

QAiST - Deliverable D.3.3

Improved extrapolation
procedure for the determination
of the performance of factory
made systems -

Description and guidelines

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Introduction

Deliverable 3.3 includes the description and guidelines of the “Improved extrapolation procedure for the determination of the performance of factory made systems”

The starting point for this sub task of WP3 (T3.2.1) was work done in the Solar Keymark II project. Here a proposal was made for an extrapolation procedure for the determination of the performance of factory made systems - BUT this proposal was NOT approved by the Solar Keymark Network and the CEN Certification Board.

It was very important for the industry to have such a procedure as fast as possible, so this was given high priority in the project - and some co-financing from ESTIF to speed up this process.

During summer 2009 such procedure was developed and tried out by the participants. In September 2009 the procedure was approved at the Solar Keymark Network meeting - and in October also approved at the CEN Certification board meeting.

Already in November 2009 at least 5 test labs had received requests for “flexible system testing” showing the big interest for this issue amongst the industry.

The first version approved by the Solar Keymark Network was not applicable to thermosyphon systems when tested according to CSTG test method.

Further work was performed for validation of the application of f-chart system performance extrapolation to systems tested according to CSTG test method and the results presented to the Solar Keymark Network in March 2011. A revised version of Annex D was approved. This corresponds to the present version - SKN_N0106R6annexDR6,28/3 2011.

It was also decided within the QAiST project to establish a Round Robin Test of the DST Evaluation and Extrapolation Method for System Families. The result of this Round Robin is described also in this Deliverable and constitutes an additional Guideline for the application of the procedure. This document provides a list of common errors made during the evaluation of factory made system families according to the SKN scheme rules. It provides a reference for the participating test labs to improve their

evaluation procedures. It may be also used by test labs not participating in this test to perform the same exercise and compare the own results to the results discussed in this document.

The most sensible part of the long term performance prediction for factory made system families is the evaluation according to the DST method. The results discussed in this document indicate that there is an uncertainty up to $\pm 5\%$ for the calculation of the solar fraction F_{sol} by different test laboratories based on the same measurement data. Most of the deviations are caused by incorrect configuration files, usage of outdated meteorological input data or oversights during the setup of the LTP prediction.

The collected results regarding the application of the extrapolation procedure for factory made system families have revealed some issues as well.

Unfortunately not all test labs achieved to calculate the correct fixed and extrapolated parameter sets. Some possible errors have been identified and discussed in chapter 0. Hopefully this document will help each laboratory to check their implemented calculation routines and improve them if necessary.

In the following is enclosed:

- Section 4.4. of the “System families”
- ANNEX D of the extrapolation procedure for the determination of the performance of factory made systems “Solar Keymark System Families”
- ”Detailed guidelines and examples for f-chart system performance extrapolation”
- ”Detailed guidelines and examples for DST system performance extrapolation”
- Proposal of Revision of Annex D – Section D4/D4.1.
- Round Robin Test of the DST Evaluation and Extrapolation Method for System Families

❑ Section 4.4. of the “System families”

4.4 System “families”

If the manufacturer produces the “same” system in different sizes, the different sizes of the system is considered being the same type (within the same system “family”); the different sizes of the system type are sub types. Detailed requirements for systems to be of the same type are given in Annex D.

Testing requirements for systems of the same type are:

- High temperature and safety tests (according to EN 12976) shall be performed on the sub system having the highest collector area to store volume ratio.
- All other tests (according to EN 12976 and including performance test) shall be performed on the “medium” sub system. Detailed testing requirements are given in Annex D.

Performance indicators for the system sub types which are not performance tested can be determined based on the performance test result on the “medium” sub system according to the procedures described in Annex D.

[Specific CEN Keymark Scheme Rules for Solar Thermal Products, Version 13.01 - January 2012]

**ANNEX D. SOLAR KEYMARK SYSTEM
FAMILIES (SKN_N0106R6annexDR6 -
28/3 2011)**

ANNEX D. SOLAR KEYMARK SYSTEM FAMILIES

D.1 System family, system subtype

A system family is a family of different system configurations / sizes of the same system subtype.

In D.2 the requirements for considering systems as being of the same subtype are given.

D.2 Requirements for grouping different system configurations into one system family

In the following the indices max and min indicates maximum and minimum values of the parameter for all systems in the family.

Values to be used to check the below requirements are taken from:

- Collector parameters: EN 12975 test report
 - Other values: Manufacturers declaration; check of values shall be performed by test lab based on drawings and other material/information provided by manufacturer.

 - Hydraulics:
 - same principle layout of solar and load loops
 - Heat transfer fluid :
 - same type of liquid (same brand and same water mixing percent - or declaration from manufacturer that the fluid is equivalent)
 - Heat exchanger(s) (if any):
 - same type of heat exchanger (mantel / spiral / external)
 - heat transfer coefficient of heat exchanger shall - for each system configuration - be known/declared and large enough to fulfil:
 - $(UA)_{hx} > 10 K_{50} \eta_{0a} (A_a a_c + U_{loop,total})$
(determination of $(UA)_{hx}$, see D.4.2.1)
- where:

- $(UA)_{hx}$: Heat transfer coefficient of the solar loop heat exchanger, W/K
- K_{50} : Collector incidence angle modifier at 50°, -
- η_{0a} : Collector zero heat loss efficiency coefficient, -
- A_a : Collector aperture area of collector array, m²
- a_c : Collector heat loss coefficient at $T_m - T_a = 40$ K, W/(K m²);
 $a_c = a_{1a} + a_{2a} * 40$
- T_a : Air temperature, °C
- T_m : Collector mean temperature, °C
- a_{1a} : 1st order collector loss heat coefficient based on aperture area, W/(K m²)
- a_{2a} : 2nd order collector heat loss coefficient based on aperture area, W/(K² m²)
- $U_{loop,total}$: Total heat transfer coefficient of solar loop; $U_{insu} + U_{un-insu}$, W/K
- $U_{un-insu}$: Heat loss coefficient of un-insulated part of collector loop piping, W/K
- U_{insu} : Heat loss coefficient of insulated part of collector loop piping, W/K

- Tank(s):

- same brand - or declaration from manufacturer that the brands of the tanks are equivalent)
- same tank orientation (vertical or horizontal)
- same tank material
- same inside coating
- requirements on heat losses:
 - same insulation material (same material specifications)
 - restricted tank heat loss coefficient for tanks with integrated supplementary heating:
 - $UA_{tank} < 0.32 * (V_{tot})^{1/2}$
 - restricted variation from tank to tank of average thickness of tank insulation:
 - $(t_{insu,tank,max} - t_{insu,tank,min})/t_{insu,tank,min} \leq 25\% \ (\sim t_{insu,tank,max} \leq 1.25 * t_{insu,tank,min})$
- or :
 - In case test results are available for heat loss according to EN 12977-3 or EN 12897, the

requirements on insulation can be expressed as : restricted variation of heat loss coefficient(Wh/l/K/day): maximum 40 % relative variation allowed.

- similar relative position of solar heat exchanger; variation to be accepted:
 - $\pm 20\%$ variation (relative to average positions) allowed in relative positions of lower and higher points of heat exchanger (positions taken relative to tank height)
 - restricted variation in total tank volume,:
 ■ $(V_{tot,max} - V_{tot,min})/V_{tot,min} \leq 200\% (\sim V_{tot,max} \leq 3 * V_{tot,min})$
 - restricted variation in relative supplementary heated tank volume, V_{aux}/V_{tot} (the indices max and min indicates maximum and minimum values):
 - $((V_{aux}/V_{tot}),max - (V_{aux}/V_{tot}),min)/(V_{aux}/V_{tot}),min \leq 25\% (\sim (V_{aux}/V_{tot}),max \leq 1.25 * (V_{aux}/V_{tot}),min)$
- Collectors:
- shall have Keymark
 - shall same Keymark licence no. (i.e. same collector subtype for all systems)
 - limitation on collector heat loss coefficient, a_c :
 - $a_c < 8 \text{ W/(K m}^2)$ (to limit dependence on wind); $a_c = a_{1a} + a_{2a} * 40$
 - restricted variation in collector aperture area of collector array, A_a :
 - $(A_{a,max} - A_{a,min})/A_{a,min} \leq 300\% (\sim A_{a,max} \leq 4 * A_{a,min})$

● Pipes/piping:

- see annex B of EN 12976-2 and tables B2 and B3 for pumped systems and thermosiphons respectively.
- guidelines for calculating piping losses:

Heat loss coefficient of un-insulated pipe surface (and other un-insulated surfaces) can be determined as:

- $U_{un-insu} = 15 * A_{surface-un-insu} [\text{W/(K)}]$

Heat loss coefficient of insulated pipe surface (and other insulated surfaces) can be determined as:

- Pipes: $U_{insu-pipe} = 2 * \pi * \lambda_{insu} * L_{pipe} / \ln((d_{pipe} + 2t_{insu,pipe})/d_{pipe}), [\text{W/K}]$

- Plane surfaces: $U_{\text{insu-plane}} = A_{\text{plane}}$
 $*\lambda_{\text{insu}}/t_{\text{insu,plane}}, [\text{W/K}]$

*Is lambda (heat conductivity of insulation) not known, use 0.04 W/(K*m)*

- total collector loop piping heat loss coefficient, $U_{\text{loop,total}}$ (total heat loss coefficient from pipes, etc. between collectors and store/heat exchanger) shall be less than 30 % of the total collector heat loss coefficient:
 - $U_{\text{loop,total}} < 0.3 A_a a_c$

- Controller(s) (if any):

- same brand, type and settings of controller(s)
- same brand, type and same/similar location of sensors; restriction on relative location(s) of sensor(s) in the tank:
 - $\pm 10\%$ variation (relative to average positions) allowed in positions relative to tank height
- overheating protection / temperature limiting functions:
 - same principle(s)/functions for all system configurations

- Pump(s) (if any)

- same specifications with respect to operating conditions (temperatures, pressure, fluid, ...). Nominal power for all pumps used in the family shall be reported. P_{NOM} for a system with a given collector aperture area shall be smaller than or equal to P_{NOM} for a system with a bigger aperture collector area.

D.3 Testing requirements

The “medium system configuration” shall be tested according to all requirements in EN 12976 - except for “Over temperature protection” (EN 12976-2 section 5.2).

The “medium system configuration” is the configuration having the ratio of collector aperture area to total store volume closest to the average value of this ratio calculated for all configurations in the family. If several configurations are equally close to the average, the configuration with the highest ratio shall be chosen.

Testing the over temperature protection and safety (EN 12976-2 5.2) shall be carried out on the configuration having the highest ratio of collector aperture area to total store volume.

Note D.3.1: Normally two system configurations have to be sampled for (parallel) testing, but in some cases one configuration could at the same time be both the “medium system configuration” and the configuration with the highest ratio of collector aperture area to total store volume. In such case it is possible to sample only one configuration and perform all testing on this configuration.

Note D.3.2: Collector aperture area is defined in EN 12975; total store volumes is declared by manufacturer for all tank sizes in the system family.

D.4 Methods for determination of performance of system configurations which are not tested

The performance of the system configurations which are not tested is determined using one of two calculation methods:

- Method I: Based on EN 15316-4-3 - in the following named “Method I (f-chart)”
- Method II: Based on EN 12976-2 / ISO 9459-5 in the following named “Method II (DST)”

The method to use depends on the test method used in D.3 and whether the system is a forced circulated system or a thermo-siphon system - see table below.

Test method applied:	ISO 9459-2 (CSTG)		ISO 9459-5 (DST)			
	Solar only / int. back-up:	Solar only	Solar only	Int. back-up	FC	TS
Forced Circ. / Thermo-Siphon:						
Method I (f-chart) valid:	✓	✓	✓		✓	
Method II (DST) valid:			✓	✓	✓	✓

*Table D.4.1
Applicable extrapolation method depending on system type and test method*

It is seen from the table that:

- Method I (f-chart) is applicable for forced circulated systems and thermosyphon systems tested as solar only/pre-heat system.
- Method II (DST) is only applicable in connection with the ISO 9459-5 (DST) performance test method

The method used for performance calculation shall be specified when reporting the results.

The two methods are described in the following.

D.4.1 Method I (f-chart)

If the system is a pumped system or thermosyphon system tested as solar only/pre-heat system Method I (f-chart) can be used. This method is based on the method B in the EN 15316-4-3 and is illustrated in the figure below:

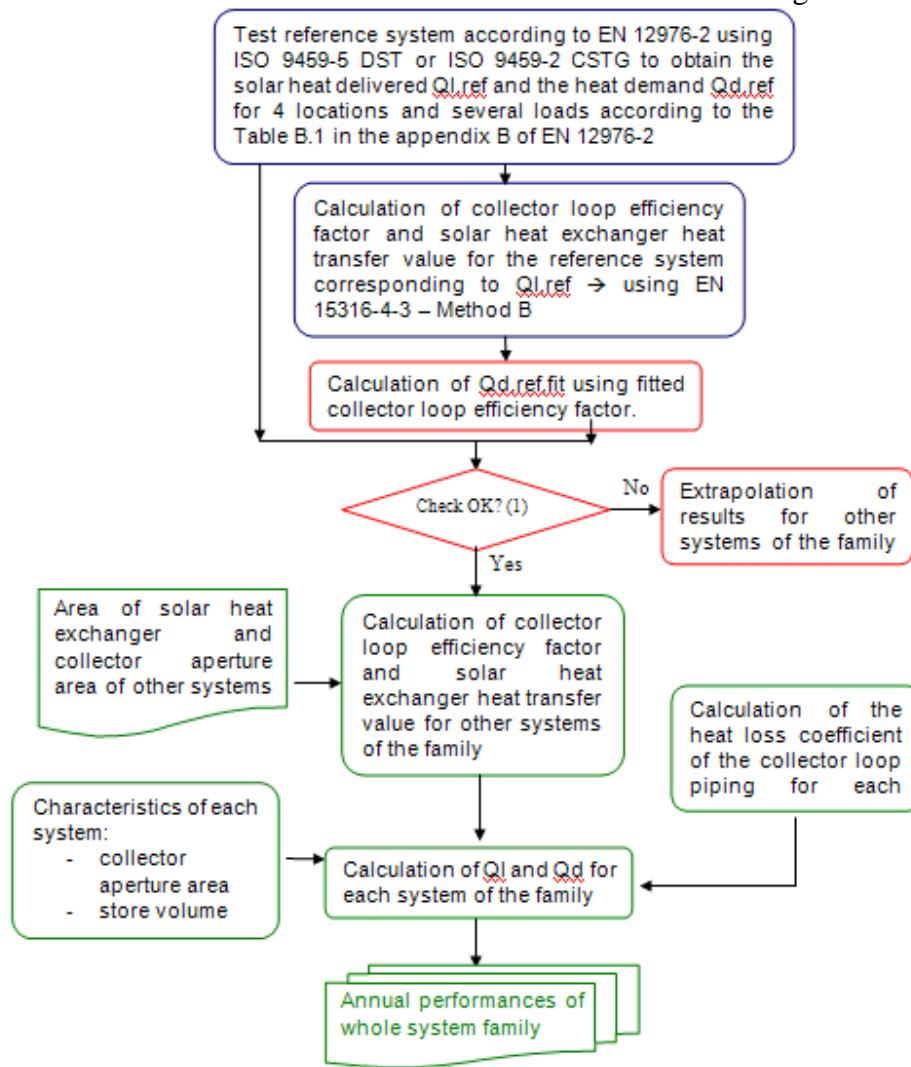


Fig. D.4.1.1 Principle of Method I (f-chart)

- (1) The check is based on the calculation of the deviation for all locations and loads according to:

$$\delta = \frac{(Q_{d,ref,measured} - Q_{d,ref,Method\{f-chart\}})}{Q_{d,ref,measured}} \times 100 (\%)$$

If $\delta \leq \pm 15\%$ the extrapolation can proceed.

Method I is organised in three stages:

a) Pre-processing of test data:

Inputs for the method I are $Q_{sol,out}$ and $Q_{sol,us}$ as defined in the EN15316-4-3, method B. Two cases have to be separated:

Preheat systems:

$$Q_{sol,out} = Q_L / 3.6 \text{ [kWh/year]}$$

$$Q_{sol,us} = Q_D / 3.6 \text{ [kWh/year]}$$

Where:

Q_D is heat demand (result from EN12976) [MJ/year]
 Q_L is heat delivered by the solar heating system (according to EN12976) [MJ/year]

Solar plus supplementary systems

$$Q_{sol,out} = (Q_D + Q_{st,ls,aux} - Q_{aux,net}) / 3.6 \text{ [kWh/year]}$$

$$Q_{sol,us} = Q_D / 3.6 \text{ [kWh/year]}$$

Where:

$Q_{st,ls,aux}$ is heat losses of the store part heated by the back-up heater [MJ/year]
 $Q_{aux,net}$ is net auxiliary energy demand [MJ/year]

$Q_{st,ls,aux}$ is calculated using the formula given in the EN 15316-4-3 § 6.3.5 using the control strategy adopted for the system, the surrounding air temperature, the set temperature, the fraction of the store volume heated by the back-up heater and the heat loss coefficient of the store. This coefficient is calculated using the following formula:

$$U_{st} = 1.2 \times \frac{\lambda_{iso} \times A_{sto}}{d_{iso}}$$

Where:

- λ_{iso} is the heat transfer coefficient of the insulation material [W/m.K]
- A_{sto} is the outside area of the auxiliary part of the store [m^2]
- d_{iso} is the thickness of the insulation material [m]

If these three parameters are not known, the following formula can be applied:

$$U_{st} = 0.16 \times \sqrt{V_{bu}}$$

Where V_{bu} is the volume of the auxiliary part of the store [L]

b) Processing:

The collector loop efficiency factor η_{loop} for the reference system is fitted using the annual outputs resulting from the EN 12976 test for each location and each load ($Q_{sol,out}$ calculated as described above).

Using the fitted collector loop efficiency factor η_{loop} the $Q_{sol,out}$ is calculated according to EN 15316-4-3 and compared with the annual energy output measured. The deviation between the measured value and the calculated values, as defined in (1), shall be lower than $\pm 15\%$. If this is verified for all reference locations and load volumes, the extrapolation procedure can proceed. If the differences are higher than $\pm 15\%$ the extrapolation is not possible.

From these fitted factors η_{loop} of the reference system, an apparent solar heat exchanger heat transfer value $(U_{st})_{hx}$ is calculated for each location and load using the calculation formula given in the appendix B.2 1 of EN 15316-4-3:

$$(1) \quad \boxed{\eta_{loop} = 1 - \Delta\eta}$$

With:

$$\boxed{\Delta\eta = \frac{\eta_0 \times A \times a_1}{(U_{st})_{hx}}}$$

Where:

- A is the total collector aperture area [m^2]
- $(U_{st})_{hx}$ is the apparent solar heat exchanger heat transfer value for the actual location and load [W/K]

- a_1 is the 1st order collector heat loss coefficient based on aperture area, [W/(K.m²)]
- η_0 is the optical efficiency based on collector aperture area

The $(U_{st})_{hx}$ coefficient for each system of the family is determined using the following formula :

$$(U_{st})_{hx,x} = (U_{st})_{hx,ref} \times \frac{A_{hx,x}}{A_{hx,ref}}$$

Where:

- $(U_{st})_{hx,x}$ is the solar heat exchanger heat transfer value of the actual system [W/K]
- $(U_{st})_{hx,ref}$ is the solar heat exchanger heat transfer value of the reference system [W/K]
- $A_{hx,x}$ is the area of the heat exchanger of the actual system [m²]
- $A_{hx,ref}$ is the area of the heat exchanger of the reference system [m²]

If the area of the heat exchanger of the actual system is unknown, its $(U_{st})_{hx}$ coefficient is considered equal to the $(U_{st})_{hx}$ of the reference system.

The collector loop efficiency factors η_{loop} can then be calculated for each other system of the family for each location and load using its collector aperture area with the calculation formula (1).

$$(2) \quad \eta_{loop,x} = 1 - \frac{\eta_0 \times A_x \times a_1}{(U_{st})_{hx,x}}$$

Where:

- A_x is the collector aperture area of the actual system [m²]

This collector loop efficiency factor is one of the elements used to calculate the solar heat delivered by the actual system. For each system, the collector aperture area, the store volume, the backup volume and the heat loss coefficient of the collector loop pipes have also to be known to carry out this calculation. The first three of these elements are provided by manufacturers.

The collector loop pipe losses can be calculated using:

$$U_{loop,p} = U_{insu} + U_{un-insu}$$

Where:

- $U_{loop,p}$ is the heat loss coefficient of the collector loop piping [W/K]
- U_{insu} is the heat loss coefficient for insulated part of collector loop piping [W/K]
- $U_{un-insu}$ is the heat loss coefficient for the un-insulated part of collector loop piping [W/K]

If no qualified values are available for the coefficients U_{insu} and $U_{un-insu}$, $U_{loop,p}$ can also be calculated using the following formula:

$$U_{loop,p} = 5 + 0.5 \times A_x$$

Finally, by using the $\eta_{loop,x}$, the collector aperture area, the store volume, the backup volume and the heat loss coefficient of the collector loop pipes, the solar heat delivered by each system of a family $Q_{sol,out,x}$ can be calculated with e.g. the software SOLEN¹.

All the equations and mathematical models used to calculate this solar heat delivered by each SDHW system of a family are written on the EN 15316-4-3 – Method B and examples of implementation of this method B are available on the appendix A of this standard.

c) After processing

The output of EN15316-4-3, method B is translated for each system of a family in terms of EN12976 according to:

Preheat systems:

$$Q_L = Q_{sol,out,x} \times 3.6 \quad [\text{MJ/year}]$$

$$Q_D = Q_{sol,us,x} \times 3.6 \quad [\text{MJ/year}]$$

¹ The software SOLEN has been developed by the CSTB, is free and can be downloaded at the following website link :
http://enr.cstb.fr/webzine/preview.asp?id_une=217

Solar plus supplementary systems:

$$Q_{aux,net,x} = (Q_D + Q_{st,ls,aux,x} - Q_{sol,out,x}) \times 3.6 \text{ [MJ/year]}$$

$$Q_D = Q_{sol,us,x} \times 3.6 \text{ [MJ/year]}$$

Finally, for preheat and solar plus supplementary systems, the auxiliary energy consumption by pumps Q_{par} has also to be calculated for each system of the family:

$$Q_{par} = \frac{P_{aux} \times t_{aux}}{1000} \times 3.6$$

Where:

- Q_{par} is the auxiliary energy consumption by pumps [MJ/year]
- P_{aux} is the total nominal input power of pumps [W]
- t_{aux} is the annual pump operation time, fixed to 2000 h

D.4.2 Method II (DST)

When the system performance test (in D.3) is done according to ISO 9459-5 (DST), the Method II (DST) can be used for both pumped systems and thermo-siphon systems. This method is based on the ISO 9459-5 procedure for performance calculation, which is one of the two methods for performance calculation already used in the EN 12976. The principle of the method is illustrated in the figure below.

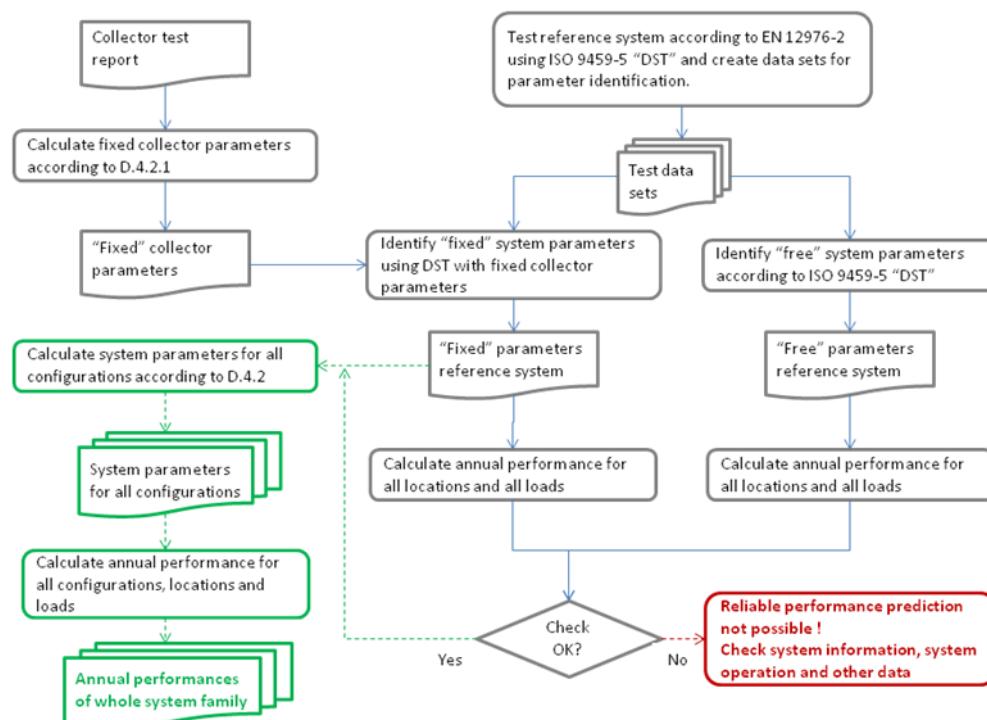


Fig. D.4.2.1 Principle of Method II (DST)

The reference system is chosen and tested (see D.3). Two sets of system parameters are identified:

- “Free” reference system parameters - these are the parameters determined according to EN 12976 / ISO 9459-5.
- “Fixed” reference system parameters. These parameters are determined **fixing the collector parameters (A_C^* and u_C^*)** according to D.4.2.1 and identifying the rest of the system parameters using the same test data as used for determination of the “free” system parameters.

Next phase is a comparison of the annual performances determined using the two sets of system parameters.

If the deviation for any location/load is higher than 15%, reliable performance prediction for other configurations is not likely to be obtained. The information/data used should be checked as well as the operation of the tested system.

If the deviation for any location/load is lower than 15%, proceed to next phase of the method.

In this phase the system parameters for all system configurations in the system family are determined:

- The collector parameters (A_C^* and u_C^*) are determined according to D.4.2.1 for all configurations (beware that these parameters also depends on heat exchanger and pipe losses - and number of collectors).
- The store heat loss parameter (U_s) is determined as:
 - $U_{s,x} = U_{s,ref,fix} * A_{x,surface}/A_{ref,surface}$
- The store heat capacity parameter (C_s) is determined as:
 - $C_{s,x} = C_{s,ref,fix} * V_x/V_{ref}$
- The parameter for back-up volume (f_{AUX}) is in all cases set to the value of $f_{AUX,fix}$ already determined using the fixed collector parameters for the reference system
- The parameters for stratification (D_L and S_L) are in all cases set to the values already determined using the fixed collector parameters for the reference system
- The parameter for load side heat exchanger (R_L) is determined as:
 - $R_{L,x} = R_{L,ref,fix} * A_{lshx,x}/A_{lshx,ref}$
- The parameter u_v is not taken into account

where:

- $U_{s,x}$: Store heat loss parameter to be determined for the actual configuration
- $U_{s,ref,fix}$: Store heat loss parameter determined for the reference system using fixed collector parameters
- $A_{x,surface}$: Surface area of store in the actual configuration
- $A_{ref,surface}$: Surface area of store in the reference configuration
- $C_{s,x}$: Store heat capacity parameter to be determined for the actual configuration
- $C_{s,ref,fix}$: Store heat capacity parameter determined for the reference system using fixed collector parameters
- V_x : Store volume in the actual configuration
- V_{ref} : Store volume in the reference configuration

- $R_{L,x}$: Load side heat exchanger parameter to be determined for the actual configuration
- $R_{L,ref,fix}$: Load side heat exchanger parameter determined for the reference system using fixed collector parameters
- $A_{lshx,x}$: Surface area of load side heat exchanger in the actual configuration
- $A_{lshx,ref}$: Surface area of load side heat exchanger in the reference configuration

Now with the system parameters determined, the annual performances of all system configurations, locations and loads can be done using the LTP part of the DST software [InSitu Scientific Software, Dynamic testing Program].

D.4.2.1 Calculation of “Fixed” collector parameters A_c^* and u_c^*

When doing the extrapolation calculations, fixed values for the parameters A_c^* and u_c^* are used in the result file DFR and DST-LTP program. The way to calculate these fixed values is shown in the following.

