	2.8
Wind Load	120	120	120	100

* "C" indicates chrome absorber
All models in stock are SRCC tested and certified
C&C of Honolulu Approval #MM81-40(1)

Mounting Details

All Mounting hardware is for frame without penetrations.

Hook Clips can be positioned anywhere on the frame as flush mount clips or as bottom clips for tilt mounts.

Interlocking Hinge Clips can be used for tilt mounts with square tubing or with a mounting base to fasten collectors to a rail or directly to the roof. Square tubing is cut to length to achieve proper orientation.

DEPARTMENT OF PLANNING AND PERMITTING

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET * HONOLULU, HAWAII 96813
Phone: (808) 768-8220 * Fax: (808) 768-6111

BUILDING PERMIT

FOR THE PERFORMANCE OF WORK UNDER THE
BUILDING ELECTRICAL PLUMBING, AND SIDEWALK CODES
CHAPTERS 16, 17,19, AND 20, RESPECTIVELY, AND UNDER CHAPTER 18
(FEES AND PERMITS) OF THE REVISED ORDINANCES OF
THE CITY AND COUNTY OF HONOLULU

LOCATION

Zone	Section	Plat	Parcel 1
9	4	099	073

A11210 UKA ST

470,230 Sq.Ft.

Site Address (if other than primary):

$0.00

PERMIT FEE
Type of Payments)
Cash
Check
Charge X

Accepted Value of Work: **$14,053**

PROJECT: **(BP #681568) ON-LINE PERMIT [TMK: 94099073] TANAKA, JEAN - New Solar Photovoltaic Installation - MM#: MM2011-0062. Photovoltaic panels to be installed per pre-approved details. There will be no battery storage equipment. PV panels and inverter are not located in setback area.**

TYPE OF WORK

Solar Photovoltaic Mato Y | **Electrical Work Y** | **Other Photovoltaic**

RIGHT OF WAY WORK

Driveway: New | Existing: | Private:

Sidewalk Types: | Curbing Types: | Driveway Types:

linear Ft. of Sidewalk: | linear Ft. of Curbing: | Linear Ft of Driveway:

Please notify the Building Inspector listed below at least 24 hours before starting work In the Right-Of-Way.

GENERAL CONTRACTOR

Revolusun LLC
Contact Info: **Phone: (808) 532-4401**
lorry@revolusun.com
Lic. No.: **CT30244**

NOTES

DATE ISSUED: **1111512011**

Location Permit Issued: **On-Line**

Location Application Created: **On-LIne**

Permission is hereby given to do above work according to conditions hereon and according to approved plans and specifications pertaining thereto, subject to compliance with ordinances and laws of the City and County of Honolulu and State of Hawaii.

is/ Timothy F. T. Hiu
FOR DIRECTOR OF DEPARTMENT OF PLANNING AND PERMITTING

THIS PERMIT MUST BE POSTED IN A CONSPICUOUS PLACE ON THE SITE DURING THE PROGRESS OF WORK. THIS PERMIT MAY BE REVOKED IF WORK IS NOT STARTED WITHIN 180 DAYS OF DATE OF ISSUANCE OR IF WORK IS SUSPENDED OR ABANDONED FOR 120 DAYS.

ELECTRICAL AND PLUMBING WORK TO BE DONE BY LICENSED PERSONS AS REQUIRED UNDER CHAPTER 44$ E. HAWAII REVISED STATUTES.
NOTICE TO HOMEOWNERS, This is to Inform all hurneutviiers that linprovements to your home may require approval by your Homeowners Association or authorized representative prior to the commencement of construction.
Approval by the Department of Ptanning and Permitting does not certify compliance with the Covenants, Conditions and Restrictions or other design restrictions administered and enforced by your Homeowners Association.
ALL CONSTRUCTION UNDER THIS BUILDING PERMIT IS SUBJECT TO INSPECTION BY THE BUILDING OFFICIAL. IT SHALL BE THE DUTY OF THE PERSON DOING THE WORK AUTHORIZED BY THIS PERMIT TO NOTIFY THE BUILDING OFFICIAL THAT THE WORK IS READY FOR INSPECTION,

THE FOLLOWING ARE THE INSPECTORS ASSIGNED TO INSPECT THE CONSTRUCTION UNDER THIS PERMIT AND THEIR TELEPHONE NUMBERS:

	Building Inspector	Electrical Inspector	**Plumbing** Inspector
Name:	**ROGER VIERRA, JR.**	RICHARD GONSALES	
Phone No.:	**(808) 768-3101**	**(808) 768-8176**	

APPLICATION NO.: **A2011-11-0946**

JobID: **43960862**
ExtemaltD: 043960842-002

PERMIT NO.: **681568**

Initial Print Date: Tuesday November 15.2011 2:01 pm

SAMPLE

APPROVED 9/22/05

VILLAGES AT WAIPIO
GUIDELINES ON SOLAR ENERGY DEVICES

WHEREAS, Act 157 effective September 1, 2005 purports to invalidate certain restrictive covenants precluding installation of solar energy devices. The purpose of the Act is to, among other things:

(1) Allow owners of single-family residential dwellings and townhouses to install solar energy devices without board approval, provided that the devices are registered with the appropriate homeowner, community or condominium association, or cooperative, within 30 days of installation; and

(2) Require "private entities" such as . . . community and condominium associations, and cooperatives to adopt rules regarding the placement of solar energy devices.

(3) The Act precludes a community association from preventing installation of a solar energy device on any single-family residential dwelling or townhouse so long as certain conditions are met. The Act recognizes, however, that community associations may adopt rules to facilitate the placement of solar energy devices.

WHEREAS, the Board of Directors wishes to adopt reasonable rules and restrictions governing installation, maintenance and use of Solar Devices to protect the interests of the Association and in the event that section 514A-89, Hawaii Revised Statutes as amended by Act 157 is upheld:

NOW, THEREFORE, the Board of Directors adopts the following guidelines and restrictions governing installation, maintenance and use of Solar Energy Devices at Villages at Waipio contingent upon the law being upheld.

1. **Definitions**

1. Solar Energy Device: Any new identifiable facility, equipment, apparatus, or the like which makes use of solar energy for heating, cooling, or reducing the use of other types of energy dependent upon fossil fuel for its generation; provided that if the equipment sold cannot be used as a solar device without its incorporation with other equipment, it shall be installed in place and be ready to be made operation in order to qualify as a "solar energy device". Solar energy device shall not include skylights or windows.

2. Townhouse: A series of individual houses having architectural unity and a common wall between each unit (where) each unit extends from the ground to the roof. Thus, for example, the Act will not apply to units located solely on the second floor.

3. Common Elements: All portions of the land and improvements within the Villages at Waipio condominium project other than the apartments, as more specifically defined in the By-Law's Declaration and Chapter 514A, Hawaii Revised Statutes.

4. Owner: Person(s) or entity as duly recorded on the property title and as shown in the Association records

5. Collector: Any conventional device used to convert solar rays to heat water as identified by; and meets specifications established by Hawaiian Electric Company (HECO)

The Act provides that owners can install solar energy devices subject to the conditions in the statute and in the rules adopted by the condominium association.

The Act provides that the rules "shall facilitate the placement of solar energy devices and shall not unduly or unreasonably restrict that placement so as to render the device more than twenty-five per cent less efficient or to increase the cost of the device by more than fifteen per cent."

II. General Rules

The conditions for installation of a device on a dwelling or townhouse include:

1. Application for installation must be submitted and receive Board consent prior to installation of any solar device.

2. The device must be installed by a State of Hawaii licensed contractor holding the appropriate specialty license and listed on Hawaiian Electric Company (HECO) participating contractor list that exists at the time of installation.

3. A building permit from the local building department having jurisdiction must be obtained and posted prior to installation.

4. The device must be installed in accordance with current county codes and (HECO) residential standards and specifications for solar water heating and/or solar electric and solar specification that may exist at the time of installation.

5. The device must be installed so that all exterior interconnecting components are minimized, and so that any exterior interconnecting components on vertical surfaces are enclosed and such enclosures shall be of finish material similar in color and texture to the exterior wall or trim.

6. All collection devices shall be placed on the flat roof with minimum tilt required to achieve at least 75% efficiency. Tilt shall never exceed 30 degrees from horizontal.

7. Only a minimum number of collectors are allowed. The total number shall be limited by the roof area above the Owners townhouse and in accordance with efficiency specifications set by HECO.

8. The statute is explicit in that if a collector(s) is installed on a townhouse, it must be installed completely within that portion of the roof located directly above the owner's own townhouse.

9. Devices must be firmly secured to the roof in accordance with applicable HECO specifications.

10. Water storage tanks shall not be placed on the roof, and if placed on apartment or exclusive use space and visible from the grounds or from other units shall be enclosed in a shed of design and location approved by the Board of Directors. Shed design specifications are available from the Site Manager.

11. Owners must be cognizant of surrounding trees, and place the collectors away from established tree branches. The Association has a tree trimming policy/schedule and will not be responsible to selectively trim trees because of improper or poorly placed collectors.