D. 4.2.1.1 Calculation of A_c^*

In ISO 9459-5 A_c^* is defined as:

- $A_c^* = F_R^* * (\tau\alpha) * A_c$

where:

- A_c : Collector aperture area of collector array in m^2
- F_R^* : Heat removal factor of the collector loop
- $(\tau\alpha)$: Effective transmission-absorbtance product

Expressing A_c^* in an approximate way in terms of collector test results related to EN 12975 and the heat exchanger factor F''' :

- $A_c^* = F''' * \eta_{0a} * K_{50^\circ} * A_a$

where:

- A_a : Total collector aperture area in m^2
- η_{0a} : Optical efficiency based on aperture area
- K_{50° : Incidence angle modifier at 50°

The heat exchanger factor F''' is defined in the following:

- $F''' = 1 - \Delta\eta_{hx}$

- $\Delta\eta_{hx} = \frac{\eta_{0a} K_{50^\circ} \cdot (A_a a_c + U_{loop,total})}{(UA)_{hx}}$
- $U_{loop,total} = U_{insu} + U_{un-insu}$

where

- a_c = $a_{1a} + a_{2a} * 40$; collector heat loss coefficient at $T_m - T_a = 40$ K, W/(K m²), T_a : air temperature, °C; T_m : collector mean temperature, °C.
- a_{1a} : 1st order collector heat loss coefficient based on aperture area, W/(K m²)
- a_{2a} : 2nd order collector heat loss coefficient based on aperture area, W/(K² m²)
- η_{0a} : Collector zero loss efficiency based on aperture area
- K_{50° : Incidence angle modifier at 50° incident angle
- A_a : Collector aperture area, m²
- $(UA)_{hx} = U_{hx} * A_{hx}$; heat transfer coefficient of the heat exchanger, W/K
- U_{hx} : Heat transfer coefficient per m² of the heat exchanger, W/(K m²)
- A_{hx} : Total surface area of heat exchanger, m²
- $U_{loop,total}$: heat loss coefficient of the collector loop piping, W/K
- U_{insu} : heat loss coefficient for insulated part of collector loop piping, W/K
- $U_{un-insu}$: heat loss coefficient for the un-insulated part of collector loop piping, W/K

For external heat exchanger actual value of $(UA)_{hx}$ is used for the temperature set:

- Primary loop 25°C, 35°C (collector loop)
- Secondary loop 15°C, 25°C (tank loop)

For tanks with internal heat exchangers a value of 200 W/K per m² heat exchanger surface (average of inner and outer surface) is chosen for U_{hx} if no qualified measurements (e.g. from EN 12977-3 test) are available for the $(UA)_{hx}$ for the heat exchanger. The test value to be used should comply with the conditions given in CEN/TS 12977-2 (6.3.6): “*(UA)_{hx} to be chosen for store temperatures of 20°C, average temperature difference 10 K and a flow rate similar to the one used for the determination of the collector parameters*” (flow rate corresponding to the minimum number of collector modules applied to the tank within the system family).

Note: The value for U_{hx} : 200 W/(K m²) is based on test of 23 tanks with internal heat exchangers (tests performed at Danish Technological Institute).

D.4.2.1.2 Calculation of u_c^*

In ISO 9459-5 A_c^* is defined as:

- $u_c^* = \frac{a_{total}}{\eta_{0a} K_{50^\circ}}$, W/(K m²)

where:

- a_{total} : Specific heat loss coefficient of the collector loop **including collector(s)**, W/(K m²)
- η_{0a} : Collector zero loss efficiency based on aperture area
- K_{50° : Incidence angle modifier at 50° incident angle

Expressing u_c^* in an approximate way in terms of collector test results related to EN 12975:

- $u_c^* = \frac{a_c + U_{loop,total}/A_a}{\eta_{0a} K_{50^\circ}}$, W/(K m²)

including also heat loss coefficients for collector piping, where:

- $a_c = a_{1a} + a_{2a}*40$ (heat loss coefficient at $dT = 40$ K), W/(K m²)
- a_{1a} : 1st order collector heat loss coefficient based on aperture area, W/(K m²)
- a_{2a} : 2nd order collector heat loss coefficient based on aperture area, W/(K² m²)
- A_a : Collector aperture area, m²
- $U_{loop,total}$ is heat loss coefficient of the collector loop piping, W/K
- U_{insu} is heat loss coefficient for insulated part of collector loop piping, W/K
- $U_{un-insu}$ is loss coefficient for the un-insulated part of collector loop piping, W/K

[Specific CEN Keymark Scheme Rules for Solar Thermal Products, Version 11.04 – December 2009]

Guidelines for extrapolation of test results according to the EN 15316-4-3 Method (f-chart) - Julien HEINTZ, CETIAT, October 2009

Guidelines for extrapolation of test results according to the EN 15316-4-3 Method (f-chart)

Julien HEINTZ, CETIAT, October 2009

0. Introduction

In order to enable accurate yield prediction of different system subtypes on the basis of just a single system test the procedure for extrapolation is being described in the annex D „SOLAR KEYMARK SYSTEM FAMILIES“ in the scheme rules. The annex D gives general definitions for system families. It defines the requirements for grouping different system configurations into one system family and describes the method for choosing referent system representing particular system family. Two methods are selected and described for extrapolation of test results, (i) the Method I, based on f-chart method and (ii) the Method II, based on the DST -method. The method I is applicable for forced circulation system (preheat systems, and solar plus supplementary systems). This document aims at illustrating the extrapolation procedure of Method I for this kind of system.

1. Forced circulation, integrated back-up system family

1. Data sheets with characteristics of two systems, family members, are listed in Appendix I as Tab A and Tab B,
2. Requirements under the D.2. Section “Requirements for grouping of different system configurations into single system family” are fulfilled.
3. According to D.3. Section, the ratios of area/volume are to be calculated. Ratio of area/volume is $6/250 \text{ m}^2/\text{l}$ and $4/350 \text{ m}^2/\text{l}$ respectively. The system with higher ratio of area vs volume has to be selected for testing. And that is system with 350 liters and area of 6 m^2 . $6/250=0.024 \text{ m}^2/\text{l}$, $4/350=0.011 \text{ m}^2/\text{l}$. The system $6/250$ is chosen as “**reference system**”. This reference system is tested according to standards EN 12976-2 and ISO 9459-5. The DST-software is then run following strictly the procedure outlined in the Standard ISO 9459-5 in order to calculate the heat delivered by auxiliary heater Qaux,net and the heat demand Qd for 4 locations and several loads. The results for Qd and Qaux,net (in MJ) for the reference system are given in the table below:

Qd (MJ)		
Location	load / day	
	110l	200l
Davos, Yield /W	6653	12107
Athens, Yield /W	4572	8323
Stockh., Yield /W	6149	11164
Wuerzb., Yield /W	5897	10688

Qaux,net (MJ)		
Location	load / day	
	110l	200l
Davos, Yield /W	504	2743
Athens, Yield /W	724	1987
Stockh., Yield /W	2081	4068
Wuerzb., Yield /W	1768	3532

4. The heat losses of the store part heated by the back-up heater are calculated. The formula used to calculate these losses is :

$$Q_{st,ls,aux} = \frac{V_{bu}}{V_{store}} \times U_{st} \times \left(\frac{V_{load}}{V_{store}} \right) \times (T_{set} - T_{a,avg}) \times \frac{t_m \times 3.6}{1000}$$

Where:

- V_{bu} is the volume of the auxiliary part of the store [L]
- U_{st} is the heat loss coefficient of the store [W/K]
- V_{load} is daily draw-off volume [L]
- V_{store} is the volume of the store [L]
- T_{set} is the set point temperature of the integrated auxiliary [°C]: $T_{set} = 52.5$ °C (EN 12976 Table B.1)
- $T_{a,avg}$ is the average ambient air temperature [°C] (fixed to 20°C for the method)
- t_m is the number of hours of the year: 8760
- the coefficient 3.6/1000 is used to convert Wh to MJ

The values of $Q_{st,ls,aux}$ for the reference systems are then:

Load/day (l)	$Q_{st,ls,aux}$ (MJ)
110	316
200	574

The characteristics of systems, used to calculate the $Q_{st,ls,aux}$ values are listed in appendix as Tab A and Tab B.

5. The part a) of the appendix D4.1 of the scheme rules is then applied to calculate the values of $Q_{sol,out}$ and $Q_{sol,us}$:

Q _{sol,out} (kWh)		
Location	load / day	
	110l	200l
Davos, Yield /W	1796	2761
Athens, Yield /W	1157	1919
Stockh., Yield /W	1218	2131
Wuerzb., Yield /W	1235	2147

Q _{sol,us} (kWh)		
Location	load / day	
	110l	200l
Davos, Yield /W	1848	3363
Athens, Yield /W	1270	2312
Stockh., Yield /W	1708	3101
Wuerzb., Yield /W	1638	2969

6. From the values of $Q_{sol,out}$ and using the part b) of the appendix D4.1 of the scheme rules, the collector loop efficiency factors η_0 are fitted for each load and each location for the reference system.

To fit the η_0 , the following data of the reference system are needed:

- the volume of the store and collector surface area

- the ratio V_{bu}/V_{store}
- the pipe heat losses coefficient $U_{loop,p}$ (W/K). The value for this coefficient is unknown for the reference system. It can be calculated using the formula given in the part b) of the appendix D4.1 of the scheme rules, $U_{loop,p} = 5+0.5*A_x$ where A_x is the collector surface area of the reference system. $U_{loop,p}$ is then equal to 8 W/K for the reference system

7. Choose a member of system family for which extrapolation has to be carried out. Let us consider a system differing from reference system in a number of collectors, collector pipes heat loss coefficient and storage volume (System Characteristics are listed in Appendix I in Tab. B)

η_0 for this second SDHW system is then calculated using the part b) of the appendix D4.1 of the scheme rules

The method B of EN 15316-4-3 is then applied to calculate the $Q_{sol,out}$ for this second system.

To apply this method, the following data about the second system are needed:

- the value of η_0 calculated above
- the volume of the store and collector surface area of the system
- the ratio V_{bu}/V_{store}
- the pipe heat losses coefficient $U_{loop,p}$ (W/K). The value for this coefficient is unknown for the second system. It can be calculated using the formula given in the part b) of the appendix D4.1 of the scheme rules, $U_{loop,p} = 5+0.5*A_x$ where A_x is the collector surface area of the second system. $U_{loop,p}$ is then equal to 7 W/K for the second system

The results of $Q_{sol,out}$ for the second system for two loads are listed below:

Location	$Q_{sol,out}$ (kWh)	
	load / day	
	110l	200l
Davos, Yield /W	1739	2438
Athens, Yield /W	1042	1675
Stockh., Yield /W	1081	1859
Wuerzb., Yield /W	1139	1909

The values of heat losses of the store part heated by the back-up heater $Q_{st,ls,aux}$ have then to be calculated using the formula given in the part 4. above:

Load/day (l)	Qst,ls,aux (kWh)
110	90
200	163

The values of the heat demand $Q_{sol,us}$ for the second system are:

Location	Qsol,us (kWh)	
	load / day	
	110l	200l
Davos, Yield /W	1849	3356
Athens, Yield /W	1269	2305
Stockh., Yield /W	1706	3094
Wuerzb.,Yield /W	1634	2968

These results for the second system are then translated in terms of EN 12976 according to part c) of the appendix D4.1 of the scheme rules

Location	Qaux,net (MJ)	
	load / day	
	110l	200l
Davos, Yield /W	720	3892
Athens, Yield /W	1141	2855
Stockh., Yield /W	2574	5033
Wuerzb.,Yield /W	2106	4399

Qd (MJ)		
Location	load / day	
	110l	200l
Davos, Yield /W	6656	12082
Athens, Yield /W	4568	8298
Stockh., Yield /W	6142	11138
Wuerzb., Yield /W	5882	10685

Finally, the auxiliary energy consumption by pumps Q_{par} has also to be calculated.

8. Identical procedure (starting from point 7) is to be carried out separately for each further member of system family.

Appendix I. System data

Project: Flexible system certification - validation of procedure for system performance prediction extrapolation

Check / data list for system test

	Solar + supplementary system	"6250" (6m ² collectors+250 litres storage) = REFERENCE SYSTEM		
Solar loop	Collector	Collector name/type		
		No. collector modules	3	
		Aperture area per collector module	2	m ²
		Optical Efficiency	0.77	
		First-order heat loss coefficient	3.8	W/(m ² K)
		Second-order heat loss coefficient	0.014	W/(m ² K ²)
		Thermal capacity of collector		kJ/K
	Incident Angle Modifier:	Angle °	30	50
		IAM, ASHRAE b0=0.1, b1=0.		70
Heat Exchanger	Collector loop pipes	Pipes Dimensions	Diameter	W/K
			Total pipe lenght	m
		Pipe insulation	Thickness of insulation	mm
			Heat conductivity of insulation	W/(m*K)
			0	m
		Overall heat loss coefficient	2.5	W/K
		Thermal capacity		kJ/K
	Type of circulation	Heat transfer coefficient or	115	W/K
		Heat transfer area		m ²
Storage	Total storage	Forced circulation/thermo-siphon	Forced circulation	
		Pump power		W
		Average flowrate		l/min
		Height (cilinder)	1.25	m
		Volume	250	litres
		Tank position - vertical/horizontal	vertical	
		Tank location - indoors/outdoors	indoors	
		Heat loss coefficient or	2.5 W/K	
Back-up part of storage	Back-up part of storage	Insulation material & thickness		
		Volume	70	litres
		(Recommend set temperature)	60	°C

Tab A. Data of Reference system representing whole system family (forced circulation with auxiliary)

Project:		Flexible system certification - validation of procedure for system performance prediction extrapolation			
Check / data list for system test					
	Solar + supplementary system	"4350" (4m ² collectors+350 litres storage)			
Solar loop	Collector	Collector name/type			
		No. collector modules	2		
		Aperture area per collector module	2		m ²
		Optical Efficiency	0.77		
		First-order heat loss coefficient	3.8		W/(m ² K)
		Second-order heat loss coefficient	0.014		W/(m ² K ²)
		Thermal capacity of collector			kJ/K
	Collector loop pipes	Incident Angle Modifier:	Angle °	30	50
		IAM, ASHRAE b0=0.1, b1=0.		0.94	
		Pipes Dimensions	Diameter		W/K
Heat Exchanger	Collector loop pipes	Total pipe lenght			m
		Pipe insulation	Thickness of insulation		mm
			Heat conductivity of insulation		W/(m*K)
			Total length of uninsulated pipes	0	m
		Overall heat loss coefficient	1.7		W/K
	Heat Exchanger	Thermal capacity			kJ/K
		Heat transfer coefficient or	175		W/K
		Heat transfer area			m ²
Type of circulation	Type of circulation	Forced circulation/thermo-siphon	Forced circulation		
		Pump power			W
		Average flowrate			l/min
Storage	Total storage	Height (cilinder)	1.25		m
		Volume	350		litres
		Tank position - vertical/horizontal	vertical		
		Tank location - indoors/outdoors	indoors		
		Heat loss coefficient or	3.5		W/K
		Insulation material & thickness			
	Back-up part of storage	Volume	100		litres
		(Recommend set temperature)	60		°C

Tab B. Data of a member of system family (forced circulation with auxiliary)

□ Guidelines for extrapolation of test results according to the DST method -

Miroslav Bosanac / Jan Erk Nielsen, PlanEnergi, October 6, 2009

0. Introduction

In order to enable accurate yield prediction of different system subtypes on the basis of just a single system test the procedure for extrapolation is being described in the annex D „SOLAR KEYMARK SYSTEM FAMILIES“. The annex D gives general definitions for system families. It defines the requirements for grouping different system configurations into one system family and describes the method for choosing referent system representing particular system family. Two methods are selected and described for extrapolation of test results, (i) the Method I, based on f-chart method and (ii) the Method II, based on the DST test. The method II, based on the DST test is applicable to both thermo-siphon systems and forced circulation system (preheat systems, and systems with supplementary auxiliary heater). This document is prepared to illustrate the extrapolation procedure with two families of systems: (i) thermo-siphon system without back-up and (ii) forced circulation system with integrated back-up. The guidelines are given separately for examples of two system types.

1. Thermo-siphon pre-heat system family

1. Data sheets of two systems, family members, are listed in Appendix as Tab A and Tab B,
2. Requirements under the D.2. Section “Requirements for grouping of different system configurations into single system family” are fulfilled.
3. According to D.3. Section, the ratios of area/volume are to be calculated. Ratio of area/volume is $6/350 \text{ m}^2/\text{l}$ and $2/150 \text{ m}^2/\text{l}$ respectively. The system with higher ratio of area vs volume has to be selected for testing. And that is system with 350 liters and area of 6 m^2 . $6/350=0.017 \text{ m}^2/\text{l}$, $2/150=0.013 \text{ m}^2/\text{l}$, The system $6/350$ is called “reference system”.
For the system “ $6/350$ ”, artificial test data according to the requirements of the **Standard (ISO 9459-5)** have been generated using the TRNSYS program. The output data files are ths635a.dat and ths635b.dat Extensive output data set is thereafter compressed avoiding insignificant information - as by usual procedure for processing measurement data (using the SDHWP program available within the DST software).
4. The batch file **th635.bat** is created for data treatment according to the Standard. This batch file identifies set of ‘free’ parameters of the reference system.
5. Execute this batchfile in order to identify the set of ‘free’ parameters. Tab A.1 gives identified set of parameters (associated filename is **th635.dfr**).

```
\Results DF_P 2.7 Sep 97 @Copyright InSitu running 07.06.2009
18:01:36
\Value,Parameters,"AC*=4.09 uC*=4.78 US=2.78 CS=1.42 DL=
SC=0.059 Obj=12.6"
```

* SDHW Plug Flow Model (V 2.1, Jun 1992)

frequency transform method..... Cosine

initial state value..... 15

time base..... 3600

filter type..... Gaussian, tf=4, CF=1.4E5

Name	mode	tvf	t_start	t_skip	t_end	N*	Size
... DAT\THS635A.D3	Mean	3.1	0	36	480	97.7	
132..1786							
... DAT\THS635B.D3	Mean	1.7	0	36.56	720	81.9	
67..1181							
AC*	uC*	US	CS	DL	SC	objective	
[m ² /K]	[W/K/m ² /K]	[W/K]	[MJ/K]	[-]	[-]	[W]	
4.091	4.778	2.778	1.424	0	0.05905	12.607	
0.0158	0.0291	0.0475	0.00569	0.00131	0.0015		

Cross correlation matrix:

1.0000000	-0.6057400	0.5671203	0.3901560	0.6349994	-
0.4757712					
-0.6057400	1.0000000	-0.4254539	-0.2255122	-0.5427860	
0.5317664					
0.5671203	-0.4254539	1.0000000	0.1943051	0.0030802	-
0.1539413					
0.3901560	-0.2255122	0.1943051	1.0000000	0.3855753	-
0.1713679					
0.6349994	-0.5427860	0.0030802	0.3855753	1.0000000	-
0.3762893					
-0.4757712	0.5317664	-0.1539413	-0.1713679	-0.3762893	
1.0000000					

Tab A.1. Identified set of 'free' parameters

6. All the above stated steps follow strictly the procedure outlined in the Standard. From this point on we start with extrapolation procedure. Procedure for extrapolation of test results requires fixing collector parameters as described in the Appendix: D.4.2.1. **Calculation of A_C^* and u_C^* for "DST-extrapolation procedure"**
7. Collector parameters are fixed for the reference system according to data listed in Tab. A.1. as it follows:

- Collector: $A_a = 6.0 \text{ m}^2$, η_{0a} = 0.77; $a_{1a} = 3.33 \text{ W}/(\text{m}^2\text{K})$; $a_{2a} = 0.012 \text{ W}/(\text{m}^2\text{K}^2)$;
- $K_{50^\circ} = 0.94$
- $U_{loop,rest} = 0.0$, $F''' = 1$
- The fixed parameters are:

- $Ac^* = 0.77 * 6 * 0.94 = 4.34 \text{ m}^2$
- $uC^* = (3.33 + 40 * 0.012) / 0.77 / 0.94 = 5.26 \text{ W/Km}^2$

8. Execute Dynamic Fitting (DF) program (within DST software) to identify set of parameters for reference system using fixed collector parameters. The windows batch filename is **th635f.bat**. The DST result file is processed requesting 80 local minima. The result file for above stated data files has filename **th635F.DFR**. This file represents a basis file for preparing substitute results files for other members of system family.

```
\Results DF_P 2.7 Sep 97 @Copyright InSitu running 21.09.2009 21:03:54
\Value,Parameters,"AC*=4.34 uC*=5.26 US=2.72 CS=1.44 DL=0.00744
SC=0.0591 Obj=17.4"
* SDHW Plug Flow Model (V 2.1, Jun 1992)
frequency transform method..... Cosine
initial state value..... 15
numerical precision..... 1
time base..... 3600
filter type..... Gaussian, tf=4, CF=2.4E5
      Name mode tvf t_start t_skip t_end N*   Size
...\\DATTHS635A.D3 Mean 2.2    0    36    480 70.2 132..1786
...\\DATTHS635B.D3 Mean 1.4    0    36.56   720 68.1 67..1181
      AC*   uC*   US   CS   DL   SC objective
      [mý]  [W/K/mý]  [W/K]  [MJ/K]  [-]  [-]  [W]
      4.34   5.26   2.723   1.444  0.007442  0.05912  17.434
      0     0     0.069   0.0113  0.0029   0.0032
Cross correlation matrix:
0.0000000 0.0000000 0.0000000 0.0000000 0.0000000 0.0000000
0.0000000 0.0000000 0.0000000 0.0000000 0.0000000 0.0000000
0.0000000 0.0000000 1.0000000 -0.0739756 -0.5828539 0.1863705
0.0000000 0.0000000 -0.0739756 1.0000000 0.2714022 0.1384388
0.0000000 0.0000000 -0.5828539 0.2714022 1.0000000 0.2974880
0.0000000 0.0000000 0.1863705 0.1384388 0.2974880 1.0000000
```

Tab 2. Identified set with the 'fixed' collector parameters

9. The energy yields computed by two sets of (1) free and (2) with fixed collector parameters are now computed. The reference batch file is **ths-ltp.bat**. The results are given in the following table:

Location	Free	Fixed	free	Fixed	free	fixed	free	fixed	free	fixed
Daily draw-off	50l	50l	110l	110l	200l	200l	300l	300l	400l	400l
Davos, Yield /W	95.3	95.1	206	206	357	357	489	490	572	578
Athens, Yield /W	63.6	63.3	135	134	228	228	318	319	386	389
Stockh., Yield /W	69	68.8	142	142	232	232	309	310	362	365
Wuerzb., Yield /W	66.6	67	137	137	224	225	305	305	368	368
Max. Error in %	Ref.	-0.6	Ref.	0.7	Ref.	0.4	Ref.	0.3	Ref.	-1.0

10. The maximum error in prediction is 1%. Criterion is that maximum error in

predicted yields should not reach 15% for any load and/or location. Therefore, we may proceed with the next step of the extrapolation procedure.

11. Choose a member of system family for which extrapolation is to be carried out.

Let us consider a system differing from reference system in a number of collectors, collector pipes heat loss coefficient and storage volume (System Characteristics are listed in Appendix in Tab. B)

12. The corresponding values for effective collector area and storage heat loss coefficient and heat capacity are:

- $AC^* = (2 \text{ m}^2) * (0.77) * (0.94) = 1.45 \text{ m}^2$
- $uC^* = (3.33 + 40 * 0.012) / 0.77 / 0.94 = 5.26 \text{ W/K m}^2$
- $CS = 150 \text{ l} * 4.191 \text{ kJ/kg/K} * 1 / 1000 = 0.628 \text{ MJ/K}$

The identified heat loss coefficient of the storage will be used in the extrapolation procedure for estimating heat loss coefficient of other family member:

- $Us = Us(350l) * \text{Area (150)} / \text{Area (350l)} = 2.723 \text{ W/K} * 1.76 / 2.86 = 1.7 \text{ W/K}$

Where $Us(350l)$ is identified value of storage heat loss coefficient by fixed collector parameters, see point 8.

Copy the result-file (**th635f.dfr**) with a new filename th2150.DFR and enter computed values under point 12, keeping other parameters unchanged.

The file **th2150.dfr** is now representing the result file for system with 2 m² collector area and 150 l storage volume corresponding to data listed in the Tab B.

Execute program LTP for long term prediction (**LTP-2150.bat**). Informative result for given meteorological and operational conditions for three loads are listed bellow.