12. If a solar device installation poses a serious, immediate safety hazard, the Association may seek injunctive relief to prohibit the installation or seek removal of the installation.

11. Because the collectors are placed on a common element (the roof) as defined in the association's declaration, then consent by the Board of Directors is required and must be obtained prior to the installation of such device provided that the homeowner binds himself and each successor:

(A) To comply with the Association design specifications and "GUIDELINES ON SOLAR ENERGY DEVICES".

(B) To maintain, repair, remove, and replace the device until the device has been permanently removed from the common elements.

(C) To furnish the Association within fourteen days of approval by the Board a certificate of insurance naming Villages at Waipio as an additional insured on the homeowner's insurance policy.

(D) The owner (and each successive owner of the dwelling or townhouse) is responsible for damages to the common elements or any adjacent units caused from the installation, maintenance, repair, removal or replacement of the device. (Shall require a recorded document)

(E) The owner (and each successive owner) is required to maintain a policy of insurance covering the above obligations and is required to name the community association as an additional insured. (Shall require a recorded document)

(F) The owner (and each successive owner) is required to remove the device if, reasonably necessary or convenient for repair, maintenance or replacement of the common elements. (Shall require a recorded document)

(G) If a roof or other warranty (material or labor) exists at the time the device is installed, the owner is required to obtain, at no cost to the Association, confirmation in writing from the entity issuing the warranty that the installation of the solar energy device will not void the warranty. The owner must provide the Association with a copy of the confirmation.

III. Severability

If any of these provisions is ruled to be invalid, the remainder of these rules shall remain in full force and effect.

Date of Adoption by Board of Directors: ____$^{11}/_{2}\,^{0}$/C)S^{-}____

RESIDENTIAL SOLAR WATER HEATING SYSTEM
STANDARDS AND SPECIFICATIONS
September 21, 2002
{supersedes 5/2/02)
Vrtass09212)

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 BR! 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 30 degrees. Thermosiphon system collectors mounted on roofs whose pitch is less than 14 degrees shall be tilted to 21 degrees or 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 Accented Products List.

2.02. COLLECTOR RATINGS. Collectors shall be of the liquid type and shall have a current Solar Rating & Certification Corporation 0G-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 x 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 manufacturers 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 thermisters, 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 manufacturers 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'/", 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 %", whichever is greater.

2.19.3. Lag-Bolt Sets. Lag-bolt sets shall consist of one lag bolt and one fiat 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. ROOFNVALUCEILING 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.

TABLES 1-5. RESIDENTIAL SOLAR WATER HEATING SYSTEM STANDARDS
[0/01/00 firtable1-53

Effective April, 1, 2000
(supersedes 7/1/99)

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

RETROFIT. OWNER BUILDER		NEW CONSTRUCTION. RENTALS. MILITARY FAMILY HOUSING	
No. of Residents	Storage	No. of Bedrooms	Storage
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.

Nominal Storage Capacity	Daily BTU Requirement	Nominal Storage Capacity	Daily BTU Requirement
30 gals.	13,745	66 gals.	30,238
40 gals.	18,326	80 gals.	36,652
50 gals.	22,908	100 gals.	45,815
52 gals.	23,824	120 gals.	54,978
60 gals.	27,489		

Table 3. Tilt Factors

Tilt (in deg.)	Addi Collector BTU	Tilt (in deg.}	Acid'I Collector BTU
14	0%	50	15%
35	0%	55	20%
40	5%	60	25%
45	10%		

Table 4. Minimum Support Structure Anchors*

No. of Collectors	Collector Size	No. of
1	any size	4
2	3' x 7' or 3' x	4
2	1©3'x8'and1 (f114'x 8'	4
2	4'x 6' or 4'x 8' or 4'x10'	6
3	3' x 7' or 3' x	6
3	2 (§)3'x8'and 1©4'x 8'	8
3	1 ©3'x8'and 2 ©4'x8'	6
3	4' x 6' or 4' x 8' or 4' x 10'	8
4	3' x 7' or 3' x	8
4	2 (g} 3'x8'and 2 (g4'x8'	B
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)

Module Output	18 AVVG	16 AWG	14 AWG	12 AVVG	10 AVVG	8 AWG
5 W	54 ft	109 ft	219 ft	327 ft	545 ft	>1000ft
10W	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/e	n/a	24 ft	36 ft	60 ft	96 ft

Form 1. Residential Solar System Sizing Verification

Customer _____ Contractor _____

Authorization No(s). _____ Phone _____

Subcontractor(s) Used 0 Yes ID No Contact _____

If yes, Name & License No. _____ Centralized Dual System 0 Yes 0 No

Collector AcceSs: One Story / 1Wo Story / Other Tank Access: Locked / Unlocked

SYSTEM DATA

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

HOT WATER STORAGE SIZING

	gat/day	Line
1. Hot Water Use (No. of Residents x 20 gal/person/day) QL1 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 lbb Baths Taken/Week x 20 4- 7 days)		3
4. Clothes Washing Hot or Warm Water Use (No. of Loads/Week x 18 4- 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) Cele	BTUWday	6
7. Tank #1		
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

	Accepted	Denied
Inspector Present . Date • I System		
Comments		

INSTRUCTIONS: Contractor to complete all unshaded areas. Company to complete shaded areas.

cir,o 12:33Rawn -nr) **Mail blue & pink copies to HECO. Contractor to retain yellow copy.**

S | PLE HECO Solar Water Heating System Inspection Check Ust

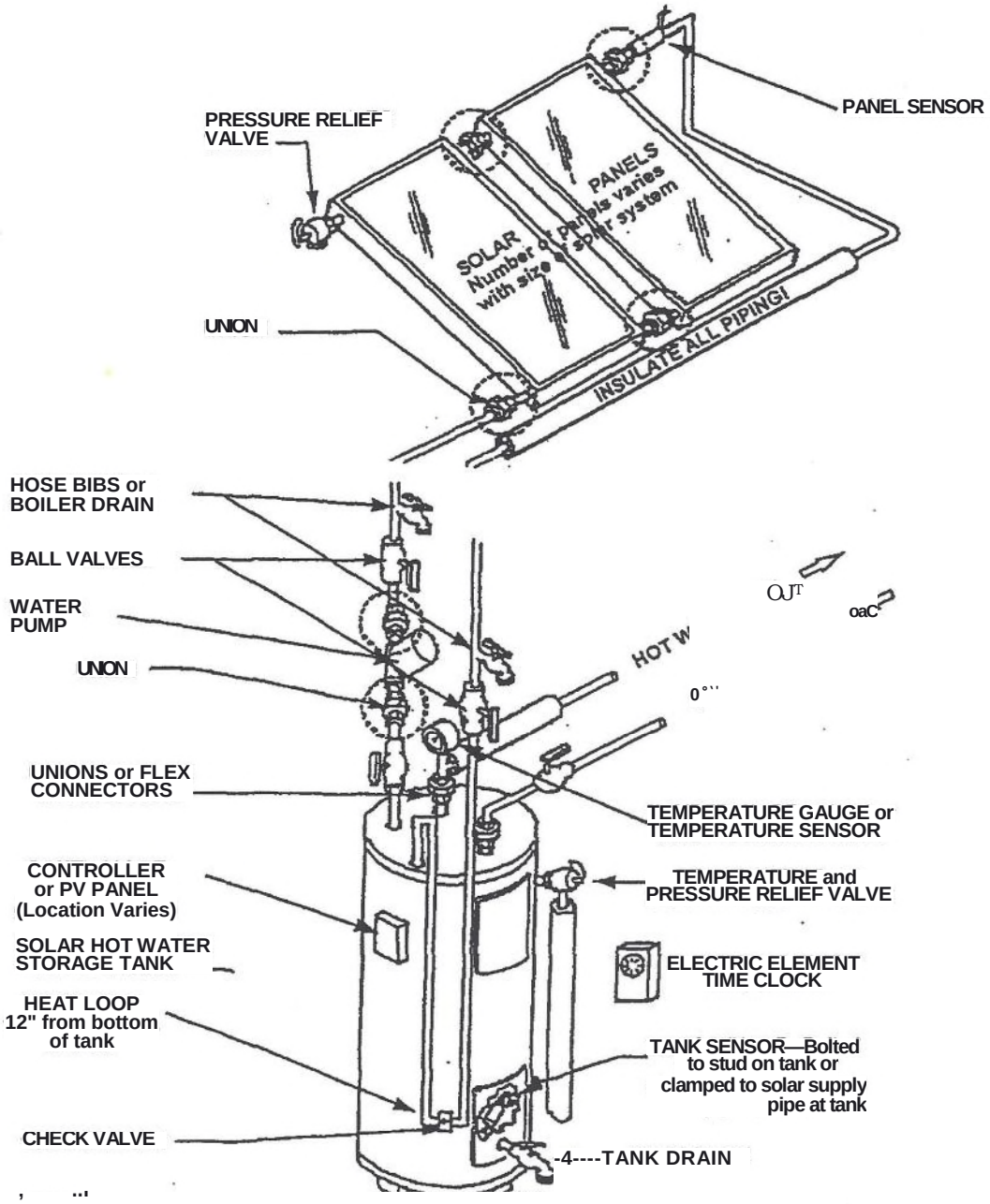
Authorization

Customer			Contractor		
Present			Inspection No. 1 / 2 / 3 / 4 / 5 1 8		
Line	Description	Requirement	Accepted	Denied	Section
1	Cofactor Exposure	unshaded			1.09
2	Multiple Collector Connection Method	parallel			
3	Collector Mounting Brackets	menufactured / number/ sealed / fasteners / mon	.., I	L j	2_04/3_022
4	Collector Lag Sets	manufactured / braced / fasteners / same	I I		2.05/3.02.4
5	Collector Support Stucker	non-axrceive / spacing /fasteners			2.08/3.02.5
5	Support Structure A. Km og Fasteners	number / location / frequency / secure			2.19/3.02.5
7	Collector Sensor Ar mitt	damped / sealed / taped / location			3.04
5	Clearance from Roof	collector / support eructs*			3.02.1/3.02.5
9	Collector Pressure Read Valve	Watts 3L other			2.01
10	Roof Penetration Seated	piping / electric / fasteners			3.09
11	Roof Sealing Method	/ /			3.09