Location	Daily draw-off volume	Prediction
	Liters/day	[W]
Davos	50	89.3
Davos	110	169
Davos	200	217
Stockholm	50	58.2
Stockholm	110	107
Stockholm	200	140
Athens	50	56.8
Athens	110	111
Athens	200	162
Wuerzburg	50	56.3

Wuerzburg	110	106
Wuerzburg	200	147

13. Identical procedure (starting from point 12) is to be carried out for each further member of system family.

2. Forced circulation, integrated back-up system family

9. Data sheets of two systems, family members, are listed in Appendix as Tab C and Tab D,
10. Requirements under the D.2. Section “Requirements for grouping of different system configurations into single system family” are fulfilled.
11. According to D.3. Section, the ratios of area/volume are to be calculated. Ratio of area/volume is 6/250 m²/l and 4/350 m²/l respectively. The system with higher ratio of area vs volume has to be selected for testing. And that is system with 350 liters and area of 6 m². 6/250=0.024 m²/l, 4/350=0.011 m²/l, The system 6/250 is chosen as “reference system”.
For the system “6/250”, artificial test data according to the requirements of the **Standard (ISO 9459-5)** have been generated using the TRNSYS program. The output data files are au625a.dat, au625b.dat and au625c.dat. This extensive output data set is thereafter compressed avoiding insignificant information - as by usual procedure for processing measurement data (using the SDHWP program available within the DST software).
12. The batch file **6250nfix.bat** is created for data treatment according to the Standard. This batch file identifies set of ‘free’ parameters of the reference system.
13. Execute this batchfile in order to identify the set of ‘free’ parameters. Tab B.1. gives identified set of parameters (associated filename is **6250nfix.dfr**).

```
\Results DF_P 2.7 Sep 97 @Copyright InSitu running 08.10.2009 16:46:06
\Value,Parameters,"AC*=3.55 uC*=6.27 US=1.7 CS=1.04 faux=0.318 DL=0.101 SC=0
Obj=10.6"
* SDHW Plug Flow Model (V 2.1, Jun 1992)
frequency transform method..... Cosine
initial state value..... 15
numerical precision..... 1
time base..... 3600
filter type..... Gaussian, tf=4, CF=1E6
      Name mode tvf t_start t_skip t_end N*    Size
AU6250A.D3  Mean 1.4     0   30.1   720 66.4 401..3781
```

AU6250B.D3	Mean	1.1	0	30.36	720	56.3	298..1866
AU6250C.D3	Mean	1.2	0	30.09	360	27.3	337..1147
AC*	uC*	US	CS	faux	DL	SC	objective
[m ² /]	[W/K/m ² /]	[W/K]	[MJ/K]	[-]	[-]	[-]	[W]
3.553	6.267	1.703	1.04	0.3179	0.1006	0	10.605
0.043	0.129	0.0907	0.00567	0.00862	0.00608	0.0117	

Cross correlation matrix:

1.0000000	0.3522315	-0.1428583	-0.1159083	-0.2161553	0.5126954	-0.7558252
0.3522315	1.0000000	-0.8531725	0.1550799	0.0764832	0.0953980	0.2356101
-0.1428583	-0.8531725	1.0000000	-0.0661884	-0.0099385	-0.2318446	-0.2571335
-0.1159083	0.1550799	-0.0661884	1.0000000	0.1072539	0.1063516	0.3551103
-0.2161553	0.0764832	-0.0099385	0.1072539	1.0000000	-0.5872346	0.2539770
0.5126954	0.0953980	-0.2318446	0.1063516	-0.5872346	1.0000000	-0.4270209
-0.7558252	0.2356101	-0.2571335	0.3551103	0.2539770	-0.4270209	1.0000000

Tab B.1. Identified set of ‘free’ parameters

14. All the above stated steps follow strictly the procedure outlined in the Standard. From this point on we start with extrapolation procedure. Procedure for extrapolation of test results requires fixing collector parameters as described in the Appendix: **Calculation of AC* and uC* for “DST-extrapolation procedure”**
15. Collector parameters are fixed for the reference system according to data listed in Tab. C. as it follows:

-
- Collector: $A_a = 6.0 \text{ m}^2$, $\eta_{0a} = 0.77$; $a_{1a} = 3.80 \text{ W}/(\text{m}^2\text{K})$; $a_{2a} = 0.014 \text{ W}/(\text{m}^2\text{K}^2)$;
- $K_{50^\circ} = 0.94$
- $U_{\text{misc}} = 0.0$
- $U_{\text{loop,rest}} = 0 \text{ W/K}$
- $(AU)_{hx} = 110 \text{ W/K}$
- $F''' = 0.811$
- $Ac^* = 0.811 * 0.77 * 6 * 0.94 = 3.52 \text{ m}^2$
- $uC^* = 6.02 \text{ W/K m}^2$

16. Execute Dynamic Fitting (DF) program (within DST software) to identify set of parameters for reference system using fixed collector parameters. Batch filename is, **6250fix.bat**. The DST result file is processed requesting a huge number of local minima, e.g. 80. The result file for above stated data files has filename **6250Fix.DFR**. This file represents a basis file for preparing substitute results files for other members of system family.

```
\Results DF_P 2.7 Sep 97 @Copyright InSitu running 08.10.2009 16:55:18
\Value,Parameters,"AC*=3.52 uC*=6.02 US=1.89 CS=1.04 faux=0.335 DL=0.0956 SC=0
Obj=12.2"
* SDHW Plug Flow Model (V 2.1, Jun 1992)
frequency transform method..... Cosine
initial state value..... 15
numerical precision..... 1
time base..... 3600
filter type..... Gaussian, tf=6, CF=1E5
      Name mode tvf t_start t_skip t_end N*   Size
AU6250A.D3 Mean 6.4    0 20.08 720 213 290..3781
AU6250B.D3 Mean 3.4    0 20.09 720 112 207..1866
AU6250C.D3 Mean 3.7    0 20.07 360 59.2 226..1147
      AC*   uC*   US   CS   faux   DL   SC   objective
      [mý]  [W/K/mý]  [W/K]  [MJ/K]  [-]  [-]  [-]  [W]
      3.52   6.02   1.889   1.043   0.335   0.09555   0   12.221
      0       0   0.0282   0.00446   0.00368   0.00282   0.00324
Cross correlation matrix:
0.0000000 0.0000000 0.0000000 0.0000000 0.0000000 0.0000000 0.0000000
0.0000000 0.0000000 0.0000000 0.0000000 0.0000000 0.0000000 0.0000000
0.0000000 0.0000000 1.0000000 0.1437257 -0.0641513 -0.4309959 0.4990773
0.0000000 0.0000000 0.1437257 1.0000000 -0.1023397 0.3713648 0.4403850
0.0000000 0.0000000 -0.0641513 -0.1023397 1.0000000 -0.3661457 -0.2015836
0.0000000 0.0000000 -0.4309959 0.3713648 -0.3661457 1.0000000 0.1075661
0.0000000 0.0000000 0.4990773 0.4403850 -0.2015836 0.1075661 1.0000000
```

Tab B.2. Identified set with the 'fixed' collector parameters

17. The energy yields computed by two sets characterized by (1) free identified and (2) with fixed collector parameters are now computed. The reference batch file is **thauxltp.bat**. The results are given in the following table:

Location	Free Qs/Qa	Fixed Qs/Qa						
Daily draw-off	110l	110l	200l	200l	300l	300l	400l	400l
Davos, Yield/W	193/16	192/18	286/87	281/91	339/181	346/176	386/266	382/276
Athens, Yield/W	121/23	119/25	198/63	196/66	260/105	257/111	300/182	297/191
Stockh, Yield/W	117/66	115/71	182/129	179/135	223/211	220/219	242/284	238/295
Wuerzb, Yield/W	122/56	120/60	194/112	191/118	243/177	246/169	270/257	266/261

18. Criterion that maximum error in predicted yields should not reach 15% is fulfilled. Therefore, we may proceed with the next step of the extrapolation procedure

19. Choose a member of system family for which extrapolation is to be carried out.

Let us consider a system differing from reference system in a number of collectors, collector pipes heat loss coefficient and storage volume (System

Characteristics are listed in Appendix in Tab. D)

12. The corresponding values for effective collector area and storage heat loss coefficient and heat capacity are:

- Collector: $A_a = 4.0 \text{ m}^2$, $\eta_{0a} = 0.77$; $a_{1a} = 3.80 \text{ W}/(\text{m}^2\text{K})$; $a_{2a} = 0.014 \text{ W}/(\text{m}^2\text{K}^2)$;
- $K_{50^\circ} = 0.94$
- $U_{\text{misc}} = 0.0 \text{ W/K}$
- $U_{\text{loop,rest}} = 0.0 \text{ W/K}$
- $(AU)_{hx} = 175 \text{ W/K}$
- $F''' = 0.92$
- $Ac^* = 0.92 * 0.77 * 4 * 0.94 = 2.66 \text{ m}^2$
- $uC^* = 6.02 \text{ W/K m}^2$
- $CS = 350 \text{ l} * 4.191 \text{ kJ/kg/K} * 1/1000 = 1.47 \text{ MJ/K}$
 $Us = Us(250\text{l}) * \text{Area (350)} / \text{Area (250l)} = 1.9 \text{ W/K} * 1.21 = 2.3 \text{ W/K}$,
 Where $Us(250\text{l})$ is identified value of storage heat loss coefficient by batchfile 625nfix.bat (e.g. identification with fixing collector parameters).

Copy the result file (**625fix.dfr**) with a new filename 4350.DFR and enter computed values under this point, keeping other parameters unchanged. The file **4350-c.dfr** is now representing the result file for system with 4 m² collector area and 350 l storage volume corresponding to data listed in the Tab B.2.

Execute program LTP for long term prediction (**LTP-4350.bat**). Result for given meteorological and operational conditions for three loads are listed bellow.

Location	Daily draw-off volume	Prediction Qsol/Qaux
	Liters/day	[W]
Davos	110	177/34
Davos	200	268/109
Davos	400	329/335
Stockholm	110	99/94
Stockholm	200	155/170
Stockholm	400	202/367
Athens	110	108/38
Athens	200	176/88
Athens	400	265/214
Wuerzburg	110	106/80
Wuerzburg	200	170/150
Wuerzburg	400	231/310

13. Identical procedure (starting from point 11) is to be carried out separately for each further member of system family.

Appendix I. System data

Project: Flexible system certification - validation of procedure for system performance prediction extrapolation	
Check / data list for system test	
	Solar preheater thermosyphon "6350" (6m ² collectors+350 litres storage)
Solar loop	Collector name/type
	No. collector modules 3
	Aperture area per collector module 2 m ²
	Optical Efficiency 0.77
	First-order heat loss coefficient 3.33 W/(m ² K)
	Second-order heat loss coefficient 0.012 W/(m ² K ²)
	Thermal capacity of collector kJ/K
	Incident Angle Modifier:
	Angle ° 30 50 70
	IAM, ASHRAE b0=0.1, b1=0. 0.94
Heat Exchanger	Pipes Dimensions Diameter W/K
	Total pipe lenght m
	Collector loop pipes Pipe insulation Thickness of insulation mm
	Heat conductivity of insulation W/(m*K)
	Total length of uninsulated pipes 0 m
	Overall heat loss coefficient W/K
	Thermal capacity kJ/K
	Heat transfer coefficient or W/K
	Heat transfer area m ²
	Type of circulation Forced circulation/thermo-siphon Thermosiphon
Storage	Pump power W
	Average flowrate l/min
	Total storage Height (cylinder) 1.2 m
	Volume 350 litres
	Tank position - vertical/horizontal vertical
	Tank location - indoors/outdoors indoors
	Heat loss coefficient or UA 2.8 W/K
Back-up part of storage	Volume litres
	Recommende set temperature °C

Tab A. Data of Reference thermo siphon system representing system family

Project:	Flexible system certification - validation of procedure for system performance prediction extrapolation
-----------------	--

Check / data list for system test

	Solar preheater thermosyphon	"2150" (2m ² collectors+150 litres storage)	
Solar loop	Collector	Collector name/type	
		No. collector modules	1
		Aperture area per collector module	2 m ²
		Optical Efficiency	0.77
		First-order heat loss coefficent	3.33 W/(m ² K)
		Second-order heat loss coefficent	0.012 W/(m ² K ²)
		Thermal capacity of collector	kJ/K
	Incident Angle Modifier:	Angle °	30 50 70
		IAM, ASHRAE b0=0.1, b1=0.	0.94
Collector loop pipes	Pipes Dimensions	Diameter	W/K
		Total pipe lenght	m
	Pipe insulation	Thickness of insulation	mm
		Heat conductivity of insulation	W/(m*K)
		Total length of uninsulated pipes	0 m
		Overall heat loss coefficent	0 W/K
		Thermal capacity	kJ/K
	Heat Exchanger	Heat transfer coefficient or	W/K
		Heat transfer area	m ²
Type of circulation	Forced circulation/thermo-siphon	Thermosiphon	
		Pump power	W
		Average flowrate	l/min
	Total storage	Height (cilinder)	m
		Volume	litres
		Tank position - vertical/horizontal	vertical
		Tank location - indoors/outdoors	indoors
		Heat loss coefficient or UA	1.5 W/K
		Volume	litres
Storage	Back-up part of storage (Recommende set temperature)	(Recommende set temperature)	°C

Tab B. Data of a member of thermo siphon system family

Project: Flexible system certification - validation of procedure for system performance prediction extrapolation

Check / data list for system test

Solar + supplementary system	"6250" (6m ² collectors+250 litres storage)	= REFERENCE SYSTEM		
Solar loop	Collector	Collector name/type		
		No. collector modules	3	
		Aperture area per collector module	2	m ²
		Optical Efficiency	0.77	
		First-order heat loss coefficent	3.8	W/(m ² K)
		Second-order heat loss coefficent	0.014	W/(m ² K ²)
		Thermal capacity of collector		kJ/K
	Collector loop pipes	Incident Angle Modifier:	Angle °	30 50 70
		IAM, ASHRAE b0=0.1, b1=0.		0.94
Heat Exchanger	Pipes Dimensions	Diameter		W/K
		Total pipe lenght		m
	Pipe insulation	Thickness of insulation		mm
		Heat conductivity of insulation		W/(m*K)
			0	m
	Overall heat loss coefficent	0		W/K
	Thermal capacity			kJ/K
Type of circulation	Heat transfer coefficient or	115		W/K
	Heat transfer area			m ²
	Forced circulation/thermo-siphon	Forced circulation		
Storage	Total storage	Pump power		W
		Average flowrate		l/min
		Height (cilinder)	1.25	m
		Volume	250	litres
		Tank position - vertical/horizontal	vertical	
	Back-up part of storage (Recommendet set temperature)	Tank location - indoors/outdoors	indoors	
		Heat loss coefficient or Insulation material & thickness	2.5 W/K	
		Volume	70	litres
		(°C)	60	°C

Tab C. Data of Reference system representing whole system family (forced circulation with auxiliary)

Project: Flexible system certification - validation of procedure for system performance prediction extrapolation			
Check / data list for system test			
	Solar + supplementary system	"4350" (4m ² collectors+350 litres storage)	
Solar loop	Collector	Collector name/type	
		No. collector modules	2
		Aperture area per collector module	2 m ²
		Optical Efficiency	0.77
		First-order heat loss coefficient	3.8 W/(m ² K)
		Second-order heat loss coefficient	0.014 W/(m ² K ²)
		Thermal capacity of collector	kJ/K
	Incident Angle Modifier:	Angle °	30 50 70
		IAM, ASHRAE b0=0.1, b1=0.	0.94
Storage	Collector loop pipes	Pipes Dimensions	Diameter W/K
			Total pipe lenght m
		Thickness of insulation	mm
		Pipe insulation Heat conductivity of insulation	W/(m*K)
			Total length of uninsulated pipes m
	Heat Exchanger	Overall heat loss coefficient	0 W/K
		Thermal capacity	kj/K
	Type of circulation	Heat transfer coefficient or	175 W/K
		Heat transfer area	m ²
		Forced circulation/thermo-siphon	Forced circulation
Storage	Total storage	Pump power	W
		Average flowrate	l/min
		Height (cilinder)	1.25 m
		Volume	350 litres
		Tank position - vertical/horizontal	vertical
	Back-up part of storage	Tank location - indoors/outdoors	indoors
		Heat loss coefficient or Insulation material & thickness	3.5 W/K
	Back-up part of storage	Volume	100 litres
		(Recommende set temperature)	60 °C

Tab D. Data of a member of system family (forced circulation with auxiliary)

Proposal of Revision of Annex D – Section D4/D4.1.

Maria João Carvalho, LNEG, *March, 2011*

Solar Keymark System Families can be formed if requirements defined in Annex D. SOLAR KEYMARK SYSTEM FAMILIES [1] of Solar Keymark – Specific Scheme Rules [2], are verified.

If a set of systems verifies Section D.1 and D.2, the System Family can be formed, but **extrapolation can only be applied if section D4 is also verified**. Presently there are limitations to the application of an extrapolation procedure when the system family is formed by Thermosyphon systems that were tested according to CSTG test method, i.e. ISO 9459-2. This limitation was imposed by lack of validation of Method I for these systems.

The present document shows results of the application of Method I to Thermosyphon Systems tested according to CSTG test method (ISO 9459-2).

Three families of systems were considered. In these families, two systems were tested for determination of Thermal Performance, one of which was selected as reference system in agreement to Section D.3 and is further referred as Reference System. The other system tested is referred as Verification System.

For the reference system, the measured value $Q_{sol,out}$ (Q_L - energy delivered by the solar heating system in kWh/year), was compared to the value $Q_{sol,out}$, calculated according to EN 15316-4-3, after determination of the factor η_{loop} by fit to the measured values for each location. This comparison was done for: three families of systems, four reference locations (Athens; Davos; Wuerzburg and Stockholm) and five loads chosen in agreement with the Storage Tank volume of the Reference system, according to Annex B, Table B1 of EN 12976-2. The values obtained are within $\pm 15\%$ of the measured value. The reference systems were formed by selective and non-selective collectors and the ratio A_a/V_{store} varied between 0.012 and 0.015. The load volumes considered ranged from 140 l to 400 l. The results are shown in Fig.1.

Taking into consideration that Extrapolation Method II (section D.4.2) also considers a deviation of $\pm 15\%$ in order to be possible to perform the extrapolation, it was also here considered that within this deviation it is acceptable to proceed to the next step of the extrapolation of results.

Note that, presently, Section D4.1 does not impose any criterion for validation of the possibility to proceed with extrapolation process.

The extrapolation process as described in D4.1 was applied to the Verification Systems and the results obtained were compared with the measured results of these Verification Systems. The verification systems had ratios A_a/V_{store} around 0.012. The load volumes considered ranged from 140 l to 400 l. The results obtained are shown in Fig.2. It was observed that the deviations are lower than $\pm 15\%$.

Based on these results it is proposed that a revision of Section D.4 is made as proposed in the Annex to this document.

References.

- [1] Annex D. SOLAR KEYMARK SYSTEM FAMILIES - Version **SKN_N0106R6annexDR5(12/10 2010)**
- [2] Solar Keymark – Specific Scheme Rules, Version 11.04 - December 2009

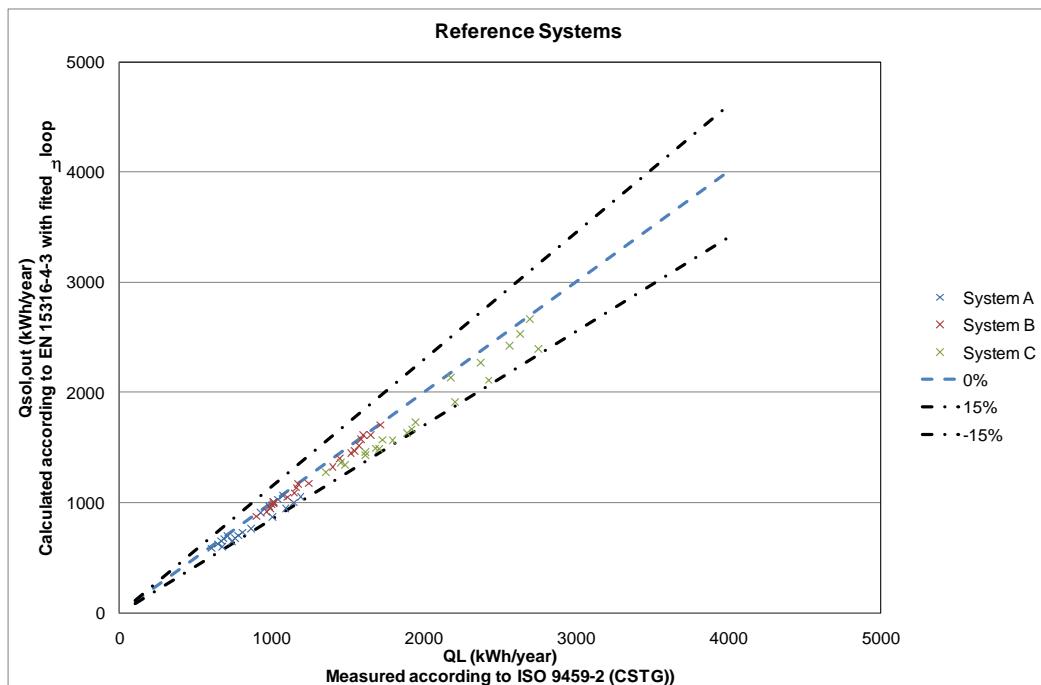


Fig.1 – Comparison of measured and extrapolated values for reference systems.

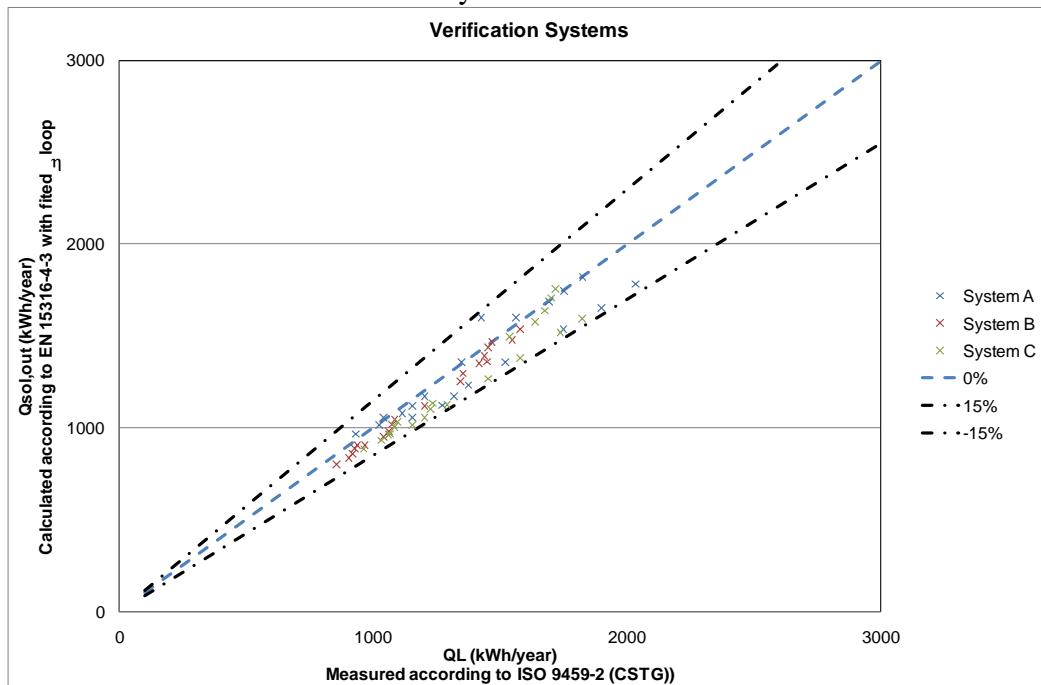


Fig.2 – Comparison of measured and extrapolated values for verification systems.

Round Robin Test of the DST Evaluation and Extrapolation Method for System Families

S. Bonk, ITW University of Stuttgart

Round Robin Test of the DST Evaluation and Extrapolation Method for System Families

ITW University of Stuttgart
S. Bonk

Version 3.0

Date: 30/04/2012

This document provides a description of a round robin test of the SKN extrapolation method based on DST method. It includes the system definition, a set of measurement data and the requirements for reporting of the results. Furthermore the results collected within the QAiST-Project are described and possible errors discussed.

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Purpose of this Document

By this round robin test the extrapolation procedure defined in the Scheme Rules Annex D provided by the Solar Keymark Network (SKN)² should be applied to a generic system family of solar domestic hot water systems. The target of this test is to identify shortcomings in the procedure definition by comparison of the evaluation results performed by different test laboratories based on the same data set and system definition.

Within this document a system family is defined in chapter 0. This system family has been evaluated based on a data set described in chapter 0. The results have been collected from 9 participating test laboratories and evaluated according to the methodology described in section 0. The results are presented and discussed in section 0. The special purpose of the document is to analyze possible error sources during the DST evaluation and extrapolation of the results according to the SKN scheme rules. This document contains all necessary information for test laboratories to repeat the exercise on their own and compare the obtained results to the results submitted by the participating test laboratories. This exercise is meant to help detect common errors and to improve the quality of the testing.

System Family Definition

The system family consists of four thermo siphon systems. Each system consists of a horizontally positioned cylindrical heat store and some flat plat collectors with uniform size for all family members. The collector is connected to the store with un-insulated copper pipes. The solar loop is connected to the store through a mantle heat exchanger. The configuration of the system is listed in Tab. 1.

System Name	Nr.	No. of Col.	Nominal Store Volume	Store Cylinder Diameter	Store Cylinder Length	Pipe Length	Pipe Diameter	Area of Heat Exchanger
		[-]	[l]	[m]	[m]	[m]	[m]	[m ²]
RR2sys1	1	1	180	0.51	1.494	2.667	0.019	1.9
RR2sys2	2	1	220	0.51	1.760	2.399	0.019	2.25
RR2sys3	3	2	220	0.51	1.760	3.030	0.019	2.25
RR2sys4	4	2	300	0.51	2.310	2.496	0.019	2.95

Tab. 1: Configuration of the system family

² <http://www.estif.org/solarkeymark/schemerules.php>

The characteristic values of the collector needed for applying the extrapolation procedure are listed in the following Tab. 2.

	FPCol
Collector Aperture Area [m ²]	1.86
η_0	0.799
a _{1a}	3.8
a _{2a}	0.018
K ₅₀	0.89

Tab. 2: Characteristic values of the used collector

The system is not equipped with any backup heater.

All requirements regarding the Solar Keymark Certificate of the collector and constructive similarities of the store are considered as fulfilled.

For quantities needed for the evaluation and not given in this definition, the SKN default values should be used.

Data Basis

The data set “QAiST_WP3.1.2_RR2_Data.zip” contains three pre-processed measurement files in the *.d3 format used by the evaluation software ISS: (QRR2SOL2.D3, QRR2SOL3.D3, QRR2STO4.D3). Furthermore one control file (QRR2sys.d3) for the evaluation software is contained within this package. The data files are also printed in the Annex A.

The measurement data was collected for the system with the A/V ratio closest to the average A/V ratio of the whole family according to the extrapolation rules of the SKN.

Report Template

For reporting of the results the template excel sheet “QAiST_WP3.1.2_RR2_results_TEMPLATE.xls” has been provided. It consists of two worksheets: “GeneralResults” and “LTP_results_template”. For reporting the results it was recommended to create additional copies of these worksheets as described in the following sections.

To lower the effort of evaluation of the results (especially if changes to committed results occur and the evaluation must be repeated) the results should be presented with a strict naming convention.

All results must be filled into the light green fields. Participants were asked not to add any additional lines to the template but they could add comments or additional information into the unused parts of the sheet.

General Results

The worksheet general results was foreseen for reporting of results that were relevant for the whole system family and not connected to one single simulation run.

The Laboratories were asked to rename the worksheet “GeneralResults” to “GeneralResults_<lab>” with <lab> indicating the short name of your test laboratory.

LTP Results

For reporting of the LTP results the laboratories were asked to copy the template worksheet to a worksheet “LTP_<lab>_<series>” where <lab> is the short name of the test laboratory and <series> is the identifier of the calculation series. The series should start with a short prefix to indicate, what kind of simulation results this worksheet does contain. The allowed prefixes are listed in Tab. 3. The second part of the series is the system number.

Prefix	Description
ref	Reference results. These results were obtained from a simulation with free parameters for the reference system.
fix	Fixed parameter results for the reference system.
ext	Extrapolation results for a system, which has not been physically tested.

Tab. 3: Allowed <series> prefixes for LTP report worksheets

Example: With this naming convention a results worksheet created by ITW for the reference system could be “LTP_ITW_refl”, if the reference system is system no. 1.

Note: Please notice that the values of Q_d and Q_l should be given in **MJ/a**, not in W. The values of F_{sol} should be provided as a **factor** and not as a percentage.

Evaluation Methodology

The collected results were evaluated using a similar methodology as in WP4 (Round Robin Test of Solar Thermal Collectors and Systems). The most significant value was the factor of solar fraction f_{sol} . This value is the final figure after performing the parameter identification and the calculation of the LTP.

The statistical evaluation for proficiency testing bases on the methodology described in ISO 13528 and EN ISO/IEC 17043. It evaluates the deviation of f_{sol} determined by laboratory X ($f_{sol,LabX}$) from the median value ($f_{sol,med}$).

For the expression of the deviation the so called Z-score is used. The Z-score is calculated by the following equation:

$$Z = \frac{f_{sol,LabX} - f_{sol,med}}{0.7413 \times (Q3 - Q1)}$$

The values Q3 and Q1 are determined using the function “QUADRILE”, which divides the value set after ascending sorting into four regimes. The value Q1 is the first value below which 25% of all values are lying (the first value of the second regime). The value Q3 represents the first value below which 75% of all values are lying (first value of the fourth regime). By multiplying the quadrille difference by the value 0.7413 the term in the nominator will be converted to a value comparable with the standardised normal distribution.

In this test there is a true value because all institutes should do the evaluation with the same software using the same boundary conditions. Since “true” value was not known at the beginning of the evaluation, the median value has been used as reference. The true value has been determined during the evaluation by using the results of the labs without deviations in any boundary conditions. This will be discussed in the following section.

Results

The extrapolation round robin test contained two major parts:

1. Parameter Identification of the tested system and calculation of LTP
2. Parameter calculation of the extrapolated system family members and calculation of the LTP for the extrapolated system family members

The results of parts 2 and 3 are influenced by the previous parts, because the results are further utilised. Since all test laboratories worked with the same set of measurement data, the measurement uncertainties do not interfere with the results.

Parameter Identification of the tested system and calculation of LTP

The main indicator of the characterisation of a system is the calculated f_{sol} value. The Z-scores of the f_{sol} values for the four standard locations are displayed in the following graphs (Fig. 1 - Fig. 9). All graphs are showing the Z-Score in a range between -3 and 3. This range is the fail criterion for the round robin test. A table below each graph gives additional information about the median value ($f_{sol,med}$) and the standardized normal deviation.