12	Roof Piping	supports / adhered / frequency / bends	1	1 1 1	3.07
13	Root Piping insulation	UV protected			3.08
14	PV Make / Model / Wire Size	/ /	1		2.0113.06
15	Collector Mounting Method	lag / lag with cup / hanger / rod / other			2.08/2.11/3.02
16	Tank a1 !Mrs / Model / Age	/ /			2.01
17	Tank 12 Make / Model / Age	/ /			2.01
18	Tank 113 Make / *Model* / Age	I /			2.01
19	Multiple Tank Connection Method	aeries / check valve / location			1.04/3.03.1
20	Tank Cover Plates / Warning Labels	accessible / visible			3.03
21	Tank Heat Loop	s 12. / secure			3.03
22	' Tank Sensor Connection	damped / sealed / taped / stud / location	1 1 I t	I I I 1	3.04
23	Tank Thermostat Setting	1120 deg. F			3.03
24	Tank Support	slab / bricks / shims / stable	1 I	I I	3.03.1
23	Tank TPR	Watts 10=L other / tight			2.0 1/3.01
26	lank Overflow Line	attached / tight			3.03
27	Pump	UP15-18SU 005BC4other / accessible			2.01/3.03
28	Controler	00794 GL30-LCO other / accessible			2.01/3.04
al	Controller Setting	automatic			3.04
30	Time Switch	WH-40 4004-71 other / accessible			2.01/3.05
31	Time Switch Setting(s)	on off / on off			3.05
32	Temperature Gauge / Temperature	Utro SL20 Pasco 1449 other /			2.01
33	Plumbing Material	piping / fittings / valves	I I	I 1	2.13/2.14/2.18
34	Isolation Valve type	ball / leofiange			2.18.1
36	Isolation Valve Location	Cwt / Lsel / Ussi / Sri	1	I 1	3.07
36	Check Valve	swing / horizontal / location	1	I 1	
37	Pit* Supports	material / frequency / bends	1		2,18,2/3,3,0,A
38	Fastening Hardware	stainless steel			2.19
39	Piping insulation	Sal I Sri / Hai / Owl / overflow tine	1 1 1 1	1 I 1 1	220,108
40	Wail / Ceiling Penetrations	pipe / wire	1	1	3.09
41	insulation Joints	sealed / butted I packed	1 1	1 1	3.08
42	System Design Type	top / side / bottom / multiple / other			1.04
43	Overall Installation	workmanlike			3.01
44	System	operational			9.01
45	Inspection Results	system			1.03
Line	Comments	Inspection Date / Tan.		Inspector	

tit Hawaiian Electric Co., Inc.

PO Box 2750 Honolulu, HI 96840-0001

FIGURE 3.
TOP-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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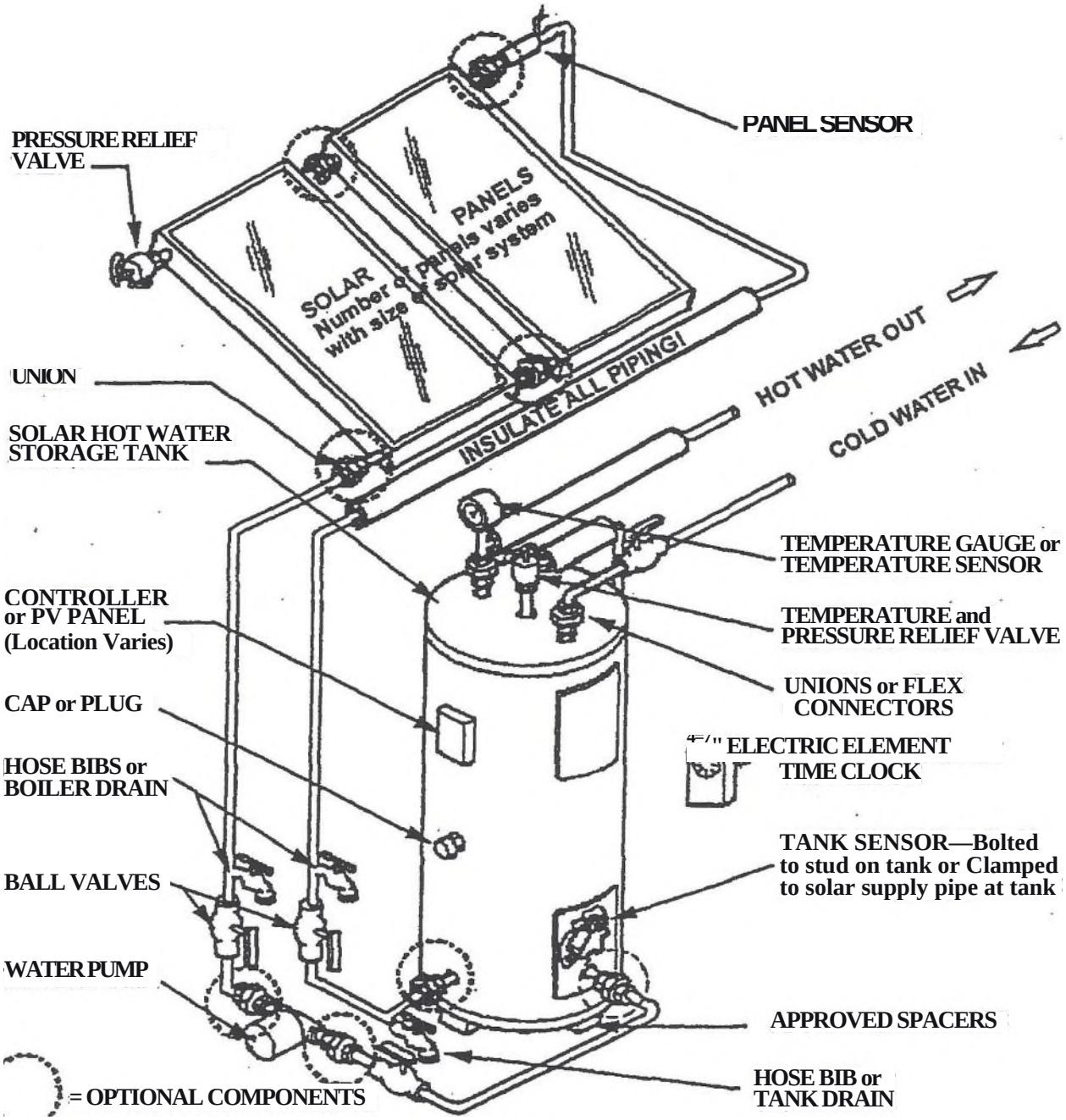
Honolulu, Hi 96840-0001