Athens

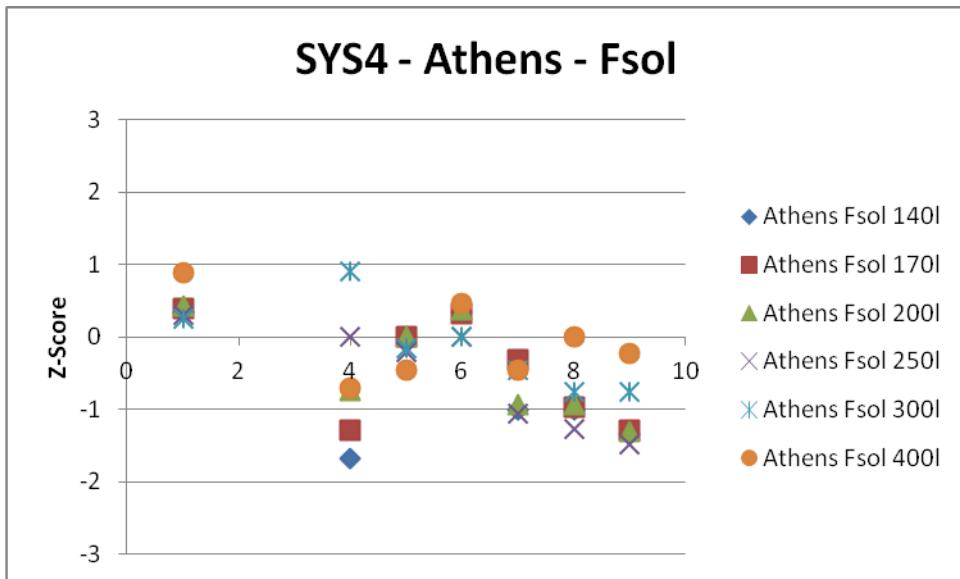


Fig. 1: Z-Scores of *fsol* values of all test labs for the reference system 4, the location of Athens and different load volumes.

Load	140l	170l	200l	250l	300l	400l
Median	92,5%	89,5%	86,5%	81,4%	76,1%	65,7%
STD	0,6%	0,6%	0,5%	0,5%	0,7%	0,4%

Tab. 4: Reference system 4 - Median and Standard deviation for the location Athens and different load volumes

In Fig. 1 the results of two test labs are missing. The Z-scores of the test laboratory 2 and 3 are significantly greater than 3. To be able to discuss this deviation, the Z-score is displayed in an additional figure (see Fig. 2).

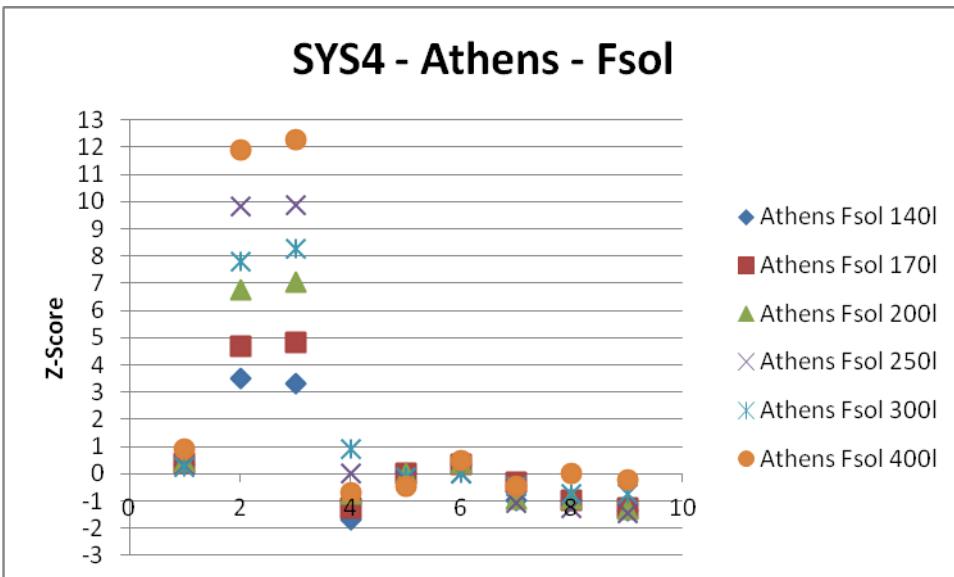


Fig. 2: Z-Scores of fsol values of all test labs for the reference system 4, the location of Athens and different load volumes scaled to show the results with high deviation.

One reason for these very high Z-scores is the low standard deviation of this result series. The absolute deviations are in a similar range as for other locations.

While looking for an explanation the additionally collected data about the simulation input data has been investigated. Both test laboratories (No. 2 and 3) are using different input parameters for calculation of the cold water temperature than the others.

LabX	Ath_Tcw_P1	Ath_Tcw_P2	Ath_Tcw_P3
1	17,8	7,4	45,75
2	17,8	7,4	137
3	17,8	7,4	137
4	17,8	-7,4	228,25
5	17,8	7,4	46
6	17,8	7,4	45,75
7	17,8	7,4	45,75
8	17,8	7,4	45,75
9	17,8	7,4	15

Tab. 5: ISS parameters for calculation of cold water temperature

The LTP routines of the program ISS uses these three parameters for the calculation of the cold water temperature (T_{cw}) by the following formula:

$$T_{cw} = P1 - P2 \times \cos \frac{2\pi(N_{day} - P3)}{365}$$

Where $P1$, $P2$, $P3$ are parameters listed in Tab. 5 and N_{day} is the number of the day of the year.

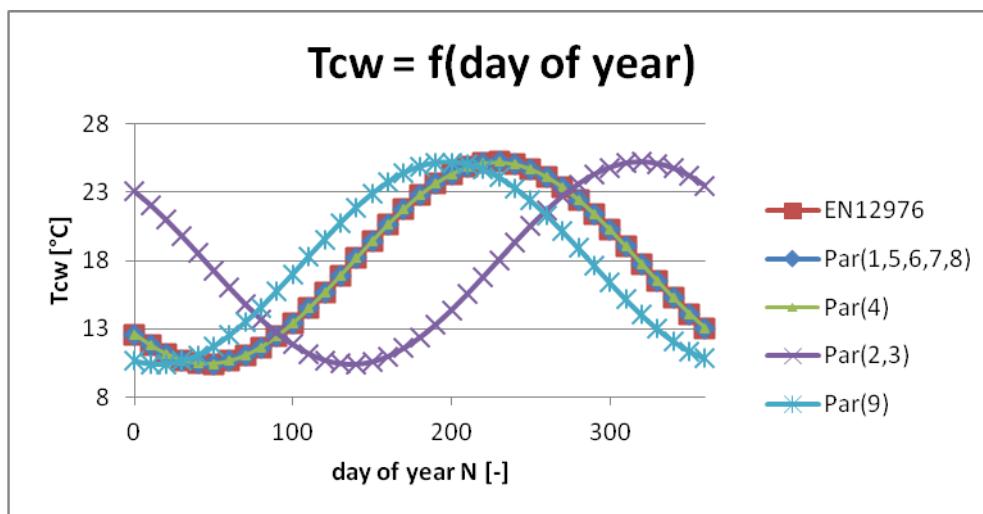


Fig. 3: Comparison of the curve progression of the cold water temperature as function of the day of year and different parameter sets used by test laboratories: Par(LabX)

The parameter sets of the curves shown in Fig. 3 are compared to the curve defined in EN 12976-2 Annex B. For the location of Athens the cold water temperature shall be calculated by the following formula:

$$T_{cw,EN12976} = 17.8 + 7.4 \times \sin \frac{2\pi(N_{day} - 137)}{365}$$

The parameter sets Par(1,5,6,7,8) and Par(4) are showing the same progression as the curve defined in EN 12976-2. The parameter set of the test labs 2 and 3 are implementing the parameters given in EN 12976, but since the function of the ISS program uses a cosines for the calculation, the progression of the cold water temperature curve is shifted towards warmer season. This leads to a higher energy demand during the summer season and to lower energy demand during the winter season. This shift causes a higher performance of the system and thus a higher solar fraction f_{sol} .

The shift of the cold water minimum Temperature in Par(9) into the cold season seems not to have any major impact on the results. Nevertheless this shift deviates from the curve defined in EN 12976 and correction measures should be taken.

The effect of this deviation is more significant on results of location with a high temperature amplitude P2 (Athens ($P2=7.4$) and Stockholm($P2=6.4$)) but it will have only small impact on results of locations Wuerzburg ($P2=3$) and nearly no impact on results of Davos ($P2=0.8$).

To avoid further location specific influences the meteorological input data was accessed as well. Since the Solar Keymark Network (SKN) has specified an irradiation sum and mean ambient temperature as crosscheck values, the collected data was plotted in comparison to the crosscheck values.

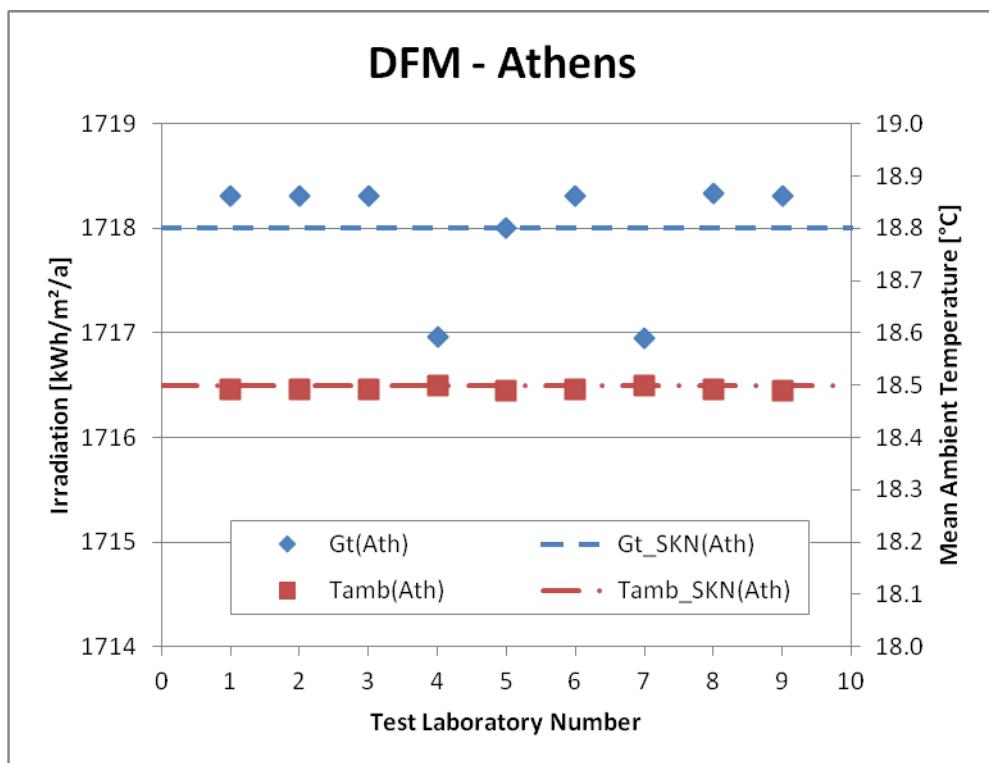


Fig. 4: Irradiation sums and mean ambient temperatures for the location of Athens of all test laboratories in comparison with the reference values specified by the Solar Keymark Network (SKN)

All participating institutes are using the same data set for the location of Athens. The deviations of ± 1 kWh/m²/a is probably caused by reporting insecurities, because the data template for the collection of information did not specify units for reporting the data. Thus some reported values have been converted from [MJ/m²/a] or [kJ/m²/a] to [kWh/m²/a] and were given with different number of digits of precision.

When comparing the settings of the laboratories for the store ambient temperatures T_{sa} , further deviations will become obvious. The Tab. 6 lists the settings used for the calculations of the store ambient temperature (T_{sa}) for the location of Davos made by all test laboratories.

LabX	T _{sa} (Athens)
1	15
2	
3	T _{sa} =T _{ca}
4	18,5
5	15
6	15
7	*1
8	
9	-

Tab. 6: Settings for the calculation of the store ambient temperature (T_{sa}) of all test laboratories for the location of Athens

The test laboratories 1, 5 and 6 used settings defined for forced circulated systems, where the store is installed inside of the building, while the laboratory 4 used the mean ambient temperature. For the location of Athens the error made by the test institutes did not show any effect, because the used store ambient temperatures were very similar to the ambient temperatures of the DFM file and the temperature variation within 24h are quite low in this climatic zone.

Davos

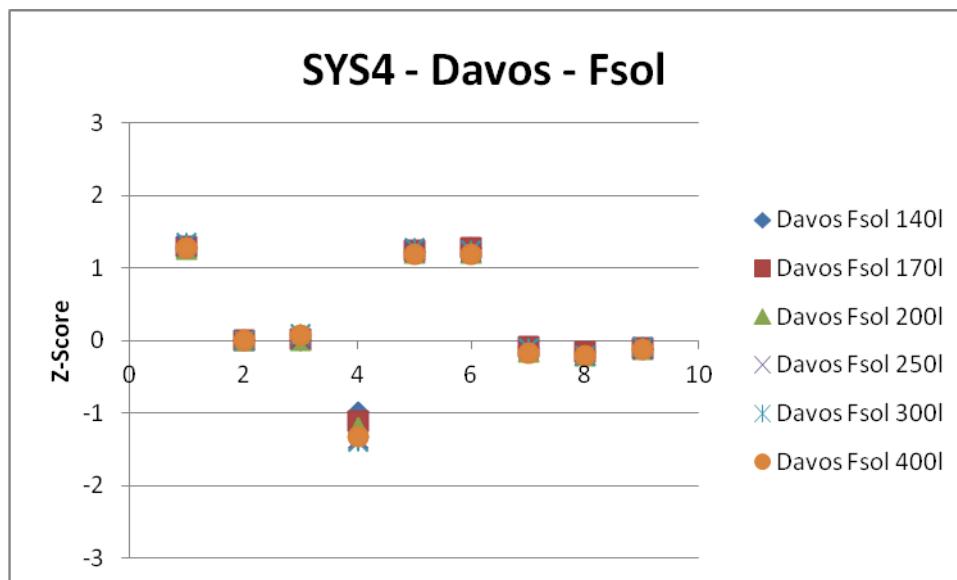


Fig. 5: Z-Scores of fsol values of all test labs for the reference system 4, the location of Davos and different load volumes.

Load	140l	170l	200l	250l	300l	400l
Median	81,8%	77,0%	72,7%	65,4%	58,3%	46,2%

STD 3,9% 3,9% 3,8% 3,4% 3,1% 2,6%

Tab. 7: Reference system 4 - Median and Standard deviation for the location Davos and different load volumes

The high deviations of the results provided by the test laboratories 1, 4, 5 and 6 may be explained with table listing the configuration of the store ambient temperature (T_{sa}):

LabX	$T_{sa}(\text{Davos})$
1	15
2	
3	$T_{sa}=T_{ca}$
4	3,22
5	15
6	15
7	*1
8	
9	-

Tab. 8: Settings for the calculation of the store ambient temperature (T_{sa}) of all test laboratories for the location of Davos

The test laboratories 1, 5 and 6 used settings defined for forced circulated systems, where the store is installed inside of the building. Since the system family used for this round robin test is of type thermo siphon, the results of this test laboratories show an overestimation of the system performance. This effect is very significant in the climate of Davos, because the average ambient temperature is very low (3.2 °C) low.

The settings of the test laboratory 4 indicate the usage of the average ambient temperature as fixed value. This might lead to a disadvantage in a climatic zone with large range of temperatures over 24h. The T_{sa} is in the simulation lower during the day than it would be when using the data from the DFM file. This will increase the store losses and thus decrease the performance of the system.

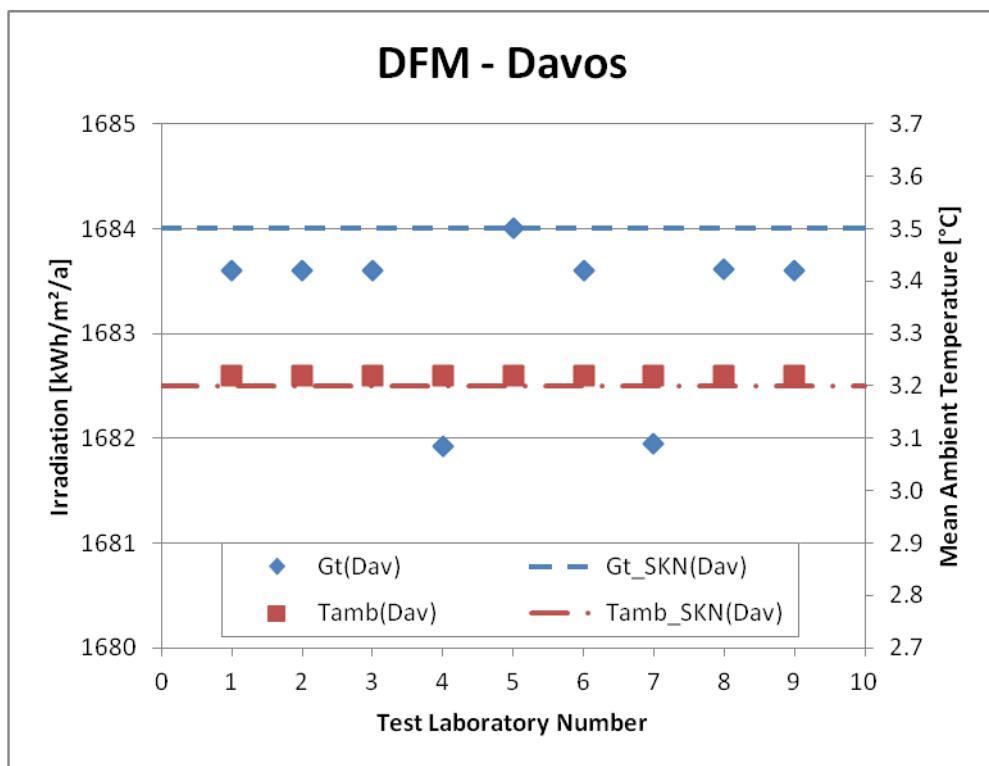


Fig. 6: Irradiation sums and mean ambient temperatures for the location of Davos of all test laboratories in comparison with the reference values specified by the Solar Keymark Network (SKN)

The DFM files of all test laboratories are consistent. As already discussed for the location of Athens the lower values of laboratory 4 and 7 can be accounted as reporting uncertainties.

Stockholm

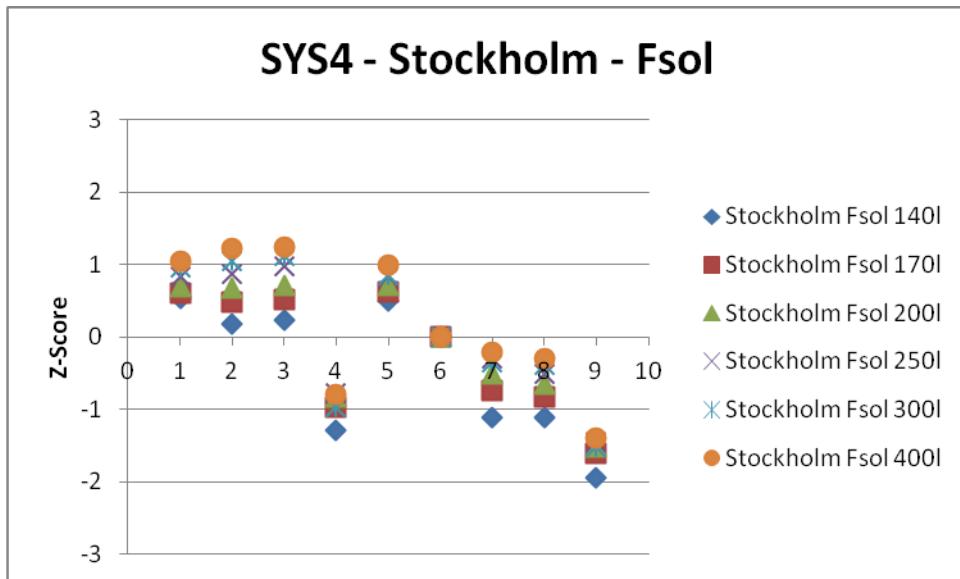


Fig. 7: Z-Scores of *fsol* values of all test labs for the reference system 4, the location of Stockholm and different load volumes.

Load	140l	170l	200l	250l	300l	400l
Median	62,3%	58,1%	54,5%	49,1%	44,0%	35,1%
STD	3,4%	3,5%	3,4%	3,0%	2,6%	2,0%

Tab. 9: Reference system 4 - Median and Standard deviation for the location Stockholm and different load volumes

The results of Stockholm contain a lot of deviations. The *fsol* values of test institutes 2 and 3 show an overestimation due to seasonal shift of the cold water temperature (see Fig. 3). This deviation was discussed in the section 0 and is confirmed in the results of Stockholm.

As already shown for Athens and Davos test labs 1, 4, 5 and 6 used the wrong configuration of the store ambient temperature. The configuration is listed in the table Tab. 10.

LabX	Tsa(Stockh.)
1	15
2	
3	Tsa=Tca
4	7,5
5	15
6	15
7	*1
8	
9	-

Tab. 10: Settings for the calculation of the store ambient temperature (T_{sa}) of all test laboratories for the location of Stockholm

The used configuration will cause an overestimation of the performance in case of test laboratories 1, 5 and 6 and an underestimation of performance in case of test lab 4. The Z-Scores of test labs 1, 4 and 5 concur with this hypothesis. The Z-Scores of test lab 6 are lower. A look at the used DFM files shown in Fig. 8 helps explaining this effect.

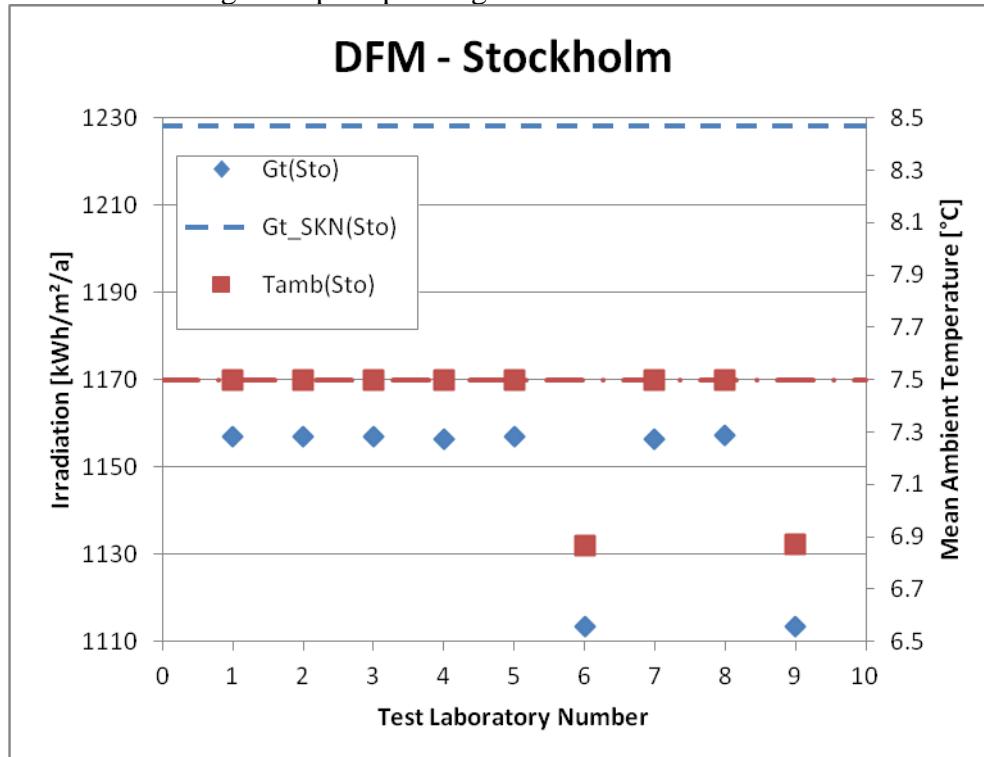


Fig. 8: Irradiation sums and mean ambient temperatures for the location of Stockholm of all test laboratories in comparison with the reference values specified by the Solar Keymark Network (SKN)

The test laboratories 6 and 9 have used a DFM file with significant lower values of irradiation and mean ambient temperature. This leads to lower system performance and hence to lower f_{sol} values. This can be seen in the results of lab 9 where the usage of the different DFM file is the major deviation. In case of lab 6 the usage of the different DFM file and the wrong configuration for T_{sa} calculation cause an impact on the results in opposite direction so that the contained errors are not obvious.

The overall Z-score of test laboratory 6 represents the median for the location of Stockholm. A result that lies in the middle of reported results by coincidence is taken as the reference result. This reveals a weakness of the evaluation procedure with test samples of only 9 test laboratories.

Wuerzburg

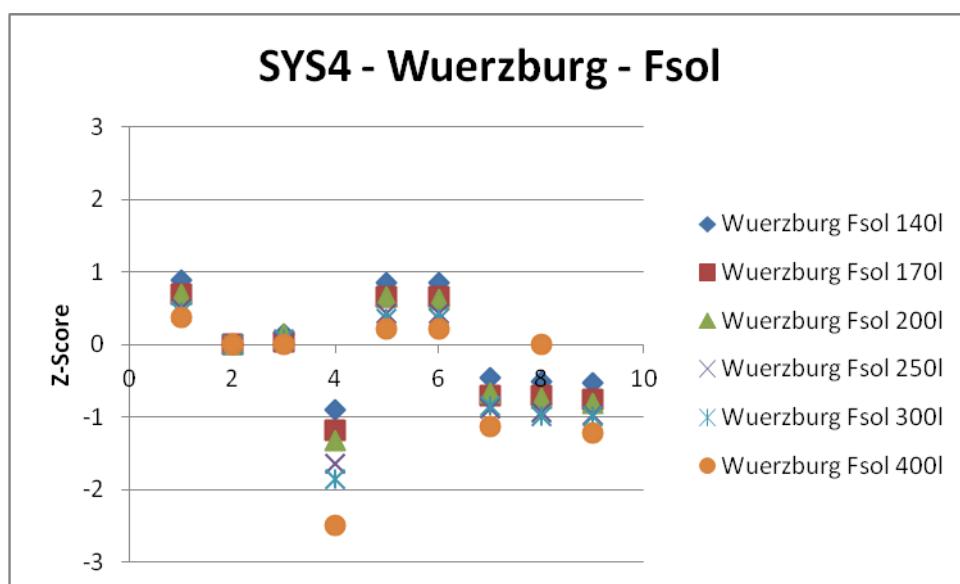


Fig. 9: Z-Scores of f_{sol} values of all test labs for the reference system 4, the location of Wuerzburg and different load volumes.

Load	140l	170l	200l	250l	300l	400l
Median	63,4%	60,7%	57,8%	53,5%	49,0%	40,0%
STD	3,6%	3,1%	2,7%	2,4%	2,1%	1,4%

Tab. 11: Reference system 4 - Median and Standard deviation for the location Wuerzburg and different load volumes

LabX	Tsa(Wuerzb.)
1	15
2	
3	Tsa=Tca
4	8,99
5	15
6	15
7	*1
8	
9	-

Tab. 12: Settings for the calculation of the store ambient temperature (T_{sa}) of all test laboratories for the location of Wuerzburg

The Z-scores of the location of Wuerzburg confirm all hypotheses set up for the locations Athens, Davos and Stockholm. Results of laboratories 2 and 3 are showing small overestimation in relation to results of labs 7 and 8. The results of labs 1, 4, 5 and 6 are driven by the effect of the wrong configuration of the T_{sa} calculation. All test laboratories are using the same DFM file (see Fig. 10).