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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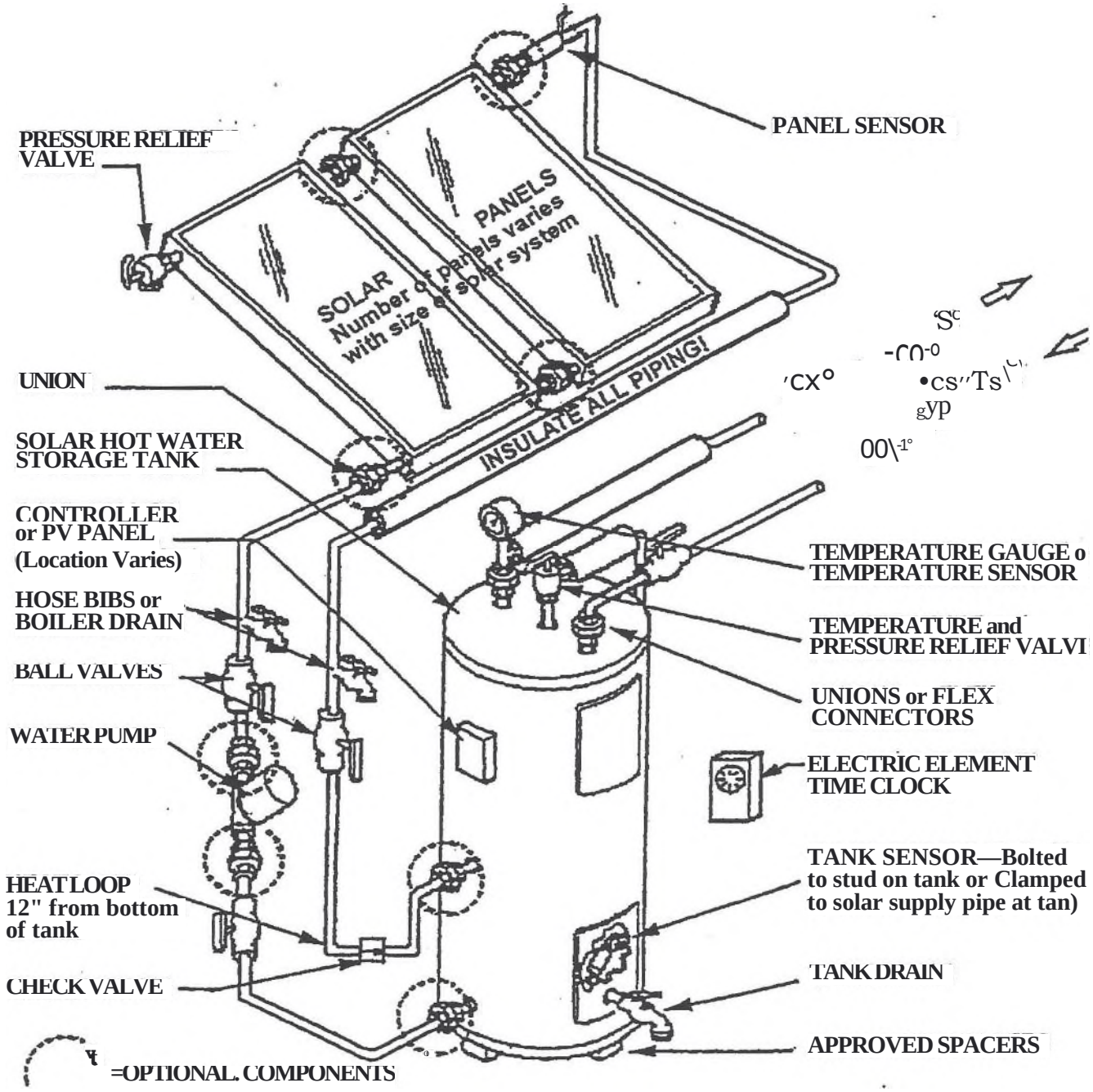
FIGUFIE