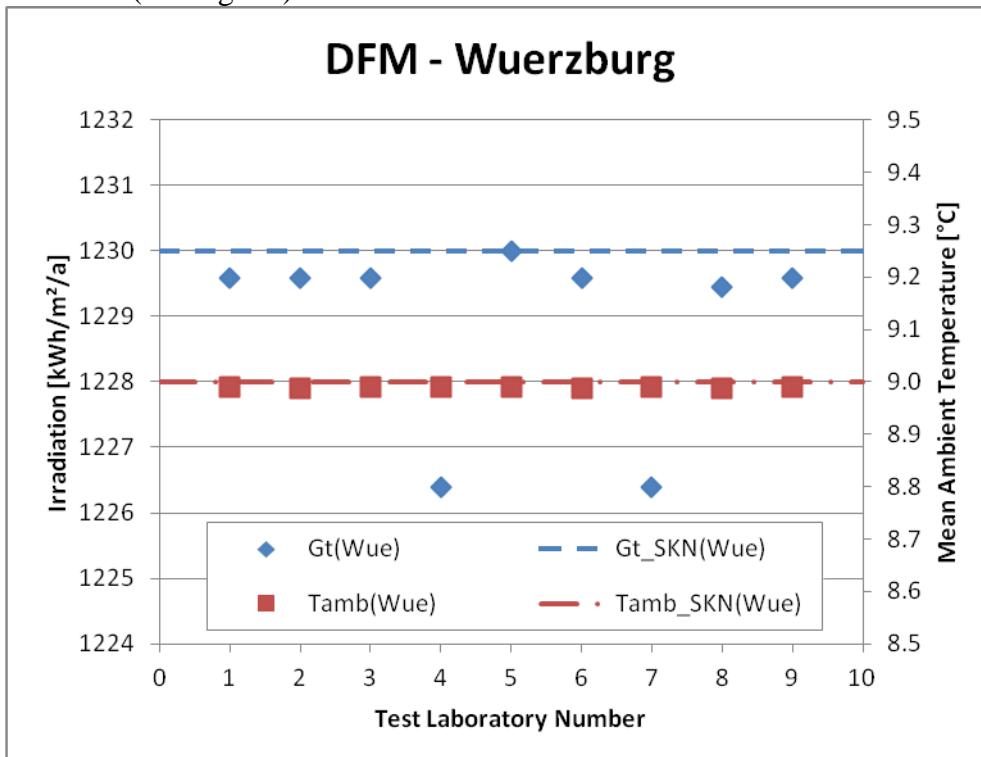


Fig. 10: Irradiation sums and mean ambient temperatures for the location of Wuerzburg of all test laboratories in comparison with the reference values specified by the Solar Keymark Network (SKN)

Configuration of the draw-off profiles

The configuration of the draw-off profiles used by all test laboratories has been investigated as well. More than the half of all participating test laboratories used a configuration with deviating draw-off start time. This is shown in the Fig. 11.

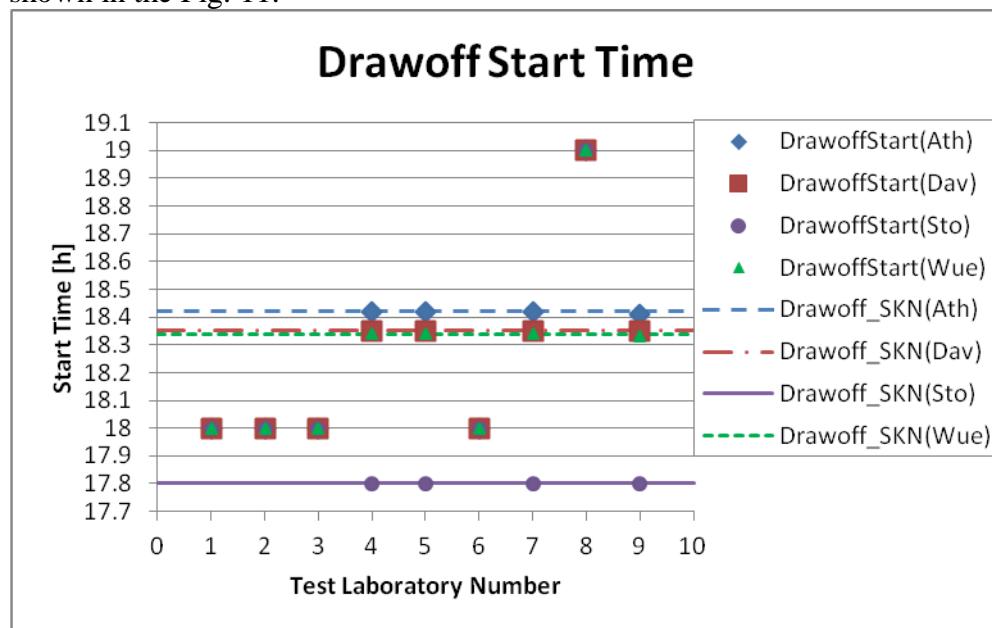


Fig. 11: Configuration used by participating test laboratories of draw-off start times in comparison with reference values defined by the SKN

Nevertheless the impact of the deviation could not be quantified in any of the Z-scores.

Since the flow rate during the taping is mainly set by the draw-off duration and the load volume, these two indicators have been compared as well. All test laboratories used the same (correct) configuration of the load volume. The draw-off duration showed very small variation caused by different number of digits of precision.

Conclusion and rating of the results

Aside from small deviation in the DFM files, which have been classified as reporting uncertainties, the results of test lab 7 are the most reliable ones. The results of test lab 8 concur with the results of test lab 7. Since the test lab 8 does only show deviations in the draw-off start time, which could not be quantified in the Z-score of fsol values, the results of test lab 7 and 8 can be considered as the “true” ones.

The test institutes with deviations caused by the seasonal shift in the cold water temperature and test institutes with deviations regarding to older weather data sets of Stockholm should update their configuration/data files

to most recent version. These deviations may also have had impact on the results reported within the round robin test of WP4.

The wrong setup of the store ambient temperature T_{sa} by 3 of 9 test labs indicates the need of additional checks of this option. The set of configuration must be chosen for each tested system, so there is no easy way to fix this error. The only solution is an increased carefulness by the person in charge of the test laboratory during the calculation of the LTP prediction.

Parameter calculation of the extrapolated system family members

The parameters used for calculation of the long term performance have been determined by the test laboratories according to Annex D of the SKN scheme rules. The results are listed in the Tab. 13.

SYS4								
LabX	Ac*	uc*	Us	Cs	DL	Sc	Objective	
1	2,2850	6,7970	3,3500	1,2870	0,0898	0,1810	23,3930	
2	2,2786	6,9759	3,2118	1,2878	0,0930	0,1829	23,4034	
3	2,2820	6,6940	3,3350	1,2860	0,0924	0,1752	23,3350	
4	2,2800	6,3020	3,5080	1,3030	0,0940	0,1595	24,0890	
5	2,2800	6,8090	3,4020	1,2870	0,0862	0,1809	23,3620	
6	2,2750	6,7650	3,2420	1,2820	0,0948	0,1760	23,3720	
7	2,2720	6,8490	3,2480	1,2860	0,0917	0,1814	23,4200	
8	2,2810	6,7960	3,3370	1,2900	0,0907	0,1802	23,3260	
9	2,2810	6,8320	3,3520	1,2840	0,0860	0,1814	23,3960	

FIX4							
1	2,5850	7,2010	3,2120	1,2670	0,2034	0,1191	
2	2,5640	7,2010	3,2363	1,2659	0,1836	0,1226	28,3069
3	2,5846	7,2020	3,1150	1,2650	0,2191	0,1170	28,8500
4	2,6450	8,1940	2,7830	1,2620	0,2294	0,1221	30,5530
5	2,5850	7,2000	3,1950	1,2700	0,2074	0,1167	28,8100
6	2,5850	7,2010	3,1300	1,2750	0,2118	0,1161	28,8340
7	2,5850	7,2010	3,1680	1,2620	0,2059	0,1183	28,8480
8	2,5850	7,2010	3,1420	1,2700	0,2042	0,1173	28,8030
9	2,5840	7,2010	3,2770	1,2590	0,1811	0,1207	28,846

EXT1							
1	1,2960	8,1620	2,1900	0,7602	0,2034	0,1191	
2	1,2870	8,1616	2,1529	0,7596	0,1836	0,1226	

3	1,2959	8,1634	2,1240	0,7590	0,2191	0,1170
4	1,3227	10,2847	1,8976	0,7572	0,2294	0,1221
5	1,2960	8,1600	2,1790	0,7620	0,2074	0,1167
6	1,2960	8,1620	2,1340	0,7650	0,2118	0,1161
7	1,2959	8,1616	2,1602	0,7572	0,2059	0,1183
8	1,2959	8,1616	2,0237	0,7620	0,2040	0,1170
9	1,2959	8,1616	1,6385	0,7554	0,1811	0,1207
EXT2						
1	1,3010	7,9800	2,5230	0,9291	0,2034	0,1191
2	1,2932	7,9802	2,5060	0,9284	0,1836	0,1226
3	1,3006	7,9820	2,4471	0,9277	0,2191	0,1170
4	1,3227	9,8899	2,1863	0,9255	0,2294	0,1221
5	1,3010	7,9800	2,5100	0,9310	0,2074	0,1167
6	1,3010	7,9800	2,4590	0,9350	0,2118	0,1161
7	1,3006	7,9802	2,4887	0,9255	0,2059	0,1183
8	1,3006	7,9802	2,3964	0,9313	0,2040	0,1170
9	1,3006	7,9802	1,6385	0,9233	0,1811	0,1207
EXT3						
1	2,5640	7,3820	2,5230	0,9291	0,2034	0,1191
2	2,5365	7,3818	2,5060	0,9284	0,1836	0,1226
3	2,5637	7,3827	2,4471	0,9277	0,2191	0,1170
4	2,6453	8,5878	2,1863	0,9255	0,2294	0,1221
5	2,5640	7,3800	2,5100	0,9310	0,2074	0,1167
6	2,5640	7,3820	2,4590	0,9350	0,2118	0,1161
7	2,5637	7,3818	2,4887	0,9255	0,2059	0,1183
8	2,5637	7,3818	2,3964	0,9313	0,2040	0,1170
9	2,5637	7,3818	3,277	0,9233	0,1811	0,1207

Tab. 13: Parameters determined by the test labs according to the extrapolation procedure (Annex D – SKN Scheme Rules)

Due to the characteristics of the parameter identification algorithm the determined parameter sets of the reference system (sys4) reported by the test labs in Tab. 13 are different. Since the parameters are correlated it is possible to achieve the same LTPP results with different parameter sets. But this fact makes it impossible to verify the parameter sets of the test lab by simple comparison.

Fixed parameter set

To determine the fixed parameter set (fix4) the same input data is used as for the free parameter identification, but the collector parameters are calculated separately according to the SKN scheme rules.

FIX4		
LabX	Ac*	uc*
1	2,5850	7,2010
2	2,5640	7,2010
3	2,5846	7,2020
4	2,6450	8,1940
5	2,5850	7,2000
6	2,5850	7,2010
7	2,5850	7,2010
8	2,5850	7,2010
9	2,5840	7,2010

Tab. 14: Fixed collector parameters with highlighted deviations

According to the SKN scheme rules the parameters Ac* and uc* are calculated as follows:

- $Ac^* = F''' * \eta_{0a} * K_{50^\circ} * A_a$

where:

- A_a : Total collector aperture area in m²
- η_{0a} : Optical efficiency based on aperture area
- K_{50° : Incidence angle modifier at 50°

The heat exchanger factor F''' is defined in the following:

- $F''' = 1 - \Delta\eta_{hx}$
- $\Delta\eta_{hx} = \frac{\eta_{0a} K_{50^\circ} (A_a \alpha_c + U_{loop,total})}{(UA)_{hx}}$
- $U_{loop,total} = U_{insu} + U_{un-insu}$
- $u_c^* = \frac{\alpha_c + U_{loop,total}/A_a}{\eta_{0a} K_{50^\circ}}$, W/(K m²)

The store heat loss parameter (U_s) is determined as:

- $U_{s,x} = U_{s,ref,fix} * A_{x,surface} / A_{ref,surface}$

The store heat capacity parameter (C_s) is determined as:

- $C_{s,x} = C_{s,ref,fix} * V_x / V_{ref}$

To be able to trace the reasons of errors, additional intermediate values have been collected and summarised in the Tab. 15. The intermediate values reported by the majority of the test laboratories are highlighted in green, while deviations are highlighted in red.

Lab X	Aa*ac (sys4)	delta_eta_hx (sys4)	F''' (sys4)	U,loop, total (sys4)	U,loop, un-insu (sys4)	U,loop, insu (sys4)	UA(hx) (sys4)	A_surface (sys4)
1	16,814	0,023	0,977	2,235	2,235	0	590	4,1097
2	16,814	0,031	0,969	2,235	2,235	0	442,5	3,7200
3	16,814	0,023	0,977	2,237	2,235	0,0024	590	0,1490
4	16,814	0,000	1,000	4,863	4,863	0	9999999	4,1097
5	16,814	0,023	0,977	2,230	0,230	0	590	4,1100
6	16,814	0,023	0,977	2,235	2,235	0	590	4,1097
7	3,720	0,023	0,977	2,235	2,235	0	590	0,1490
8	16,814	0,023	0,977	2,235	2,235	0	590	2,9500
9	16,814	0,023	0,977	2,235	2,235	0	590	3,7011

Tab. 15: Intermediate values for calculation of the fixed parameter set

The intermediate values of $U_{loop,total}$ reported by laboratories 3,4 and 5 differ from the results of the other test laboratories. Small deviations in this value don't show any effect on the F''' value and thus they don't have any impact on the Ac^* parameter. These small deviations have a very small impact on the uc^* parameter. Higher deviations like reported by lab 4 have significant impact on both parameters.

Additionally labs 2 and 4 did not calculate the UA_{hx} value correctly. This deviation has a significant effect on the F''' value and thus a large impact on the Ac^* parameter.

Some of the deviations of the intermediate values may also be due to reporting errors. For example it is expected that the deviation of the $Aa*ac$ value reported by Lab 7 would have a major impact on the F''' value. But this is not the case. This indicates that the used value for determination of the F''' was the correct one.

Extrapolated parameter sets

The calculated parameters of the extrapolated systems (ext1, ext2 and ext3) are based on the fixed parameter set. Since all parameters are influenced by

the effects of the parameter identification algorithm, possible deviations shall be revealed by comparison of the ratio calculated by division of each parameter by the same parameter of the fixed parameter set. The scale colours are set separately for each parameter; they do not rate the result but just indicate differences between reported results.

LabX	Ac*	uc*	Us	Cs	DL	Sc	F'''
EXT1							
1	0,501	1,133	0,682	0,6	1,000	1,000	0,379
2	0,502	1,133	0,665	0,6	1,000	1,000	0,380
3	0,501	1,134	0,682	0,6	1,000	1,000	0,379
4	0,500	1,255	0,682	0,6	1,000	1,000	0,378
5	0,501	1,133	0,682	0,6	1,000	1,000	0,379
6	0,501	1,133	0,682	0,6	1,000	1,000	0,379
7	0,501	1,133	0,682	0,6	1,000	1,000	0,379
8	0,501	1,133	0,644	0,6	0,999	0,997	0,379
9	0,502	1,133	0,500	0,6	1,000	1,000	0,379
EXT2							
1	0,503	1,108	0,785	0,733	1,000	1,000	0,381
2	0,504	1,108	0,774	0,733	1,000	1,000	0,381
3	0,503	1,108	0,786	0,733	1,000	1,000	0,380
4	0,500	1,207	0,786	0,733	1,000	1,000	0,378
5	0,503	1,108	0,786	0,733	1,000	1,000	0,381
6	0,503	1,108	0,786	0,733	1,000	1,000	0,381
7	0,503	1,108	0,786	0,733	1,000	1,000	0,380
8	0,503	1,108	0,763	0,733	0,999	0,997	0,380
9	0,503	1,108	0,500	0,733	1,000	1,000	0,381
EXT3							
1	0,992	1,025	0,785	0,733	1,000	1,000	0,375
2	0,989	1,025	0,774	0,733	1,000	1,000	0,374
3	0,992	1,025	0,786	0,733	1,000	1,000	0,375
4	1,000	1,048	0,786	0,733	1,000	1,000	0,378
5	0,992	1,025	0,786	0,733	1,000	1,000	0,375
6	0,992	1,025	0,786	0,733	1,000	1,000	0,375
7	0,992	1,025	0,786	0,733	1,000	1,000	0,375
8	0,992	1,025	0,763	0,733	0,999	0,997	0,375
9	0,992	1,025	1,000	0,733	1,000	1,000	0,375

Tab. 16 Comparison of parameter ratio for all extrapolated systems

The deviations of the parameter ratio of Ac* and uc* are in line with the deviations detected in the fixed parameter set in section 0. Since the

parameters DL and Sc should not be extrapolated at all, a ratio different than 1 indicates errors. But since the ratio is very close to 1, the deviations are caused by reporting the values with a different number of digits.

The parameter Us of the extrapolated parameter set is determined by the ratio of the store surface of the extrapolated system to the store surface of the reference system. The values of the store surface “A_surface” have been collected as well as intermediate results. These are listed in

LabX	A_surface (sys1)	A_surface (sys2)	A_surface (sys3)	A_surface (sys4)
1	2,802	3,228	3,228	4,110
2	1,860	1,860	3,720	3,720
3	0,159	0,143	0,181	0,149
4	2,802	3,228	3,228	4,110
5	2,800	3,230	3,230	4,110
6	2,802	3,228	3,228	4,110
7	0,159	0,143	0,181	0,149
8	1,900	2,250	2,250	2,950
9	2,394	2,820	2,820	3,701

Tab. 17: Heat store surface reported by all test labs

To verify the reported values the ratios Aext/Aref and Us,ext/Us,ref are listed in the Tab. 18 for each extrapolated parameter set.

LabX	Us,ext1 / Us,ref	Aext1 / Aref	Us,ext2 / Us,ref	Aext2 / Aref	Us,ext3 / Us,ref	Aext3 / Aref
1	0,682	0,682	0,785	0,786	0,785	0,786
2	0,665	0,500	0,774	0,500	0,774	1,000
3	0,682	1,069	0,786	0,961	0,786	1,214
4	0,682	0,682	0,786	0,786	0,786	0,786
5	0,682	0,681	0,786	0,786	0,786	0,786
6	0,682	0,682	0,786	0,786	0,786	0,786
7	0,682	1,069	0,786	0,961	0,786	1,214
8	0,644	0,644	0,763	0,763	0,763	0,763
9	0,500	0,647	0,500	0,762	1,000	0,762

Tab. 18: Comparison of the ratios Aext/Aref and Us,ext/Us,ref for all extrapolated parameter sets

The comparison of the ratios shows some additional reporting errors. The ratio Aext/Aref should be equal to the ratio of Us,ext/Us,ref, but these are deviating in some cases (see lab 2, 3, 7, 9). These deviations may have been caused by inadequate description of the reporting template.

The most labs used the correct area to calculate the surface of the heat store. In the case of labs 3 and 7 the correct values were used to calculate the Us parameters, but the surface of the pipings have been reported as A_surface. In case of the lab 8 there is a reproducible deviation of the Aext/Aref ratio. The reported values by lab 2 and 9 are deviating in both cases (Aext and Us,ext) from the correct values. All three labs should check their routines for calculation of the heat store surface.

Conclusions

This document provides a list of common errors made during the evaluation of factory made system families according to the SKN scheme rules. It provides a reference for the participating test labs to improve their evaluation procedures. It may be also used by test labs not participating in this test to perform the same exercise and compare the own results to the results discussed in this document.

The most sensible part of the long term performance prediction for factory made system families is the evaluation according to the DST method. The results discussed in this document indicate that there is an uncertainty up to $\pm 5\%$ for the calculation of the solar fraction F_{sol} by different test laboratories based on the same measurement data. Most of the deviations are caused by incorrect configuration files, usage of outdated meteorological input data or oversights during the setup of the LTP prediction.

The collected results regarding the application of the extrapolation procedure for factory made system families have revealed some issues as well. Unfortunately not all test labs achieved to calculate the correct fixed and extrapolated parameter sets. Some possible errors have been identified and discussed in chapter 0. Hopefully this document will help each laboratory to check their implemented calculation routines and improve them if necessary.

Annex A Data Samples

QRR2SOL2.D3	
* All integral/mean values (except for time) exclude the skip time	
* Integral time	[d] 7.510
* Skipped time	[d] 0.250
* Integral load	[MJ] 247.962
* Mean load	[W] 382.152
* Integral load (CRL*DT)	[MJ] 247.819
* Integral load capacitance	[MJ/K] 11.359
* Integral load volume	[l] 2710.968
* Mean load volume	[l/d] 360.984
* Mean load capacitance	[W/K] 17.506
* Mean cold water temperature	[°C] 14.813
* Mean load temp. difference	[K] 21.830
* Integral auxiliary energy	[MJ] 0.000
* Integral solar irradiance	[MJ/m²] 145.904
* Mean solar irradiance	[W/m²] 224.862
* Mean collector ambient temperature	[°C] 19.227
* Mean store ambient temperature	[°C] 19.227
* Mean wind speed	[m/s] 0.060
\DataMode,Mean	
\Skip,21600	
\Value,DaySum,	1
\Value,Declination,	22.53839
\DefineChannel,Time,1[s],Sample,'time'	
\DefineChannel,Tca,1[°C],Mean,'collector ambient temperature'	
\DefineChannel,Ictot,1[W/m²],Mean,'hemispherical irradiance in collector plane'	
\DefineChannel,Tsa,1[°C],Mean,'store ambient temperature'	
\DefineChannel,Tcw,1[°C],Mean,'cold water temperature'	
\DefineChannel,Ts,1[°C],Mean,'hot water temperature'	
\DefineChannel,Tl,1[°C],Mean,'hot water temperature'	
\DefineChannel,C1,1[W/K],Mean,'load capacitance rate'	
\DefineChannel,Pnet,1[W],Mean,'net system power'	
\DefineChannel,Paux,1[W],Mean,'auxiliary heater thermal power'	
\DefineChannel,wc,1[m/s],Mean,'air velocity in collector plane'	
\DefineChannel,Pcp,1[W],Mean,'collector loop pump power'	
\UseChannels,Time,Tca,Ictot,Tsa,Tcw,Ts,Tl,C1,Pnet,Paux,wc,Pcp	
*Time Tca Ictot Tsa Tcw Ts Tl C1 Pnet Paux wc Pcp	
\TimeStep,1	
\DefineChannel,Time,1[s],Sample,'time'	
\DefineChannel,T_ca,[°C],Mean,'collector ambient temperature'	
\DefineChannel,Gt_e,[W/m²],Mean,'irradiance on collector plane times Kac'	
\DefineChannel,T_sa,[°C],Mean,'store ambient temperature'	
\DefineChannel,T_cw,[°C],Mean,'cold water temperature'	
\DefineChannel,T_S,[°C],Mean,'store outlet temperature'	
\DefineChannel,T_L,[°C],Mean,'temperature delivered to the user'	
\DefineChannel,dC_S,[W/K],Mean,'load capacitance rate through the store'	
\DefineChannel,P_net,[W],Mean,'net system power (delivered minus aux)'	
\DefineChannel,P_aux,[W],Mean,'auxiliary power'	
\DefineChannel,v_wind,[m/s],Mean,'wind velocity in collector plane'	
\DefineChannel,P_cp,[W],Mean,'collector pump power'	
\UseChannels,Time,T_ca,Gt_e,T_sa,T_cw,T_S,T_L,dC_S,P_net,P_aux,v_wind,P_cp	
*Time T_ca Gt_e T_sa T_cw T_S T_L dC_S P_net P_aux	
v_wind P_cp	
0	

33	11.6	0	11.6	17.6	26.9	26.9	642.9	6531	0	0	0
67	11.6	0	11.6	18.8	27.9	27.9	776.8	7078	0	0	0
97	11.5	0	11.5	21.1	27.9	27.9	776.8	5290	0	0	0
127	11.4	0	11.4	21.2	27.8	27.8	775	5119	0	0	0
157	11.3	0	11.3	21.1	27.3	27.3	776.7	4852	0	0	0
192	11.4	0	11.4	20.4	27.4	27.4	775	5442	0	0	0
226	11.5	0	11.5	19	27.5	27.5	774.5	6577	0	0	0
256	11.4	0	11.4	17.7	27.5	27.5	774.7	7616	0	0	0
291	11.3	0	11.3	16.9	27.5	27.5	772.8	8198	0	0	0
325	11.4	0	11.4	16.4	26.9	26.9	777.3	8196	0	0	0
359	11.4	0	11.4	16	26.8	26.8	773.7	8336	0	0	0
394	11.3	0	11.3	15.9	27.2	27.1	774.1	8736	0	0	0
428	11.4	0	11.4	15.8	26.8	26.8	775.2	8585	0	0	0
463	11.3	0	11.3	15.7	26.4	26.4	774.4	8289	0	0	0
493	11.4	0	11.4	15.8	26.3	26.3	776.2	8191	0	0	0
527	11.5	0	11.5	15.8	26.3	26.3	776.6	8129	0	0	0
562	11.4	0	11.4	15.9	26.4	26.3	776.5	8122	0	0	0
592	11.4	0	11.4	15.9	25.9	25.9	779	7783	0	0	0
622	11.3	0	11.3	16	25.4	25.4	775.6	7346	0	0	0
656	11.3	0	11.3	16	24.8	24.8	779.3	6903	0	0	0
690	11.4	0	11.4	15.9	24.8	24.8	775.9	6874	0	0	0
721	11.4	0	11.4	15.8	24.4	24.5	774.6	6688	0	0	0
755	11.3	0	11.3	15.7	24.2	24.2	781	6669	0	0	0
789	11.3	0	11.3	15.5	23.8	23.8	775.7	6493	0	0	0
819	11.4	0	11.4	15.3	23.5	23.5	771.3	6385	0	0	0
850	11.4	0	11.4	15.1	23.2	23.2	779.5	6353	0	0	0
880	11.4	0	11.4	14.9	23.2	23.2	777.1	6451	0	0	0
914	11.4	0	11.4	14.8	22.9	22.9	775.6	6307	0	0	0
948	11.4	0	11.4	14.6	22.6	22.6	778.4	6242	0	0	0
979	11.3	0	11.3	14.5	22.4	22.4	775.9	6126	0	0	0
1013	11.3	0	11.3	14.4	22.3	22.3	777.4	6142	0	0	0
1043	11.3	0	11.3	14.3	21.9	21.9	779.2	5905	0	0	0
1073	11.3	0	11.3	14.2	21.8	21.8	775.7	5844	0	0	0
1108	11.3	0	11.3	14.1	21.6	21.6	779	5788	0	0	0
1138	11.2	0	11.2	14.1	21.5	21.5	776.8	5758	0	0	0
1172	11.3	0	11.3	14	21.2	21.2	777.4	5629	0	0	0
1202	11.3	0	11.3	13.9	21	21	780.8	5548	0	0	0
1232	11.3	0	11.3	13.9	20.8	20.8	779.2	5374	0	0	0
1267	11.3	0	11.3	13.8	20.6	20.6	778.2	5273	0	0	0
1301	11.3	0	11.3	13.7	20.5	20.5	778.7	5256	0	0	0
1335	11.3	0	11.3	13.7	20.3	20.3	777.9	5197	0	0	0
1370	11.3	0	11.3	13.6	19.9	19.9	779.2	4950	0	0	0
1400	11.4	0	11.4	13.5	19.8	19.8	774.4	4843	0	0	0
1434	11.4	0	11.4	13.4	19.6	19.6	778	4805	0	0	0
1464	11.4	0	11.4	13.3	19.4	19.4	774.9	4724	0	0	0
1499	11.4	0	11.4	13.3	19.2	19.2	772.7	4606	0	0	0
1533	11.3	0	11.3	13.2	19.2	19.2	780.1	4695	0	0	0
1563	11.3	0	11.3	13.1	18.9	18.9	774.4	4467	0	0	0
1593	11.4	0	11.4	13.1	18.8	18.8	771.7	4447	0	0	0
1628	11.4	0	11.4	13	18.7	18.7	778.4	4415	0	0	0
1662	11.3	0	11.3	13	18.6	18.5	773.9	4324	0	0	0
1692	11.3	0	11.3	12.9	18.3	18.3	776.3	4185	0	0	0
1727	11.2	0	11.2	12.8	18.3	18.3	777.5	4220	0	0	0
1757	11.2	0	11.2	12.8	18.1	18.2	773.1	4152	0	0	0
1787	11.2	0	11.2	12.7	18.1	18.1	777.7	4180	0	0	0
1821	11.4	0	11.4	12.7	17.9	17.9	776.7	4080	0	0	0
1851	11.3	0	11.3	12.6	17.7	17.7	774.5	3905	0	0	0
1886	11.4	0	11.4	12.6	17.5	17.5	778.4	3800	0	0	0
1916	11.3	0	11.3	12.6	17.3	17.3	773.4	3695	0	0	0
1946	11.4	0	11.4	12.5	17.3	17.3	777	3738	0	0	0
1980	11.6	0	11.6	12.5	17.1	17.1	778.9	3616	0	0	0
2010	11.4	0	11.4	12.5	17	17	773.2	3547	0	0	0
2041	11.4	0	11.4	12.4	17	17	776.9	3532	0	0	0

2075	11.4	0	11.4	12.4	16.9	16.9	777.5	3486	0	0	0
2105	11.3	0	11.3	12.4	16.8	16.8	774.4	3451	0	0	0
2135	11.4	0	11.4	12.3	16.6	16.6	778.5	3357	0	0	0
2165	11.3	0	11.3	12.3	16.5	16.5	777.9	3272	0	0	0
2195	11.3	0	11.3	12.3	16.4	16.5	775.3	3250	0	0	0
2226	11.3	0	11.3	12.2	16.4	16.4	778.7	3218	0	0	0
2260	11.4	0	11.4	12.2	16.3	16.3	777.1	3157	0	0	0
2294	11.4	0	11.4	12.1	16.1	16.1	771.4	3062	0	0	0
2329	11.3	0	11.3	12.1	15.9	15.9	780.8	2979	0	0	0
2359	11.3	0	11.3	12.1	15.9	15.9	778.1	3008	0	0	0
2389	11.3	0	11.3	12	15.9	15.9	771.1	2961	0	0	0
2423	11.3	0	11.3	12	15.8	15.8	774	2915	0	0	0
2453	11.3	0	11.3	12	15.7	15.7	775.1	2849	0	0	0
2483	11.2	0	11.2	12	15.5	15.5	771.7	2733	0	0	0
2518	11.2	0	11.2	12	15.4	15.4	774.6	2694	0	0	0
2548	11.3	0	11.3	11.9	15.3	15.3	774	2610	0	0	0
2578	11.3	0	11.3	11.9	15.2	15.2	772.4	2539	0	0	0
2612	11.2	0	11.2	11.9	15.3	15.3	774.5	2595	0	0	0
2643	11.3	0	11.3	11.9	15.2	15.2	773.4	2527	0	0	0
2677	11.3	0	11.3	11.9	15.1	15.1	774.7	2466	0	0	0
2707	11.3	0	11.3	11.9	14.9	14.9	774	2378	0	0	0
2737	11.3	0	11.3	11.8	14.8	14.9	774.1	2324	0	0	0
2767	11.3	0	11.3	11.8	14.8	14.8	773.7	2296	0	0	0
2802	11.3	0	11.3	11.8	14.7	14.7	774.9	2254	0	0	0
2836	11.3	0	11.3	11.8	14.7	14.7	772.1	2212	0	0	0
2870	11.3	0	11.3	11.8	14.6	14.6	771.7	2132	0	0	0
2900	11.3	0	11.3	11.8	14.5	14.5	772.9	2134	0	0	0
2931	11.3	0	11.3	11.8	14.5	14.5	776.5	2094	0	0	0
2961	11.3	0	11.3	11.8	14.4	14.4	774.6	2038	0	0	0
2995	11.3	0	11.3	11.7	14.3	14.3	771.3	2001	0	0	0
3029	11.4	0	11.4	11.7	14.2	14.2	774.2	1963	0	0	0
3064	11.3	0	11.3	11.7	14.1	14.1	776.1	1891	0	0	0
3094	11.2	0	11.2	11.7	14	14	771.3	1828	0	0	0
3124	11.3	0	11.3	11.6	14	14	769	1808	0	0	0
3154	11.3	0	11.3	11.6	14	14	775.7	1801	0	0	0
3184	11.2	0	11.2	11.6	13.9	13.9	775.6	1751	0	0	0
3219	11.3	0	11.3	11.7	13.8	13.9	772	1700	0	0	0
3249	11.2	0	11.2	11.6	13.8	13.8	772.8	1666	0	0	0
3283	11.3	0	11.3	11.6	13.8	13.8	772.8	1635	0	0	0
3313	11.3	0	11.3	11.6	13.7	13.7	772.6	1597	0	0	0
3348	11.3	0	11.3	11.6	13.6	13.6	773.9	1533	0	0	0
3382	11.3	0	11.3	11.6	13.5	13.5	772.7	1487	0	0	0
3416	11.3	0	11.3	11.6	13.5	13.5	773.3	1490	0	0	0
3451	11.2	0	11.2	11.6	13.5	13.5	775.1	1485	0	0	0
3485	11.2	0	11.2	11.6	13.4	13.4	771.5	1402	0	0	0
3515	11.2	0	11.2	11.6	13.4	13.4	773.1	1396	0	0	0
3550	11.3	0	11.3	11.6	13.3	13.3	774.1	1363	0	0	0
3584	11.3	0	11.3	11.6	13.3	13.3	772.5	1332	0	0	0
3614	11.3	0	11.3	11.6	13.2	13.2	773.6	1303	0	0	0
3649	11.3	0	11.3	11.6	13.2	13.2	771.4	1252	0	0	0
3679	11.3	0	11.3	11.6	13.2	13.2	771.5	1250	0	0	0
3713	11.2	0	11.2	11.6	13.2	13.2	773.3	1244	0	0	0
3743	11.2	0	11.2	11.6	13.1	13.1	772.4	1212	0	0	0
3773	11.2	0	11.2	11.6	13.1	13.1	773.8	1200	0	0	0
3803	11.2	0	11.2	11.5	13.1	13.1	770.2	1179	0	0	0
3838	11.2	0	11.2	11.5	13	13	775.1	1123	0	0	0
3868	11.2	0	11.2	11.5	12.9	12.9	770.5	1078	0	0	0
3902	11.2	0	11.2	11.5	12.9	12.9	767	1063	0	0	0
3932	11.2	0	11.2	11.5	12.9	12.9	777.4	1087	0	0	0
3963	11.2	0	11.2	11.5	12.9	12.9	772.7	1055	0	0	0
3993	11.2	0	11.2	11.5	12.9	12.9	768.1	1041	0	0	0
4023	11.2	0	11.2	11.5	12.9	12.9	774.8	1054	0	0	0
4053	11.3	0	11.3	11.5	12.8	12.8	771.2	993	0	0	0

4083	11.3	0	11.3	11.5	12.7	12.7	768.8	942	0	0	0
4117	11.2	0	11.2	11.5	12.7	12.7	774.8	929	0	0	0
4148	11.2	0	11.2	11.5	12.7	12.7	772	924	0	0	0
4178	11.1	0	11.1	11.5	12.7	12.7	771.5	906	0	0	0
4208	11.2	0	11.2	11.5	12.7	12.7	773.4	914	0	0	0
4238	11.2	0	11.2	11.5	12.6	12.6	768.6	898	0	0	0
4268	11.1	0	11.1	11.5	12.6	12.6	772.1	877	0	0	0
4298	11.2	0	11.2	11.5	12.6	12.6	776.5	849	0	0	0
4328	11.2	0	11.2	11.5	12.5	12.5	770.4	835	0	0	0
4359	11.2	0	11.2	11.5	12.6	12.6	772.9	869	0	0	0
4389	11.2	0	11.2	11.4	12.6	12.6	773.5	861	0	0	0
4419	11.1	0	11.1	11.4	12.5	12.5	769.8	820	0	0	0
4449	11.1	0	11.1	11.4	12.5	12.5	772.6	790	0	0	0
4479	11.1	0	11.1	11.4	12.5	12.5	772.6	786	0	0	0
4509	11.1	0	11.1	11.4	12.5	12.5	772	783	0	0	0
4543	11.3	0	11.3	11.4	12.4	12.4	768.5	773	0	0	0
4578	11.2	0	11.2	11.4	12.4	12.4	774.5	750	0	0	0
4608	11.2	0	11.2	11.4	12.4	12.4	771.1	728	0	0	0
4638	11.2	0	11.2	11.4	12.3	12.4	767.9	715	0	0	0
4668	11.3	0	11.3	11.4	12.3	12.3	774	723	0	0	0
4698	11.2	0	11.2	11.4	12.3	12.3	773.5	699	0	0	0
4729	11.2	0	11.2	11.4	12.3	12.3	768.7	660	0	0	0
4759	11.2	0	11.2	11.4	12.2	12.2	771.8	629	0	0	0
4789	11.1	0	11.1	11.4	12.2	12.2	772.4	636	0	0	0
4819	11.2	0	11.2	11.4	12.2	12.2	769.1	639	0	0	0
4849	11.2	0	11.2	11.4	12.2	12.2	772.3	636	0	0	0
6568	11.1	0	11.1	11.4	12.2	12.2	13.46	10.73	0	0	0
14519	10.9	0	10.9	11.2	10.9	10.94	0	0	0	0	0
21912	10.9	29.8	10.9	11	10.7	10.65	0	0	0	0	0
28596	12.1	72.1	12.1	12	12.2	12.18	0	0	0	4.488E-4	0
30716	12.1	69.9	12.1	13	12.4	12.4	0	0	0	0	0
30897	11.8	64.5	11.8	17.5	13.9	13.89	114.2	-414.2	0	0	0
33593	12.7	142	12.7	18.6	13.7	13.7	5.905	-29.59	0	0.001113	0
37860	12.5	76.5	12.5	14.1	13.4	13.35	0	0	0	0.01151	0
38114	11.8	91.4	11.8	16.4	15.7	15.65	83.66	-54.47	0	0.02441	0
43305	12.4	167	12.4	14.4	13.7	13.71	0	0	0	0.01426	0
45030	13.9	352	13.9	15.1	15.1	15.12	0	0	0	0.03588	0
45288	13.3	107	13.3	17.5	20.8	20.75	85.57	289.8	0	0.2473	0
48685	13.3	197	13.3	16.3	17.3	17.28	0	0	0	0.03559	0
51192	14.5	422	14.5	16.5	17.8	17.76	0	0	0	0.07084	0
52271	15	410	15	18.1	19.3	19.3	0	0	0	0.0798	0
52529	14.8	370	14.8	18.3	25.8	25.76	83.66	632	0	0.1248	0
55655	14.8	251	14.8	18.7	22.2	22.21	0	0	0	0.08231	0
59474	13.3	55.1	13.3	17.6	18.5	18.54	0	0	0	0.006991	0
59655	12.6	113	12.6	18.3	25.2	25.2	114.1	811.7	0	0	0
62411	13	127	13	18.5	24.9	24.9	5.83	36.53	0	0.003447	0
69347	13.1	55.9	13.1	17.5	17.9	17.91	0	0	0	0.01404	0
77107	11.8	8.15	11.8	16.5	15.7	15.69	0	0	0	0.001611	0
84989	10.3	0	10.3	15.6	14.2	14.16	0	0	0	0	0
92916	9.06	0	9.06	15.1	13.2	13.2	0	0	0	0	0
100873	9.02	0	9.02	14.9	12.8	12.83	0	0	0	0	0
108665	9.61	9.54	9.61	15.2	13.3	13.31	0	0	0	0	0
114849	10.7	109	10.7	16.1	15	15	0	0	0	0	0
117102	11.8	219	11.8	17.5	17.5	17.55	0	0	0	0.05016	0
117283	12	290	12	17	23.6	23.56	114.3	764.7	0	0.03315	0
119265	12.7	319	12.7	16.8	23.2	23.2	8.171	51.78	0	0.01039	0
122722	13.4	350	13.4	19.4	21.9	21.92	0	0	0	0.1399	0
124215	14.2	502	14.2	20.1	22.8	22.77	0	0	0	0.1031	0
124499	14.5	586	14.5	16.4	30.4	30.36	74.73	1058	0	0.07394	0
127444	15	422	15	20.1	27.8	27.79	0	0	0	0.1241	0
129719	15.2	435	15.2	22.9	26.8	26.77	0	0	0	0.1321	0
131469	15.7	529	15.7	24.2	27.5	27.52	0	0	0	0.0584	0
131748	16.5	748	16.5	18.5	35.9	35.88	76.01	1332	0	0.2204	0

134182	16.3	517	16.3	23.5	32.7	32.72	0	0	0	0	0.1267	0
136418	16.9	638	16.9	27.9	32.5	32.48	0	0	0	0.1818	0	
138693	16.5	338	16.5	29.1	32.1	32.08	0	0	0	0.05033	0	
138977	16.5	212	16.5	20.2	41	40.94	74.67	1567	0	0	0	
142227	16.8	322	16.8	27.3	34.8	34.83	0	0	0	0.07711	0	
145641	17.5	434	17.5	31.7	33.7	33.66	0	0	0	0.1184	0	
145925	17.2	213	17.2	21.3	42.3	42.24	35.01	752.5	0	0.1127	0	
146179	17.1	196	17.1	18.7	42.8	42.77	46.15	1111	0	0.01181	0	
150552	17.7	309	17.7	31.2	36.5	36.52	0	0	0	0.226	0	
157183	17.4	76.1	17.4	32.9	33.2	33.17	0	0	0	0.1168	0	
165083	15	1.67	15	31.3	29.2	29.22	0	0	0	0	0	
173002	13.6	0	13.6	30.6	27.6	27.6	0	0	0	0	0	
180921	12.2	0	12.2	30.1	26.9	26.87	0	0	0	0	0	
188887	11.1	0	11.1	29.4	25.8	25.75	0	0	0	0	0	
196290	11.5	30	11.5	29.1	25.8	25.84	0	0	0	0.001756	0	
201884	15.1	159	15.1	29	26.9	26.94	0	0	0	0.03613	0	
203424	17.2	369	17.2	27.2	28	27.99	0	0	0	0.3267	0	
203605	17.4	426	17.4	18.5	37.8	37.78	114.3	2232	0	0.2486	0	
204942	17.8	473	17.8	18.5	37.9	37.9	13.95	270.9	0	0.3439	0	
207995	18.7	606	18.7	29.1	30.5	30.55	0	0	0	0.4605	0	
210631	19.8	749	19.8	30.9	33	33.04	0	0	0	0.3853	0	
210910	20.1	817	20.1	17.7	48.2	48.14	76.2	2342	0	0.6186	0	
213289	20.5	869	20.5	30.9	42.5	42.52	0	0	0	0.5364	0	
215559	20.5	935	20.5	37.4	41.3	41.28	0	0	0	0.3992	0	
217765	21.1	966	21.1	41.3	44.1	44.08	0	0	0	0.2624	0	
218019	21.6	979	21.6	27.7	59.5	59.5	72.92	2342	0	1.773	0	
219950	22	983	22	18.5	60	60	1.843	76.51	0	0.2544	0	
222186	22.1	961	22.1	46.7	49.8	49.79	0	0	0	0.4917	0	
224503	22.9	917	22.9	50.5	52	51.97	0	0	0	0.3317	0	
225161	23.2	869	23.2	52.4	53.5	53.46	0	0	0	0.2421	0	
225406	24	849	24	30.3	67.9	67.93	90.41	3427	0	0.04082	0	
227944	23.4	797	23.4	49.8	58.2	58.19	0	0	0	0.3665	0	
230807	23.9	669	23.9	56	54.6	54.58	0	0	0	0.197	0	
232256	23.7	548	23.7	58	55.9	55.88	0	0	0	0.05618	0	
232528	23.8	494	23.8	26.5	69.5	69.44	77.05	3348	0	0.2537	0	
236531	24	370	24	55.5	59.5	59.47	0	0	0	0.1006	0	
243153	23.4	77.4	23.4	57.3	55.3	55.28	0	0	0	0.0177	0	
251018	20.9	2.16	20.9	55.9	51.5	51.55	0	0	0	0	0	
259007	18.5	0	18.5	54.8	49.6	49.55	0	0	0	0	0	
266918	17.4	0	17.4	54	48.7	48.65	0	0	0	0	0	
274866	16	0	16	52.7	46	46.03	0	0	0	0	0	
282350	17.2	25.8	17.2	52	45.9	45.93	0	0	0	0	0	
288113	22.9	143	22.9	51.4	46.1	46.11	0	0	0	0	0	
289877	23.7	352	23.7	46.9	47.7	47.67	0	0	0	0	0	
290156	24.1	410	24.1	21.1	61.8	61.82	76.3	3137	0	0	0	
293494	24.5	521	24.5	47.2	52.5	52.46	0	0	0	0.01058	0	
296301	25.3	688	25.3	53	50.2	50.24	0	0	0	0.009441	0	
297054	25.1	770	25.1	54.5	52.1	52.07	0	0	0	0.09416	0	
297334	24.9	787	24.9	25.7	67.8	67.77	76.42	3243	0	0.2264	0	
299781	25.1	844	25.1	51.8	58.8	58.78	0	0	0	0.3597	0	
302107	26.6	900	26.6	58	57.5	57.47	0	0	0	0.05993	0	
304356	27.6	938	27.6	60.9	59.3	59.3	0	0	0	0.03193	0	
304597	27.4	944	27.4	36.2	77.2	77.25	89.96	3718	0	0.2992	0	
306859	27.2	941	27.2	59.1	67.9	67.92	0	0	0	0.1722	0	
309142	28.3	928	28.3	66.3	65	64.99	0	0	0	0.03824	0	
311477	29.6	888	29.6	68.8	65.4	65.42	0	0	0	0.06775	0	
311666	30.6	854	30.6	38.2	84.1	84.08	119	5496	0	0	0	
311697	30	855	30	22.7	84.1	84.1	556.9	34100	0	0	0	
311727	29.5	854	29.5	20	84.2	84.2	615.8	39490	0	0	0	
311757	29.3	852	29.3	13.3	84.1	84.1	588.8	41730	0	0	0	
311787	28.8	847	28.8	11.1	83.8	83.8	580.5	42170	0	0	0	
311817	28.6	842	28.6	10.6	83.7	83.7	578.9	42330	0	0	0	
311847	28.5	840	28.5	10.4	83.6	83.6	576	42220	0	1.3	0	

311882	28.5	837	28.5	10.2	83.5	83.5	588.7	43170	0	0.6	0
311912	28.9	834	28.9	10.1	83	83.1	580.3	42320	0	0	0
311942	28.8	831	28.8	10.1	82.9	83	592.1	43160	0	0	0
311972	28.3	830	28.3	10	83	83	585.8	42730	0	0	0
312006	28.2	826	28.2	10	83.2	83.2	585.6	42850	0	0	0
312036	28.1	827	28.1	9.98	82.8	82.9	590	43000	0	0	0
313038	28.6	804	28.6	9.97	82.4	82.5	18.13	1314	0	0.1235	0
315760	28.8	726	28.8	42.8	69.4	69.44	0	0	0	0.01098	0
318628	29.6	544	29.6	51.6	66.5	66.48	0	0	0	0.009205	0
318822	29.8	507	29.8	20	80.2	80.25	116.3	7050	0	0	0
318852	30.2	508	30.2	17.8	80.3	80.3	546.3	34160	0	0	0
318882	29.5	507	29.5	15.1	80.3	80.3	606.9	39540	0	0	0
318912	29.2	507	29.2	12	80.3	80.2	589.7	40240	0	0	0
318942	29.2	506	29.2	11	80.2	80.2	585.4	40540	0	0	0
318972	29.1	500	29.1	10.7	80.2	80.2	586.1	40750	0	0	0
320486	29	439	29	10.6	80	80	11.61	806	0	0	0
325345	28.6	240	28.6	46.6	64.2	64.22	0	0	0	0.01453	0
332927	26.4	19.1	26.4	49.7	60	60	0	0	0	0	0
340812	23.2	0	23.2	51.1	56.2	56.22	0	0	0	0	0
348773	22.4	0	22.4	51.5	52	52.04	0	0	0	0	0
356724	20.6	0	20.6	51.7	50.1	50.11	0	0	0	0	0
364594	19.6	5.99	19.6	52.1	50	50.04	0	0	0	0	0
369037	21.5	53.3	21.5	50	48.6	48.59	0	0	0	0.002701	0
369162	24.8	74.5	24.8	23.5	65.4	65.35	113.7	4834	0	0	0
369192	23.8	75	23.8	18.6	66	66	533.2	25380	0	0	0
369222	23.2	75	23.2	16.6	65.9	65.9	580.7	28660	0	0	0
369252	22.9	75	22.9	12.3	65.9	65.9	574.4	30790	0	0	0
369282	23.8	76	23.8	10.9	65.8	65.8	572.1	31400	0	0	0
369317	24	77	24	10.6	65.8	65.8	571.3	31580	0	0	0
369347	24.8	77	24.8	10.4	65.9	65.9	572.6	31770	0	0	0
369377	24.7	77	24.7	10.3	65.9	65.9	572.1	31800	0	0	0
369407	24.7	77	24.7	10.3	65.8	65.8	572.6	31820	0	0	0
369437	25.3	76	25.3	10.3	65.7	65.7	572	31720	0	0	0
369472	24.8	75	24.8	10.2	65.7	65.7	572.2	31730	0	0	0
369502	24.8	75	24.8	10.2	65.7	65.7	574	31850	0	0	0
369532	25.7	76	25.7	10.2	65.8	65.7	573.8	31860	0	0	0
369562	25.4	77	25.4	10.2	65.7	65.7	573.4	31800	0	0	0
369592	25	79	25	10.2	65.5	65.5	573.1	31700	0	0	0
369622	25.2	77	25.2	10.2	65.4	65.4	573.4	31630	0	0	0
369652	25.3	78	25.3	10.2	65.3	65.3	572.1	31510	0	0	0
372177	25.6	103	25.6	10.2	65.3	65.3	7.039	387.4	0	0.001188	0
376262	25.6	272	25.6	23.6	50.1	50.1	0	0	0	0.02585	0
376387	28	398	28	19.2	63.1	63.13	113.3	5022	0	0	0
376417	30.4	392	30.4	18.5	63.6	63.6	535.8	24140	0	0	0
376451	31.5	385	31.5	17.2	63.5	63.5	578.9	26810	0	0	0
376482	29.6	395	29.6	13.1	63.3	63.3	570.3	28650	0	0	0
376512	29.1	422	29.1	12	63.3	63.3	569.5	29230	0	0	0
376542	28.1	426	28.1	11.7	63.3	63.3	570	29420	0	0	0
376572	28.9	426	28.9	11.6	63	63	571.5	29370	0	0	0
376602	29.2	427	29.2	11.5	62.8	62.8	571.5	29320	0	0	0
376637	28.1	428	28.1	11.5	63.1	63	570.5	29420	0	0	0
376667	27.8	429	27.8	11.5	62.9	62.9	570.5	29360	0	0	0
376697	27.1	430	27.1	11.5	62.7	62.7	570.2	29220	0	0	0
376731	27	433	27	11.5	62.2	62.2	571.2	28990	0	0	0
376761	26.5	432	26.5	11.5	61.9	61.9	571.1	28780	0	0	0
376791	26.2	436	26.2	11.5	61.8	61.8	571.3	28750	0	0	0
376822	26.6	441	26.6	11.6	61.6	61.7	571.1	28600	0	0	0
376852	26.8	444	26.8	11.6	61.6	61.6	570.4	28540	0	0	0
376886	27.3	447	27.3	11.6	61.4	61.4	571.6	28500	0	0	0
378366	28.4	486	28.4	11.7	61.1	61.1	11.61	574.5	0	0.03791	0
381435	29.5	602	29.5	23.9	45.8	45.75	0	0	0	0.06553	0
383465	30	721	30	28.3	44.1	44.1	0	0	0	0.03764	0
383586	29.2	785	29.2	20.7	54.9	54.92	112.3	3885	0	0.09917	0

383616	29.3	799	29.3	19.9	54.9	54.9	535.7	18690	0	0	0
383646	30.5	792	30.5	19.7	54.8	54.8	584.7	20520	0	0	0
383676	29.6	792	29.6	15.6	54.6	54.6	575.7	22460	0	0	0
383711	29.8	793	29.8	14.3	54.5	54.5	574.9	23100	0	0	0
383741	30	800	30	14	54.7	54.7	577.6	23500	0	0	0
383771	30.3	802	30.3	13.9	54	54	576.6	23110	0	0	0
383801	31.4	802	31.4	13.9	53.7	53.7	578.4	23010	0	0	0
383831	31.3	805	31.3	13.9	52.8	52.8	576.1	22450	0	0	0
383861	30.7	806	30.7	13.8	53.5	53.5	577	22870	0	0	0
383891	30.8	805	30.8	13.8	53.5	53.5	576.9	22870	0	0	0
383921	29.9	803	29.9	13.8	53.2	53.2	576.1	22690	0	0	0
383952	29.7	804	29.7	13.8	53	53.1	575.7	22590	0	0	0
383982	30.4	803	30.4	13.8	52.5	52.5	576.8	22320	0	0	0
384012	30.4	805	30.4	13.8	51.5	51.5	576.1	21720	0	0	0
384042	29.6	806	29.6	13.9	51.1	51.1	576.9	21510	0	0	0
384072	30.4	809	30.4	13.8	51	51	577.1	21430	0	0	0
384863	31.1	840	31.1	13.8	50.9	50.9	25.53	945.7	0	0.04172	0
387143	31.3	839	31.3	24.5	45.2	45.23	0	0	0	0.008289	0
387268	30.6	913	30.6	20.5	50.2	50.24	135.6	4058	0	0	0
387298	31.6	933	31.6	23.3	49.8	49.8	634.8	16720	0	0	0
387328	31.7	945	31.7	23.5	49.7	49.7	699.1	18300	0	0	0
387358	31.2	942	31.2	22.8	49.7	49.7	694.6	18680	0	0	0
387388	31.3	939	31.3	21.5	49.3	49.3	704.8	19580	0	0	0
387422	31.9	955	31.9	19.3	49.8	49.8	721.9	22050	0	0.1	0
387453	32.1	971	32.1	16.9	49.2	49.2	726.7	23470	0	0	0
387483	31.8	985	31.8	15.3	49	49	730.2	24630	0	0.2	0
387517	32.3	1E3	32.3	14.2	48.2	48.2	725.8	24710	0	0.3	0
387551	32.4	1020	32.4	13.5	47.9	47.9	720.2	24760	0	0	0
387582	32.1	1020	32.1	13.2	48.1	48.1	699.9	24410	0	0	0
387616	31.6	1010	31.6	13	48	48	717.5	25060	0	0	0
387650	31.9	913	31.9	12.9	47.5	47.5	727.9	25160	0	0.1	0
388222	30.9	896	30.9	12.8	47	47	39.56	1351	0	0	0
390708	30.1	738	30.1	25.2	45	44.97	0	0	0	0.001207	0
390837	30.4	293	30.4	18.9	48.2	48.16	135.3	3983	0	0	0
390867	30.7	312	30.7	17	47.8	47.8	640.1	19670	0	0	0
390897	31.3	365	31.3	15.7	47.6	47.6	697.5	22300	0	0	0
390927	31	301	31	14.8	47.5	47.4	709	23140	0	0	0
390957	30.5	297	30.5	14.4	47.1	47.1	716.3	23420	0	0	0
390988	30.1	341	30.1	14	47.4	47.4	718.9	24040	0	0	0
391022	29.5	340	29.5	13.6	47.1	47.1	723.9	24240	0	0	0
391052	29.8	438	29.8	13.3	46.8	46.8	713.7	23940	0	0	0
391082	30.2	310	30.2	13	45.9	45.9	713.9	23500	0	0	0
391112	30.9	725	30.9	12.8	45.2	45.2	725.2	23560	0	0	0
391142	30.9	982	30.9	12.6	46	46	724.8	24240	0	0	0
391173	30.4	874	30.4	12.4	45.7	45.7	717.9	23900	0	0	0
391203	30.3	695	30.3	12.3	45.6	45.6	721.6	24000	0	0	0
391233	30.4	852	30.4	12.2	45.1	45.1	723	23800	0	0	0
392248	29.8	417	29.8	12.2	44.9	44.9	21.21	693.9	0	0.01034	0
394900	30	743	30	26.3	42.2	42.15	0	0	0	0.00871	0
397854	29.1	309	29.1	32.2	41.5	41.48	0	0	0	0.0106	0
397983	28.4	268	28.4	21.9	44.9	44.86	136.3	3159	0	0	0
398013	28.6	256	28.6	19.1	44.5	44.5	644	16440	0	0	0
398048	28.8	251	28.8	17.1	44.5	44.5	700.2	19180	0	0	0
398078	29	245	29	16.1	44.4	44.4	700.2	19770	0	0	0
398108	29	242	29	15.7	43.9	43.9	703.2	19820	0	0	0
398138	28.9	243	28.9	15.2	44.3	44.3	700.9	20400	0	0	0
398168	28.5	249	28.5	14.6	44.3	44.3	708.3	21080	0	0	0
398198	28.3	255	28.3	14	43.9	43.9	711.5	21320	0	0	0
398228	28.3	260	28.3	13.5	43.7	43.8	710.4	21510	0	0	0
398259	28.4	265	28.4	13.1	43.2	43.2	724.6	21830	0	0	0
398293	28.5	268	28.5	12.8	42.4	42.4	715.8	21160	0	0	0
398323	29.2	272	29.2	12.7	42.9	42.9	717.6	21740	0	0	0
398353	29.3	278	29.3	12.5	42.9	42.9	716.4	21730	0	0	0