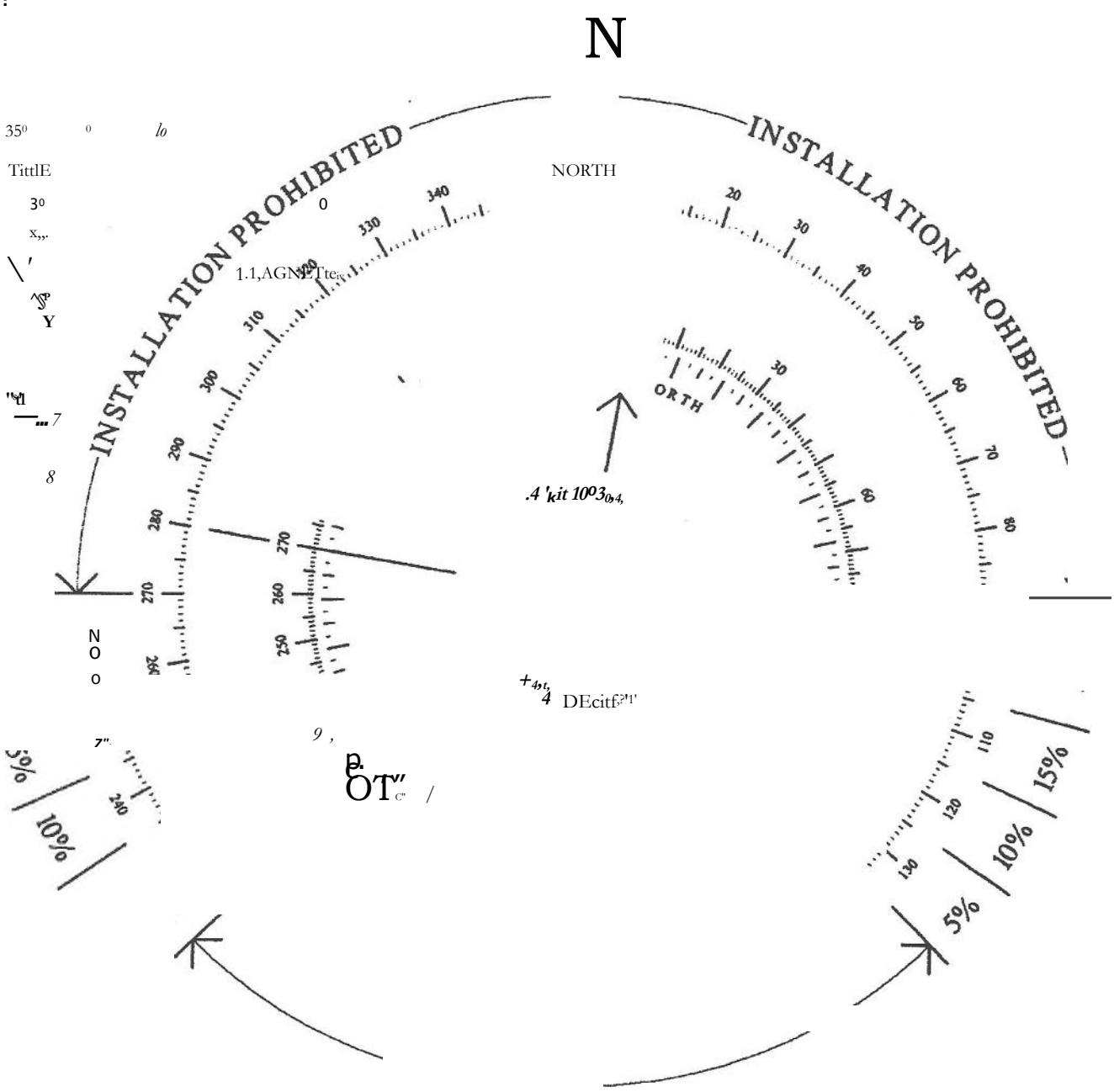
SIDE-RETURN RESIDENTIAL FORCED CIRCULATION SYSTEM DESIGN



(Effective 7112/98)

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

Chart 1. Orientation Factors for Solar Installations in Hawaii



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

0G-100 Protocol Format	1(BTU/sq ft day)	1843	1661	1.476	1292
Hawaii Sunshine Zone	!(Cal/ cm/day)	500	450	400	350
140m.Sizi- iCoating	;Model				
4' x 7'	;Paint	jAE-28E	19,926	16,728	12,915
		MSC-28E	16,728		12,915
4' x 7'	Selectivei	,AE 28	25,830	22,298	18,696
		;MSC-28	26,753	23,247	19,680
4'x 8'	Paint	AE-32E	26,753	22,773	14,465
EP-32			29,620	25,619	17,564
1EPI-308CU (4' x 8')			27,875	23,721	15,498
		IEP1-308SS (4' x 81	23,721	19,750	15,498
T			26,094	21,648	17,564
		1MSC-32E	26,753	22,773	14,981
		SP-32	29 520	25,619	21.648
		SSP-32	28,598	24,670	20,664
		,5 P 32	27,675	23,721	19,750
		1408P-14P	28,598	24,196	19,680
4' x 8'	Selective	IAE-32	29,520	25,619	21,648
		EC-32	31,365	27,517	23,616
		IC-32	31,365	27,517	23,616
		MSC-32	29,520	25,619	21,648
		SC-32	31,365	27,517	23,616
1SSC-32		I408C-HP	30,443	26,568	22,632
			33,210	28,940	24 600
	Paint	1AE-40E	33,210		
22,214 36,900		JEP-40			32,261
11P-40			37,823	32,736	27,552
		MSC-40E	33,210	28,466	23,616
		SP-40	36 900	32,261	127,552
		SSP-40	35,978	31.312	26,568
		SI-40E	32,288	27,517	22,632
S4POrG40			35,055	29,889	24,600
		-HP	35 055	29.889	24,600
		EC-40	31,787	26,568	21,697
		-40	36,900 38,745	33,684	28,536 23,247
			39,668	34,633	29,520 23,754
		SSC-40	33,684	28,536	23,247
		MSC40	38,745	33,684	28,536
			38,745		23,764
			37,823	32,736	27,552 22,736
		-HP	41,513	35,582	29,520
		-Hp	42,435	35,582	28,536
	Paint	74			21,697
		412c-Hp	49,815	43,737	37,146
WXfi	rBiliCU Ve				29;46

1.ilaluealiiiiiiiiiiiiniF4iiituiiiiiiii Zones are interpolated assuming a linear relationship.

2. Values for the 300 Sunshine Zone equals the 350 Sunshine Zone per Section 2.02,

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