398388	28.7	287	28.7	12.4	42.6	42.6	706.8	21340	0	0	0
399540	28.6	369	28.6	12.4	42.5	42.5	18.57	560.1	0	0.003038	0
402597	30.1	605	30.1	28.2	41.1	41.14	0	0	0	0.01322	0
406226	30	444	30	35	41	40.98	0	0	0	0.01201	0
408691	30.5	384	30.5	36.5	40.9	40.88	0	0	0	0.03542	0
408811	30.7	318	30.7	24.8	43.7	43.69	134.8	2562	0	0	0
408841	30.7	285	30.7	21.4	43.5	43.5	631	14050	0	0	0
408876	30.8	291	30.8	19.1	43.4	43.4	692.8	16840	0	0	0
408907	30.7	299	30.7	18	43.4	43.4	691.4	17570	0	0	0
408941	31.1	291	31.1	17.4	43	43	692.3	17720	0	0	0
408971	30.4	267	30.4	16.7	43	43	699.2	18420	0	0	0
409002	29.9	277	29.9	15.7	43.4	43.4	704.1	19440	0	0	0
409036	30.2	290	30.2	14.8	43.3	43.3	698.2	19910	0	0	0
409066	30.2	298	30.2	14	42.9	42.9	713.5	20650	0	0.5	0
409100	30.3	314	30.3	13.5	42.8	42.8	721	21140	0	0.1	0
409130	30.4	318	30.4	13.2	42.6	42.6	720.3	21130	0	0.1	0
409161	30.2	319	30.2	13.1	42	42	719.2	20830	0	0	0
409195	30.2	319	30.2	13	41.9	41.9	719.4	20820	0	0	0
409229	30.4	311	30.4	12.9	42.1	42.1	718.9	21020	0	0	0
410463	30	242	30	12.8	42	42	18.09	527.2	0	0.04425	0
417403	28.2	56.9	28.2	28.5	37.3	37.34	0	0	0	0.002781	0
425304	25.2	0.446	25.2	27.4	31.7	31.66	0	0	0	0	0
433202	23.1	0	23.1	27	29.8	29.81	0	0	0	0	0
441085	21.6	0	21.6	26.9	28	28.01	0	0	0	0	0
449062	20.8	0.226	20.8	26.7	26.5	26.45	0	0	0	0	0
455433	21	52.6	21	27	26.4	26.44	0	0	0	0	0
455554	21.5	97.8	21.5	25.2	35.2	35.21	111.8	1148	0	0	0
455588	21.6	98	21.6	24.9	35.5	35.5	541.1	5725	0	0	0
455618	21.6	98	21.6	19.5	35.4	35.4	583.4	9317	0	0	0
455648	21.7	98	21.7	13.8	35.4	35.4	579.3	12510	0	0	0
455683	21.7	98	21.7	12.4	35.4	35.4	578.5	13300	0	0	0
455713	21.8	98	21.8	12	35.3	35.3	579.9	13500	0	0	0
455743	21.7	100	21.7	11.8	35.1	35.1	579.3	13470	0	0	0
455777	21.6	100	21.6	11.7	35.3	35.3	579	13670	0	0	0
455807	21.5	100	21.5	11.6	35.4	35.4	579.9	13770	0	0	0
455838	21.4	100	21.4	11.6	35.5	35.5	579.9	13860	0	0	0
455868	21.3	102	21.3	11.6	35.4	35.4	579.8	13840	0	0	0
455902	21.3	102	21.3	11.5	35.3	35.3	579.4	13790	0	0	0
455932	21.5	102	21.5	11.5	35.3	35.3	579.8	13780	0	0	0
455962	21.5	103	21.5	11.5	35.1	35.1	579.8	13700	0	0	0
455992	21.4	104	21.4	11.5	35	35	580	13580	0	0	0
456023	21.4	104	21.4	11.5	34.8	34.8	580.4	13510	0	0	0
456053	21.7	105	21.7	11.5	34.7	34.7	579.4	13420	0	0	0
458548	21.5	123	21.5	11.6	34.6	34.6	6.969	160.9	0	0.001363	0
462689	25.3	271	25.3	21.3	28.4	28.36	0	0	0	8.452E-4	0
462810	27.4	351	27.4	20.5	34.2	34.16	112.3	1551	0	0	0
462844	27.4	408	27.4	20.4	34.3	34.3	543	7504	0	0	0
462874	27.3	406	27.3	18.2	34.2	34.2	584.5	9332	0	0	0
462904	26.7	407	26.7	14.1	34.2	34.2	582.2	11670	0	0	0
462934	27.3	414	27.3	13.1	34.1	34.1	581.5	12220	0	0	0
462964	27.3	424	27.3	12.8	33.8	33.8	582.4	12270	0	0	0
462995	27.3	430	27.3	12.7	34	34	582.2	12420	0	0	0
463025	27.1	423	27.1	12.6	34.1	34.1	582.2	12510	0	0	0
463055	27.5	422	27.5	12.6	34.2	34.2	581.8	12570	0	0	0
463089	27	453	27	12.6	34.1	34.1	583.1	12580	0	0	0
463119	27.9	417	27.9	12.5	34	34	582.7	12520	0	0	0
463150	28.7	438	28.7	12.5	33.7	33.7	582.8	12320	0	0	0
463184	27.8	460	27.8	12.5	33.2	33.3	582.5	12070	0	0	0
463218	27.6	456	27.6	12.6	33	33	582.7	11890	0	0	0
463248	28.5	463	28.5	12.6	33.2	33.2	582.8	11990	0	0	0
463278	28.8	418	28.8	12.6	33.3	33.3	582.3	12060	0	0	0
463309	28	420	28	12.6	33.5	33.4	583.3	12150	0	0	0
464805	28.6	449	28.6	12.6	33.5	33.5	11.69	244.1	0	0.009091	0

468047	29	550	29	22.4	31.7	31.75	0	0	0	0	0.003979	0
469845	29.4	667	29.4	26.1	34	33.99	0	0	0	0	0.007175	0
469969	27.9	464	27.9	21.7	39.3	39.24	112.4	1987	0	0	0	
4.7E5	26.3	312	26.3	21	38.6	38.6	536.3	9333	0	0	0	
470030	25.9	321	25.9	20.1	38.4	38.4	585.4	10710	0	0	0	
470060	26.7	326	26.7	15.6	38.4	38.4	581.9	13300	0	0	0	
470094	28	676	28	14.2	38	38	583.5	13880	0	0	0	
470124	27	843	27	13.9	37.1	37.1	582.9	13520	0	0	0	
470154	27.1	839	27.1	13.8	38.3	38.3	582.2	14280	0	0	0	
470185	27.2	517	27.2	13.7	38.6	38.6	582.9	14500	0	0	0	
470215	27.2	423	27.2	13.7	37.5	37.5	581.8	13860	0	0	0	
470245	27.9	389	27.9	13.7	37	37	583.2	13640	0	0	0	
470275	29.1	370	29.1	13.6	36.5	36.5	582.2	13300	0	0	0	
470305	30.6	473	30.6	13.6	35.8	35.8	582.2	12910	0	0.1	0	
470340	29.2	777	29.2	13.6	35.5	35.5	582.4	12720	0	0.2	0	
470374	27.8	794	27.8	13.6	36.3	36.3	582.7	13190	0	0	0	
470404	27.5	770	27.5	13.7	36.3	36.3	583.5	13200	0	0	0	
470438	29	740	29	13.7	36.4	36.4	582.7	13240	0	0	0	
470469	29.6	752	29.6	13.7	36.3	36.3	582.5	13150	0	0	0	
472300	27.9	300	27.9	13.8	36	36	9.555	212.3	0	0	0	
473535	27.8	405	27.8	22.5	34.5	34.53	0	0	0	0	0	
473659	27.7	486	27.7	19.2	36.6	36.6	112.5	1968	0	0	0	
473689	28	544	28	19.3	36	36.1	538.1	8908	0	0	0	
473720	27.6	488	27.6	19.8	36	36	587.3	9458	0	0	0	
473754	27.6	450	27.6	16.2	35.9	35.9	583.4	11540	0	0	0	
473784	27.8	461	27.8	15.1	35.5	35.5	584.9	11930	0	0	0	
473814	28.2	500	28.2	14.9	35.3	35.3	584.2	11900	0	0	0	
473844	28.6	577	28.6	14.9	35.7	35.7	584.4	12170	0	0	0	
473874	28.9	584	28.9	14.8	36	36	584.1	12370	0	0	0	
473905	28.6	505	28.6	14.8	35.4	35.4	585.9	12040	0	0	0	
473935	28.4	498	28.4	14.8	35.1	35.1	584.2	11850	0	0	0	
473965	28.2	602	28.2	14.8	34.9	34.9	585.4	11750	0	0	0	
473995	27.8	709	27.8	14.8	34.3	34.3	585.1	11410	0	0	0	
474029	28.2	826	28.2	14.8	33.9	33.9	584.7	11190	0	0	0	
474060	29.1	887	29.1	14.8	34.3	34.3	584.5	11380	0	0	0	
474090	28.4	860	28.4	14.8	34.3	34.3	584.8	11370	0	0	0	
474120	27.6	871	27.6	14.8	34.1	34.1	584.9	11270	0	0	0	
474150	27.7	844	27.7	14.9	34.3	34.3	584.4	11320	0	0	0	
475388	27.7	624	27.7	14.9	34.2	34.2	14.17	272.8	0	0	0	
477096	27	362	27	23	35.6	35.6	35.62	0	0	0	0.06604	0
477220	26.2	476	26.2	20.5	36.2	36.21	133.9	2103	0	0.5452	0	
477255	26	366	26	23.6	35.3	35.3	640.6	7366	0	1.4	0	
477285	25.8	358	25.8	23.6	35.3	35.3	692	8042	0	0.9	0	
477315	25.8	357	25.8	22.9	35.2	35.2	695.1	8544	0	0	0	
477345	26.1	359	26.1	22.1	34.6	34.6	707	8871	0	0	0	
477375	26.3	369	26.3	20.8	34.2	34.2	721.2	9645	0	0	0	
477405	26.1	371	26.1	19.3	34.4	34.4	725.8	10900	0	1.1	0	
477440	25.8	372	25.8	18	35	35	728.4	12380	0	1.2	0	
477470	25.5	372	25.5	17.1	34.3	34.3	728.7	12560	0	1	0	
477500	25.3	375	25.3	16.5	33.7	33.7	726.4	12480	0	1.5	0	
477530	25.3	381	25.3	16.2	33.8	33.8	728.7	12830	0	0.1	0	
477560	25.4	387	25.4	16	33.4	33.4	726.4	12660	0	0	0	
477591	25.5	385	25.5	15.8	32.9	32.9	714	12260	0	0	0	
477625	25.6	383	25.6	15.6	33	33	727.8	12650	0	0	0	
478145	25.8	596	25.8	15.5	32.7	32.7	47.8	820.6	0	0.5604	0	
481074	26.8	641	26.8	24.3	34.6	34.6	0	0	0	0.01782	0	
483657	28.7	782	28.7	31.1	39.2	39.19	0	0	0	0.06779	0	
484324	28.2	544	28.2	31	41.5	41.51	0	0	0	0.161	0	
484444	27.4	168	27.4	24	42.4	42.38	133.9	2466	0	0	0	
484475	27.2	171	27.2	21.6	41.4	41.4	623.5	12360	0	0	0	
484505	27.4	175	27.4	19.9	41.3	41.3	690.5	14740	0	0	0	
484535	27.4	180	27.4	18.9	41.2	41.2	690	15340	0	0.1	0	
484565	27.3	186	27.3	18.4	40.2	40.2	694.8	15160	0	0	0	

484595	27.5	190	27.5	17.9	39.5	39.5	703.8	15210	0	0	0	
484625	28.1	194	28.1	17.4	41.4	41.4	705.7	16910	0	0	0	
484655	28.4	201	28.4	16.8	40.6	40.6	703.5	16740	0	0	0	
484685	28.7	210	28.7	16.2	39.5	39.5	708.3	16460	0	0	0	
484716	28.9	219	28.9	15.9	39	39	712.1	16450	0	0	0	
484750	28.8	228	28.8	15.6	38.2	38.2	710.3	16040	0	0	0	
484784	28.7	240	28.7	15.5	37.4	37.4	713.2	15610	0	0	0	
484819	29.1	255	29.1	15.4	37.9	37.9	718.2	16170	0	0	0	
484849	30	304	30	15.4	37.7	37.7	714.4	15920	0	0	0	
485666	28.8	646	28.8	15.4	37.6	37.6	26.18	581.2	0	0.04627	0	
488646	29.6	630	29.6	28.2	39.7	39.67	0	0	0	0.0398	0	
492103	29.7	491	29.7	34.4	41.1	41.06	0	0	0	0.009257	0	
495126	28.9	137	28.9	34.9	39.6	39.58	0	0	0	0.01882	0	
495255	26.8	63.3	26.8	25.5	41.3	41.31	133.4	2138	0	0.2132	0	
495290	26.6	58	26.6	22.6	41.2	41.2	628.8	11750	0	0.7	0	
495320	26.3	56	26.3	20.8	41	41	698.2	14110	0	0.1	0	
495350	26	54	26	20.1	41	41	699.1	14610	0	0.5	0	
495380	25.7	53	25.7	19.7	40.7	40.7	701	14730	0	1	0	
495410	25.6	52	25.6	19.1	40	40	702.4	14680	0	0.4	0	
495445	25.5	50	25.5	18.2	41	41	702.3	15990	0	0.8	0	
495475	25.6	50	25.6	17.2	40.9	40.9	702.5	16630	0	0	0	
495509	25.5	49	25.5	16.5	40.5	40.5	704.2	16920	0	0.2	0	
495539	25.4	48	25.4	15.9	40.1	40.1	704.2	17040	0	0.3	0	
495570	25.7	47	25.7	15.6	40.1	40.1	704.9	17280	0	0	0	
495604	25.6	46	25.6	15.3	39.5	39.5	705.1	17060	0	0	0	
495634	25.3	46	25.3	15.1	39	39	706.4	16830	0	0	0	
495668	25.1	44	25.1	15	39.3	39.3	707.2	17170	0	0.3	0	
496872	21	63.8	21	15	39.1	39.1	20.48	495.6	0	0.4199	0	
503939	19.4	48.1	19.4	22.1	26.8	26.77	0	0	0	0.007754	0	
511892	18.2	0	202	18.2	22.9	25.9	25.94	0	0	0	0.05514	0
519841	17.8	0	17.8	23.3	24.7	24.66	0	0	0	0	0	
527721	17.4	0	17.4	23.6	23.9	23.86	0	0	0	0.01834	0	
535709	17.1	0.0757	17.1	23.6	22.4	22.43	0	0	0	0.001515	0	
541851	16.7	14.6	16.7	23.6	22.1	22.1	0	0	0	0.002931	0	
541972	16.6	29	16.6	23.7	32	31.98	112.1	968.8	0	0	0	
542003	16.6	30	16.6	23.6	32.5	32.5	531.1	4732	0	0	0	
542033	16.5	31	16.5	19.1	32.4	32.4	585.5	7781	0	0	0	
542063	16.5	31	16.5	13.2	32.4	32.4	581	11170	0	0	0	
542094	16.6	32	16.6	11.6	32.4	32.4	581.8	12080	0	0	0	
542124	16.7	33	16.7	11.2	32.3	32.3	581.6	12310	0	0	0	
542154	16.6	33	16.6	11	32.1	32.1	581.4	12260	0	0	0	
542185	16.5	35	16.5	10.9	32.1	32.1	581.1	12350	0	0	0	
542215	16.4	35	16.4	10.8	32.3	32.3	582.1	12500	0	0	0	
542245	16.4	37	16.4	10.8	32.4	32.4	581.8	12570	0	0	0	
542276	16.4	38	16.4	10.7	32.4	32.4	581.1	12610	0	0	0	
542306	16.5	39	16.5	10.7	32.4	32.4	580.5	12600	0	0	0	
542336	16.5	41	16.5	10.7	32.3	32.3	581.2	12570	0	0	0	
542366	16.6	43	16.6	10.7	32.3	32.3	581.8	12560	0	0	0	
542397	16.6	45	16.6	10.7	32.2	32.2	581.8	12540	0	0	0	
542427	16.6	46	16.6	10.7	32.1	32.1	580.9	12430	0	0	0	
542457	16.7	47	16.7	10.7	31.9	31.9	583	12370	0	0	0	
542487	16.7	48	16.7	10.7	31.8	31.8	581	12250	0	0	0	
545123	16.9	76.4	16.9	10.7	31.7	31.7	6.833	143.3	0	0.01844	0	
549119	17.7	123	17.7	17.7	22.7	22.68	0	0	0	0.03926	0	
549241	18.4	79.5	18.4	18.8	30.8	30.87	112.3	1383	0	0	0	
549271	18.2	72	18.2	18.8	31.1	31.1	536.5	6551	0	0	0	
549301	18.2	70	18.2	17.3	31	31	586.8	8004	0	0	0	
549332	18.2	69	18.2	13.2	30.9	30.9	583.9	10360	0	0	0	
549362	18.2	68	18.2	12	30.9	30.9	583.3	10990	0	0	0	
549392	18.1	71	18.1	11.8	30.6	30.6	584.4	10980	0	0	0	
549423	18.1	78	18.1	11.7	30.6	30.6	582.8	11050	0	0	0	
549453	17.9	88	17.9	11.6	30.8	30.8	584.8	11210	0	0	0	
549483	18	100	18	11.6	30.9	30.9	583.7	11260	0	0	0	

549513	18.1	111	18.1	11.6	30.9	30.9	583.8	11290	0	0	0
549544	18.1	118	18.1	11.5	30.8	30.8	584.4	11250	0	0	0
549574	18	124	18	11.5	30.5	30.5	584.7	11080	0	0	0
549604	17.9	129	17.9	11.5	30.1	30.1	584	10830	0	0	0
549634	17.9	132	17.9	11.5	29.6	29.6	584.8	10610	0	0	0
549665	18	132	18	11.5	29.5	29.5	585.7	10520	0	0	0
549695	17.9	130	17.9	11.5	29.7	29.7	584.2	10590	0	0	0
549725	17.8	125	17.8	11.6	29.6	29.6	583.5	10520	0	0	0
551875	18	176	18	11.6	29.7	29.7	8.436	152.7	0	0.0254	0
556235	18.8	195	18.8	18.1	22.8	22.79	0	0	0	0.02633	0
556356	18.5	79	18.5	19	28.5	28.46	112.4	1082	0	0	0
556386	19.2	79	19.2	19.1	28.4	28.3	538.6	4947	0	0	0
556416	18.6	83	18.6	18.1	28.3	28.3	587.5	6014	0	0	0
556447	18.5	87	18.5	14.2	28.3	28.3	584.7	8266	0	0.1	0
556477	18.4	88	18.4	13.1	28.2	28.2	584.1	8839	0	0	0
556507	18.6	90	18.6	12.8	27.9	27.9	585.6	8854	0	0	0
556538	18.4	94	18.4	12.7	27.4	27.4	585	8594	0	0	0
556568	18.5	99	18.5	12.6	27.7	27.7	583	8804	0	0	0
556598	18.5	105	18.5	12.6	28	28	585.9	9004	0	0	0
556628	18.5	110	18.5	12.6	28.3	28.3	585.1	9177	0	0	0
556659	18.5	118	18.5	12.6	28.1	28.1	585	9066	0	0	0
556689	18.4	126	18.4	12.6	27.8	27.8	584.8	8917	0	0	0
556719	18.5	131	18.5	12.6	27.5	27.5	584.9	8736	0	0	0
556750	18.2	131	18.2	12.6	27.2	27.2	585	8547	0	0	0
556780	18.6	129	18.6	12.6	26.8	26.8	583.8	8275	0	0.2	0
556810	18.6	127	18.6	12.6	26.4	26.4	584.6	8075	0	0	0
556840	18.5	130	18.5	12.6	26.3	26.3	586.3	8033	0	0	0
558899	19.1	199	19.1	12.7	26.3	26.3	8.796	120	0	0.01321	0
559838	19.8	291	19.8	17.4	23.4	23.36	0	0	0	0.05122	0
559959	20.2	400	20.2	17	26.5	26.52	112.5	1087	0	0	0
559989	20.5	562	20.5	17.6	26.2	26.2	536.3	4549	0	0	0
560020	20.6	632	20.6	18	26.1	26.1	586.4	4742	0	0	0
560050	20.8	519	20.8	14.9	26.2	26.2	583.9	6604	0	0	0
560080	20.8	564	20.8	13.9	26.1	26.1	584.6	7145	0	0	0
560111	20.7	705	20.7	13.7	25.8	25.8	585.5	7123	0	0.3	0
560141	20.6	714	20.6	13.6	25.3	25.3	584.9	6851	0	0.1	0
560171	20.5	732	20.5	13.6	25.4	25.4	584.2	6909	0	0	0
560201	20.8	804	20.8	13.6	25.5	25.5	585.8	7024	0	0	0
560232	21.3	781	21.3	13.6	25.9	25.9	585.8	7228	0	0	0
560262	21.3	813	21.3	13.6	26.1	26.1	584.8	7342	0	0	0
560292	21.2	787	21.2	13.5	25.9	25.9	585.2	7220	0	0	0
560322	21.1	780	21.1	13.5	25.4	25.4	584.5	6940	0	0	0
560353	20.5	745	20.5	13.6	25.5	25.5	585.3	6980	0	0	0
560383	20.9	678	20.9	13.6	25.2	25.2	585.2	6791	0	0	0
560413	21.6	636	21.6	13.6	24.9	24.9	584.1	6594	0	0	0
560444	21.4	636	21.4	13.6	24.6	24.6	584.7	6388	0	0	0
561504	21.8	783	21.8	13.7	24.5	24.5	16.53	179.2	0	0.08283	0
563441	22.3	531	22.3	19.2	26.1	26.09	0	0	0	0.06097	0
563562	22.4	286	22.4	17.9	31.1	31.13	112.5	1499	0	0.02479	0
563592	22.4	290	22.4	18.2	30.4	30.4	536.4	6393	0	0.2	0
563623	22.1	290	22.1	18.9	30.1	30.1	587.4	6566	0	0.1	0
563653	22.2	289	22.2	15.7	30	30	584.6	8390	0	0.1	0
563683	22	280	22	14.7	29.7	29.7	586.8	8811	0	0	0
563713	22.1	276	22.1	14.4	28.8	28.8	585.1	8381	0	0	0
563744	22.2	281	22.2	14.3	27.8	27.8	585.5	7914	0	0	0
563774	21.9	289	21.9	14.3	28.9	28.9	585.8	8542	0	0	0
563804	22	299	22	14.3	29.5	29.5	584.7	8909	0	0	0
563835	21.9	325	21.9	14.3	29.3	29.3	585.1	8783	0	0.2	0
563865	21.6	336	21.6	14.3	28.4	28.3	586.6	8257	0	0	0
563895	21.9	338	21.9	14.3	27.9	27.9	586.3	7974	0	0	0
563925	21.6	346	21.6	14.3	27.5	27.5	584.6	7712	0	0	0
563956	21.7	351	21.7	14.3	26.9	26.9	585.2	7384	0	0	0
563986	21.7	339	21.7	14.3	26.5	26.5	585.4	7115	0	0.1	0

564016	21.9	336	21.9	14.4	26.2	26.2	585.6	6955	0	0.3	0
564047	21.8	350	21.8	14.4	26.1	26.1	584.9	6859	0	0	0
565711	22	363	22	14.4	26.1	26.1	10.54	122.7	0	0.08317	0
570675	19.7	137	19.7	20.4	23.4	23.42	0	0	0	0.05048	0
570796	17.8	67	17.8	20.2	27	27.04	112.4	793.8	0	0.07438	0
570826	17.5	68	17.5	20.4	26.9	26.9	531.5	3377	0	0.1	0
570857	17.4	69	17.4	19.8	26.8	26.8	587.1	4126	0	0	0
570887	17.5	69	17.5	16	26.7	26.7	584.2	6291	0	0	0
570917	17.6	69	17.6	14.9	26.7	26.8	583.7	6921	0	0	0
570947	17.8	69	17.8	14.6	26.6	26.6	584	7003	0	0.1	0
570978	17.6	71	17.6	14.5	25.9	25.9	583.7	6652	0	0	0
571008	17.8	71	17.8	14.4	25.5	25.5	584.9	6462	0	0	0
571038	17.7	72	17.7	14.4	26	25.9	583.1	6742	0	0	0
571069	17.5	72	17.5	14.4	26.1	26.1	583.9	6819	0	0.4	0
571099	17.3	73	17.3	14.4	26.6	26.6	584.6	7140	0	0.1	0
571129	17.2	73	17.2	14.4	26.6	26.6	584.3	7142	0	0	0
571160	17.4	73	17.4	14.4	26.3	26.3	582.9	6943	0	0	0
571190	17.4	74	17.4	14.4	25.7	25.7	584.8	6624	0	0	0
571220	17.2	75	17.2	14.4	25.6	25.6	583.9	6566	0	0.2	0
571251	17.4	75	17.4	14.4	25.4	25.4	584.5	6431	0	0.1	0
571281	17.4	75	17.4	14.4	25	25	584.5	6195	0	0	0
573642	17.5	151	17.5	14.5	24.7	24.7	7.438	76.25	0	0.03723	0
577759	18.2	266	18.2	18.4	20.4	20.41	0	0	0	0.0412	0
581422	20.4	408	20.4	22.6	24.5	24.51	0	0	0	0.086	0
581543	20.4	191	20.4	21.7	28.9	28.97	112.1	820.5	0	0.04959	0
581574	20.4	185	20.4	21.3	28.4	28.4	530.8	3704	0	0	0
581604	20.5	196	20.5	19.9	28.3	28.3	585.9	4932	0	0.3	0
581634	20.4	195	20.4	15.6	28.2	28.2	581	7342	0	0	0
581664	20.4	185	20.4	14.3	28.2	28.2	583.2	8063	0	0	0
581695	20.2	177	20.2	14	27.9	27.9	583.9	8117	0	0	0
581725	20.2	199	20.2	13.9	27.4	27.4	581.7	7822	0	0	0
581755	20.6	215	20.6	13.9	26.8	26.8	582.5	7529	0	0	0
581786	20.7	218	20.7	13.8	27.1	27.1	582.8	7715	0	0	0
581816	20.5	228	20.5	13.8	28	28	581.2	8228	0	0	0
581846	20	238	20	13.8	28.5	28.5	582.3	8579	0	0	0
581876	19.8	239	19.8	13.8	28.2	28.2	582.3	8386	0	0.2	0
581907	20.1	240	20.1	13.8	27.2	27.2	582.2	7832	0	0.6	0
581937	20.1	235	20.1	13.7	26.9	26.9	581.7	7650	0	0	0
581967	20	227	20	13.8	26.7	26.7	583.6	7552	0	0	0
581998	20.3	236	20.3	13.8	26.5	26.4	582	7382	0	0	0
582028	20.4	214	20.4	13.8	26.2	26.2	582.1	7194	0	0	0
582058	20.4	198	20.4	13.8	26	26	581.6	7083	0	0	0
584451	20	148	20	13.9	25.8	25.8	7.3	87.47	0	0.02411	0
591394	18.9	53.7	18.9	20.3	22.5	22.47	0	0	0	0.03313	0
599387	16.6	0	16.6	18.6	18.7	18.67	0	0	0	0.08784	0
607376	14.5	0	14.5	17.3	16.3	16.26	0	0	0	0.01212	0
615363	14.2	0	14.2	17.4	16.2	16.24	0	0	0	0	0
623229	13.4	3.71	13.4	17	15.5	15.45	0	0	0	0	0
628222	13.7	39.8	13.7	17.4	15.9	15.92	0	0	0	0	0
628343	14	57.2	14	20.4	22.6	22.59	112.6	266.6	0	0	0
628373	14.1	70	14.1	19.8	22.9	22.8	531.5	1691	0	0	0
628404	14	74	14	16.9	22.8	22.8	584.3	3447	0	0	0
628434	13.9	75	13.9	12.7	22.8	22.8	581.2	5906	0	0	0
628464	14	75	14	11.5	22.8	22.8	581.2	6586	0	0	0
628495	13.9	73	13.9	11.2	22.8	22.8	581.2	6759	0	0.3	0
628525	13.9	74	13.9	11.1	22.8	22.8	582.9	6849	0	0	0
628555	13.9	77	13.9	11	22.8	22.8	581.4	6867	0	0	0
628585	13.9	77	13.9	10.9	22.7	22.7	581.3	6840	0	0	0
628616	13.9	72	13.9	10.9	22.5	22.5	582	6739	0	0	0
628646	14	68	14	10.9	22.4	22.4	582.1	6731	0	0	0
628676	14.1	64	14.1	10.9	22.6	22.6	581.3	6797	0	0	0
628706	14	61	14	10.9	22.6	22.6	581.7	6849	0	0	0
628737	14	58	14	10.9	22.6	22.6	581.6	6848	0	0	0

628767	14	51	14	10.9	22.6	22.6	582.7	6809	0	0	0
628797	14	48	14	10.9	22.6	22.6	581.8	6814	0	0	0
628828	14	52	14	10.9	22.7	22.7	580.7	6839	0	0	0
628858	14	58	14	10.9	22.7	22.7	583	6896	0	0	0
631281	15	136	15	10.9	22.7	22.7	7.207	85.25	0	0	0.01498
635489	16.8	292	16.8	15.6	17.8	17.76	0	0	0	0.05176	0
635610	17.4	511	17.4	17	23.7	23.67	112.9	775	0	0.6	0
635640	17.1	514	17.1	17.3	23.5	23.5	531	3262	0	0.6	0
635671	17.3	486	17.3	16.6	23.4	23.4	585.2	3973	0	0.5	0
635701	16.8	436	16.8	13	23.4	23.5	582.1	6107	0	0.1	0
635731	16.7	463	16.7	11.9	23.4	23.4	582.6	6679	0	0.5	0
635762	16.9	437	16.9	11.7	23.4	23.4	583	6818	0	0.6	0
635792	16.8	441	16.8	11.6	23.3	23.2	583.5	6817	0	0.2	0
635822	16.9	442	16.9	11.5	22.9	22.9	584.2	6635	0	0.1	0
635852	17.1	436	17.1	11.5	22.7	22.7	583.7	6562	0	0.1	0
635883	17.2	423	17.2	11.4	23.1	23.1	583.3	6798	0	0	0
635913	17.2	444	17.2	11.4	23.4	23.4	582.6	6990	0	0.2	0
635944	17.1	441	17.1	11.4	23.8	23.8	582.8	7207	0	1.1	0
635974	16.7	447	16.7	11.4	23.5	23.5	582	7040	0	0	0
636004	16.6	470	16.6	11.4	23.3	23.3	582.6	6890	0	0.4	0
636034	16.7	468	16.7	11.5	23.2	23.2	581.4	6817	0	0.4	0
636065	16.5	454	16.5	11.5	23.2	23.2	581.6	6806	0	0.4	0
636095	16.5	464	16.5	11.5	23.1	23.1	583.2	6754	0	0.5	0
636125	16.4	420	16.4	11.5	23	23	582.3	6700	0	0.7	0
637640	16.8	402	16.8	11.5	22.9	22.9	11.92	135.5	0	0.08805	0
640970	17.7	522	17.7	16.5	20	20.03	0	0	0	0.217	0
642636	18.1	624	18.1	18.5	21.3	21.31	0	0	0	0.2259	0
642757	18.4	756	18.4	17.5	30.8	30.81	112.8	1534	0	0.7983	0
642787	18.3	678	18.3	17.5	30.5	30.5	532	6820	0	1.2	0
642818	18.4	802	18.4	17.3	30.3	30.3	588.5	7651	0	0.5	0
642848	18.5	679	18.5	13.6	30.2	30.2	581.9	9695	0	0.4	0
642878	18.9	762	18.9	12.5	30.2	30.2	583.2	10290	0	0.4	0
642909	18.5	692	18.5	12.3	29.3	29.3	582.5	9930	0	0.3	0
642939	17.9	647	17.9	12.2	28.6	28.6	582.7	9579	0	0.5	0
642969	17.9	676	17.9	12.1	29.9	29.9	582.3	10360	0	0	0
642999	18.4	679	18.4	12.1	30.7	30.7	582.6	10850	0	0.2	0
643030	18.6	660	18.6	12	29.9	29.9	583.5	10430	0	0.7	0
643060	18.7	621	18.7	12	28.9	28.9	582.1	9821	0	0.1	0
643090	18.5	528	18.5	12	28.6	28.6	581.9	9668	0	0	0
643121	18.1	530	18.1	12	28.3	28.3	583.7	9523	0	0.4	0
643151	17.9	574	17.9	12	27.8	27.8	581.7	9157	0	0.5	0
643181	18.1	628	18.1	12	27.5	27.5	583.3	9036	0	0.4	0
643211	18.1	625	18.1	12	27.4	27.4	583.8	8949	0	0.5	0
643242	18.1	636	18.1	12	27.7	27.7	581.8	9103	0	0	0
643272	18.3	561	18.3	12.1	27.7	27.7	582.9	9089	0	0.1	0
644665	18.1	518	18.1	12.1	27.6	27.6	12.55	194.1	0	0.2291	0
646270	17.2	353	17.2	17.1	23.2	23.25	0	0	0	0.09614	0
646391	17.3	349	17.3	15.6	29.9	29.9	112.8	1635	0	0.05041	0
646421	17	351	17	16.1	29.6	29.6	534.9	7078	0	0.4	0
646451	17.2	366	17.2	16.9	29.4	29.4	587.1	7313	0	0	0
646482	17.2	366	17.2	13.9	29.3	29.3	584.4	9017	0	0.1	0
646512	16.9	359	16.9	13	29.1	29.1	583.2	9413	0	0.6	0
646542	16.6	359	16.6	12.8	28.4	28.4	585.1	9142	0	0.1	0
646573	17	347	17	12.7	27.9	27.8	584.2	8868	0	0	0
646603	17.2	343	17.2	12.6	28.8	28.8	582.6	9445	0	0.1	0
646633	17.1	355	17.1	12.6	29.3	29.3	583.2	9727	0	0.5	0
646664	17.2	372	17.2	12.6	29	29	586.6	9615	0	0.1	0
646694	17.2	393	17.2	12.6	27.9	27.9	584.8	8915	0	0.1	0
646724	17	434	17	12.6	27.7	27.7	582.6	8806	0	0.7	0
646755	16.9	428	16.9	12.6	27.5	27.5	583.9	8674	0	0.1	0
646785	17.4	394	17.4	12.6	27.1	27.1	584.5	8448	0	0	0
646815	17.5	406	17.5	12.6	26.5	26.5	582.9	8077	0	0	0
646845	17.9	468	17.9	12.7	26.5	26.5	583.9	8045	0	0	0

646876	17.7	526	17.7	12.7	26.5	26.5	583.5	8045	0	0	0
648329	17.4	472	17.4	12.7	26.5	26.5	12.07	167.4	0	0.07694	0
649873	18.5	807	18.5	17.3	23.1	23.15	0	0	0	0.3085	0
649994	19	819	19	16.1	31.4	31.41	112.8	1754	0	0.7818	0
650024	18.7	844	18.7	16.5	30.9	30.9	535.9	7585	0	0	0
650055	19	831	19	17.6	30.7	30.7	589.1	7736	0	0.2	0
650085	19.3	1040	19.3	14.6	30.6	30.6	584.3	9360	0	0	0
650115	19.3	1090	19.3	13.7	30.4	30.4	585	9777	0	0.7	0
650146	19.4	1050	19.4	13.5	29.4	29.4	586	9336	0	0.5	0
650176	19.3	983	19.3	13.4	29	29	585.3	9155	0	0	0
650206	19.2	1010	19.2	13.3	30.4	30.4	584.5	9945	0	1.1	0
650237	19.2	884	19.2	13.3	30.8	30.8	584.8	10240	0	0.9	0
650267	19	1010	19	13.3	29.9	29.9	586	9706	0	0.1	0
650297	18.9	1140	18.9	13.3	28.9	28.9	584.6	9137	0	1.4	0
650328	19.2	1050	19.2	13.3	28.8	28.8	585.8	9058	0	0.8	0
650358	19.3	1140	19.3	13.3	28.5	28.5	586.7	8872	0	0.2	0
650388	19.7	1090	19.7	13.3	28	28	584.2	8561	0	0.4	0
650418	19.6	920	19.6	13.4	27.9	27.9	585.3	8499	0	1.1	0
650449	19.4	1060	19.4	13.4	27.8	27.8	585.4	8424	0	1.1	0
650479	19.4	1160	19.4	13.4	28	28	587.1	8542	0	2	0
651508	19.7	828	19.7	13.5	27.9	27.9	17.03	246	0	0.5761	0
653809	20.4	921	20.4	20	26.3	26.28	0	0	0	0.3167	0
656381	20.5	788	20.5	23.6	27.7	27.71	0	0	0	0.4325	0
657108	20.1	422	20.1	23.5	28.5	28.55	0	0	0	0.3241	0
657229	19.2	446	19.2	19	39	39.02	112.5	2287	0	0.3223	0
657259	19.4	591	19.4	18.6	38.7	38.7	540.1	10730	0	0.7	0
657289	19.2	984	19.2	18.9	38.5	38.5	588.8	11570	0	0.7	0
657320	19.6	1130	19.6	15.1	38.5	38.5	585.7	13700	0	0.6	0
657350	19.8	917	19.8	14	37.9	37.9	584.1	13940	0	0.2	0
657380	19.8	756	19.8	13.7	37.2	37.2	584.2	13720	0	0.1	0
657411	20.1	966	20.1	13.7	38.2	38.2	585.3	14390	0	0.6	0
657441	20.1	541	20.1	13.6	38.3	38.3	585.3	14450	0	0.4	0
657471	20.3	899	20.3	13.6	37.2	37.2	584.2	13780	0	0.1	0
657502	20.3	851	20.3	13.6	36.9	36.9	585.5	13670	0	0	0
657532	20.2	926	20.2	13.6	36.1	36.1	584.9	13170	0	0	0
657562	20.2	990	20.2	13.6	35.1	35.1	585	12560	0	0	0
657592	20.1	979	20.1	13.6	35.2	35.2	585.8	12690	0	0.1	0
657623	20.4	978	20.4	13.6	36	36	585.3	13130	0	0.2	0
657653	20.4	968	20.4	13.6	35.6	35.6	584.2	12870	0	0.3	0
657683	20.2	958	20.2	13.6	35.7	35.7	585.1	12920	0	0.7	0
657714	20.1	950	20.1	13.6	35.8	35.8	585.9	12980	0	0.6	0
658713	19.9	850	19.9	13.7	35.3	35.3	17.58	379.1	0	0.6107	0
661770	18.7	410	18.7	21	27.3	27.28	0	0	0	0.7557	0
665342	18.6	440	18.6	24.2	26.7	26.71	0	0	0	0.5544	0
667855	14	179	14	24.1	24.8	24.78	0	0	0	0.4717	0
667977	13.8	333	13.8	19.5	36.3	36.23	135	2306	0	0.323	0
668007	13.7	403	13.7	22.7	36.6	36.6	635.3	8634	0	0.1	0
668037	13.8	324	13.8	23.7	36.4	36.4	705.4	8992	0	0.8	0
668068	13.7	176	13.7	23.2	36.4	36.3	707.3	9272	0	0	0
668098	13.7	158	13.7	22.2	36.3	36.3	713.6	10060	0	0.6	0
668128	13.6	173	13.6	20.7	35.4	35.4	719	10550	0	1	0
668158	13.4	304	13.4	19.3	35.9	35.9	720.4	11890	0	0.1	0
668189	13.5	337	13.5	18.4	35.9	35.9	726	12690	0	0	0
668219	13.5	294	13.5	17.8	36.2	36.2	730.1	13430	0	0	0
668249	13.8	259	13.8	17.4	35.6	35.6	727.9	13230	0	0	0
668279	14	332	14	17.2	35.6	35.6	726.7	13340	0	0.3	0
668310	13.8	262	13.8	17.1	35.6	35.6	730.5	13510	0	0	0
668340	13.8	239	13.8	17	35.4	35.4	728.2	13390	0	1.4	0
668370	13.7	146	13.7	16.9	34.8	34.7	728	13000	0	0.2	0
668401	13.8	183	13.8	16.9	34.4	34.4	731.3	12830	0	0	0
668431	13.9	173	13.9	16.8	34.4	34.4	731.4	12820	0	0	0
668461	13.5	265	13.5	16.8	34.3	34.3	731	12780	0	0	0
668491	13.2	267	13.2	16.8	34.1	34.1	735.6	12740	0	0	0

668522	13.6	197	13.6	16.7	33.9	33.8	732.5	12540	0	0	0
668552	13.6	133	13.6	16.7	33.7	33.7	732.7	12460	0	0	0
668582	13.7	132	13.7	16.6	33.8	33.8	732.5	12580	0	0	0
668613	14	136	14	16.5	33.7	33.7	734.1	12620	0	0.1	0
668643	13.5	163	13.5	16.4	33.5	33.5	732.7	12530	0	0.1	0
668673	13.1	281	13.1	16.3	33.5	33.5	733.4	12640	0	0	0
668703	12.8	229	12.8	16.1	33.2	33.3	734.4	12600	0	0.6	0
668734	12.8	140	12.8	15.9	33.1	33.1	735.4	12640	0	0	0
668764	12.9	130	12.9	15.8	32.9	32.9	730.1	12500	0	0.1	0
668794	12.9	124	12.9	15.6	32.6	32.6	737.9	12580	0	0	0
668825	13.1	118	13.1	15.5	32.6	32.6	735.7	12620	0	0	0
668855	13	113	13	15.3	32.4	32.4	733.6	12540	0	0	0
668885	13.2	108	13.2	15.2	32.1	32.2	731.9	12400	0	0.2	0
668916	13.1	103	13.1	15.1	31.9	31.9	737.4	12390	0	0.1	0
668946	13	99	13	15	31.7	31.7	733.6	12270	0	0	0
668976	13.2	95	13.2	14.9	31.4	31.4	733.6	12090	0	0	0
669007	13.2	92	13.2	14.8	31.1	31.1	735.3	11930	0	0	0
669037	13	87	13	14.8	30.9	30.9	736.3	11860	0	0	0
669067	13	83	13	14.7	30.5	30.5	735.9	11630	0	0	0
669097	13.1	80	13.1	14.6	30.1	30.1	735.5	11410	0	0	0
669128	13.1	76	13.1	14.5	29.9	29.9	737.6	11380	0	0	0
669158	13.1	74	13.1	14.4	29.7	29.7	733.5	11190	0	0.6	0
669188	12.8	71	12.8	14.4	29	29	735.6	10750	0	0.1	0
669219	12.8	71	12.8	14.3	28.5	28.5	738	10480	0	0.1	0
669249	13.1	71	13.1	14.2	27.9	27.9	737.6	10110	0	0.1	0
669279	13.1	71	13.1	14.2	27.7	27.7	735	9970	0	0	0
669310	13.1	72	13.1	14.1	27.5	27.5	738.9	9930	0	0	0
669340	13	73	13	14.1	27.1	27	737.5	9585	0	0	0
669370	13	73	13	14	26.3	26.3	736.4	9032	0	0	0
669400	13.1	71	13.1	13.9	26.1	26.1	738.4	8992	0	0	0
669431	13.2	70	13.2	13.9	25.7	25.7	738.3	8735	0	0	0
669461	13.2	68	13.2	13.8	25	25	739.3	8287	0	0	0
669491	13.2	67	13.2	13.7	25.1	25.1	739.2	8431	0	0	0
669521	13	67	13	13.7	24.6	24.6	738.2	8071	0	0	0
669552	13.1	65	13.1	13.6	24.1	24.1	737.6	7765	0	0	0
669582	12.9	65	12.9	13.6	24	24	737.4	7688	0	0	0
669612	13	64	13	13.5	23.3	23.3	739.2	7216	0	0	0
669643	13.3	63	13.3	13.5	22.8	22.8	738.5	6872	0	0	0
669673	13.1	61	13.1	13.4	22.5	22.5	733.7	6674	0	0	0
669703	13	59	13	13.4	22.6	22.6	739.5	6819	0	0	0
669733	13.3	58	13.3	13.4	22	22	740.7	6421	0	0	0
669764	12.9	55	12.9	13.3	22	22	738	6398	0	0	0
669794	12.9	53	12.9	13.3	21.5	21.5	737	6054	0	0	0
669824	13	50	13	13.2	21.2	21.2	736.4	5861	0	0	0
669855	13	47	13	13.2	21	21	737.9	5754	0	0	0
669885	12.9	45	12.9	13.2	20.6	20.6	741	5513	0	0	0
669915	13.2	44	13.2	13.1	20.4	20.4	741.5	5433	0	0	0
669945	13.4	43	13.4	13.1	20.2	20.2	740.9	5275	0	0	0
669976	13.1	42	13.1	13	20.1	20.1	739.7	5240	0	0	0
670006	13	42	13	13	20.1	20.1	738	5236	0	0	0
670036	12.8	43	12.8	13	19.6	19.6	739.7	4943	0	0	0
670066	12.7	44	12.7	12.9	19.5	19.5	739.6	4855	0	0	0
670097	12.7	44	12.7	12.9	19.2	19.2	737.8	4674	0	0	0
670127	12.8	46	12.8	12.9	19.1	19.1	740.3	4596	0	0	0
670157	13.1	46	13.1	12.8	18.9	18.9	739.6	4467	0	0	0
670188	12.7	46	12.7	12.8	18.6	18.6	739.8	4286	0	0	0
670218	13.1	46	13.1	12.8	18.8	18.8	738.7	4437	0	0	0
670248	12.9	46	12.9	12.8	18.5	18.5	735.9	4195	0	0	0
670278	13	46	13	12.8	18.3	18.3	738.6	4057	0	0	0
670309	13	46	13	12.7	18	18	740.3	3876	0	0	0
670339	12.9	45	12.9	12.7	17.9	17.9	735.6	3797	0	0	0
670370	12.9	44	12.9	12.7	17.9	17.9	737	3863	0	0	0
670400	13	42	13	12.6	17.7	17.7	740.7	3752	0	0	0

670430	13.2	40	13.2	12.6	17.4	17.4	734.5	3536	0	0	0
670461	12.9	38	12.9	12.6	17.3	17.3	738.8	3473	0	0	0
670491	12.7	36	12.7	12.6	17.2	17.2	739.7	3408	0	0	0
670521	12.9	35	12.9	12.5	17	17	736.1	3301	0	0	0
\End SDHWPRE 2.6 Jun 97 @Copyright InSitu											
QRR2SOL3.D3											
* All integral/mean values (except for time) exclude the skip time											
* Integral time	[d]	8.511									
* Skipped time	[d]	0.250									
* Integral load	[MJ]	209.457									
* Mean load	[W]	284.854									
* Integral load (CRL*DT)	[MJ]	209.248									
* Integral load capacitance	[MJ/K]	9.047									
* Integral load volume	[l]	2159.283									
* Mean load volume	[l/d]	253.718									
* Mean load capacitance	[W/K]	12.304									
* Mean cold water temperature	[°C]	14.790									
* Mean load temp. difference	[K]	23.151									
* Integral auxiliary energy	[MJ]	0.000									
* Integral solar irradiance	[MJ/m²]	149.667									
* Mean solar irradiance	[W/m²]	203.542									
* Mean collector ambient temperature	[°C]	16.347									
* Mean store ambient temperature	[°C]	16.347									
* Mean wind speed	[m/s]	0.178									
\DataMode,Mean											
\Skip,21600											
\Value,DaySum,	1										
\Value,Declination,	23.4324										
\DefineChannel,Time,1[s],Sample,'time'											
\DefineChannel,Tca,1[°C],Mean,'collector ambient temperature'											
\DefineChannel,Ictot,1[W/m²],Mean,'hemispherical irradiance in collector plane'											
\DefineChannel,Tsa,1[°C],Mean,'store ambient temperature'											
\DefineChannel,Tcw,1[°C],Mean,'cold water temperature'											
\DefineChannel,Ts,1[°C],Mean,'hot water temperature'											
\DefineChannel,Tl,1[°C],Mean,'hot water temperature'											
\DefineChannel,C1,1[W/K],Mean,'load capacitance rate'											
\DefineChannel,Pnet,1[W],Mean,'net system power'											
\DefineChannel,Paux,1[W],Mean,'auxiliary heater thermal power'											
\DefineChannel,wc,1[m/s],Mean,'air velocity in collector plane'											
\DefineChannel,Pcp,1[W],Mean,'collector loop pump power'											
\UseChannels,Time,Tca,Ictot,Tsa,Tcw,Ts,Tl,C1,Pnet,Paux,wc,Pcp											
*Time Tca Ictot Tsa Tcw Ts Tl C1 Pnet Paux wc Pcp											
\TimeStep,1											
\DefineChannel,Time,1[s],Sample,'time'											
\DefineChannel,T_ca,[°C],Mean,'collector ambient temperature'											
\DefineChannel,Gt_e,[W/m²],Mean,'irradiance on collector plane times Kac'											
\DefineChannel,T_sa,[°C],Mean,'store ambient temperature'											
\DefineChannel,T_cw,[°C],Mean,'cold water temperature'											
\DefineChannel,T_S,[°C],Mean,'store outlet temperature'											
\DefineChannel,T_L,[°C],Mean,'temperature delivered to the user'											
\DefineChannel,dC_S,[W/K],Mean,'load capacitance rate through the store'											
\DefineChannel,P_net,[W],Mean,'net system power (delivered minus aux)'											
\DefineChannel,P_aux,[W],Mean,'auxiliary power'											
\DefineChannel,v_wind,[m/s],Mean,'wind velocity in collector plane'											
\DefineChannel,P_cp,[W],Mean,'collector pump power'											
\UseChannels,Time,T_ca,Gt_e,T_sa,T_cw,T_S,T_L,dC_S,P_net,P_aux,v_wind,P_cp											
*Time T_ca Gt_e T_sa T_cw T_S T_L dC_S P_net P_aux v_wind P_cp											
0											
29 12.6 0 12.6 19.7 28.1 28.2 589.3 5705 0 0 0											
59 12.7 0 12.7 19.2 29.4 29.4 765.9 7800 0 0 0											

93	12.8	0	12.8	23	29.4	29.3	764.1	4862	0	0	0
123	12.7	0	12.7	23.9	29.4	29.4	761.1	4148	0	0	0
158	12.6	0	12.6	23.9	29.3	29.3	759.1	4058	0	0	0
188	12.7	0	12.7	23.1	28.9	28.9	757.2	4453	0	0	0
218	12.7	0	12.7	21.5	29.1	29.1	761.6	5806	0	0	0
248	12.8	0	12.8	19.8	29	29	759.3	6997	0	0	0
278	12.7	0	12.7	18.6	29.1	29.1	758.4	7966	0	0	0
308	12.7	0	12.7	17.8	29	29	759.6	8463	0	0	0
338	12.7	0	12.7	17.4	28.9	28.9	761.4	8738	0	0	0
368	12.7	0	12.7	17.2	28.5	28.5	762.8	8611	0	0	0
398	12.7	0	12.7	17.1	28.1	28.1	760.9	8363	0	0	0
428	12.7	0	12.7	17	28.6	28.6	759.1	8799	0	0	0
459	12.7	0	12.7	17	28.9	28.9	762.3	9109	0	0	0
489	12.7	0	12.7	17	28.9	28.9	762.7	9055	0	0	0
523	12.7	0	12.7	17	29	29	762.7	9151	0	0	0
553	12.7	0	12.7	17	29	29	764.4	9121	0	0	0
583	12.6	0	12.6	17	28.6	28.6	763.3	8860	0	0	0
613	12.6	0	12.6	17	28.4	28.4	763.9	8691	0	0	0
643	12.7	0	12.7	17	28.3	28.3	763.5	8593	0	0	0
674	12.6	0	12.6	16.9	28	28	763.6	8446	0	0	0
704	12.7	0	12.7	16.8	27.7	27.7	763.3	8327	0	0	0
738	12.7	0	12.7	16.7	27.7	27.7	764	8409	0	0	0
768	12.7	0	12.7	16.5	27.4	27.4	766.1	8379	0	0	0
798	12.7	0	12.7	16.3	27.2	27.2	763.5	8277	0	0	0
833	12.7	0	12.7	16.1	27.1	27.1	764	8381	0	0	0
867	12.7	0	12.7	16	27.1	27.1	764.9	8524	0	0	0
897	12.8	0	12.8	15.8	27	26.9	764	8507	0	0	0
927	12.9	0	12.9	15.7	26.7	26.7	764.5	8418	0	0	0
957	12.8	0	12.8	15.6	26.5	26.5	765.2	8344	0	0	0
987	12.8	0	12.8	15.5	26.6	26.6	761.2	8441	0	0	0
1017	12.8	0	12.8	15.4	26.4	26.4	763.1	8415	0	0	0
1048	12.7	0	12.7	15.3	26.1	26.1	764.1	8267	0	0	0
1078	12.8	0	12.8	15.2	25.7	25.7	759.8	8002	0	0	0
1108	12.8	0	12.8	15.1	25.4	25.4	759.8	7827	0	0	0
1138	12.7	0	12.7	15	25.2	25.2	760.8	7735	0	0	0
1168	12.6	0	12.6	15	25.1	25.1	757	7680	0	0	0
1198	12.7	0	12.7	14.9	24.9	24.9	762.2	7643	0	0	0
1228	12.7	0	12.7	14.8	24.6	24.6	764	7458	0	0	0
1258	12.7	0	12.7	14.7	24.4	24.4	758.3	7311	0	0	0
1288	12.7	0	12.7	14.7	24	24	761.1	7116	0	0	0
1318	12.7	0	12.7	14.6	23.7	23.7	752.1	6849	0	0	0
1349	12.6	0	12.6	14.5	23.7	23.7	749.3	6831	0	0	0
1379	12.7	0	12.7	14.5	23.3	23.3	764.3	6736	0	0	0
1409	12.7	0	12.7	14.4	23.2	23.2	762.6	6662	0	0	0
1439	12.7	0	12.7	14.4	22.9	22.9	758.2	6455	0	0	0
1469	12.7	0	12.7	14.3	22.7	22.7	762.7	6370	0	0	0
1499	12.7	0	12.7	14.3	22.2	22.2	766.5	6085	0	0	0
1529	12.8	0	12.8	14.2	21.9	21.9	771.3	5944	0	0	0
1563	12.7	0	12.7	14.1	22	22	770.8	6094	0	0	0
1594	12.6	0	12.6	14.1	21.7	21.7	767.5	5834	0	0	0
1624	12.6	0	12.6	14	21.4	21.4	765.7	5648	0	0	0
1654	12.5	0	12.5	13.9	21.1	21.1	769	5533	0	0	0
1684	12.5	0	12.5	13.9	21.1	21.1	767.2	5507	0	0	0
1718	12.6	0	12.6	13.8	20.9	20.9	765.7	5411	0	0	0
1748	12.7	0	12.7	13.8	20.3	20.3	767.9	4999	0	0	0
1778	12.7	0	12.7	13.7	20.2	20.2	765.4	4937	0	0	0
1809	12.6	0	12.6	13.7	20.2	20.2	766	4986	0	0	0
1843	12.7	0	12.7	13.7	19.9	19.9	763.3	4757	0	0	0
1877	12.7	0	12.7	13.6	19.8	19.8	763.6	4682	0	0	0
1907	12.7	0	12.7	13.6	19.6	19.6	766.4	4606	0	0	0
1937	12.8	0	12.8	13.6	19.2	19.2	762.5	4302	0	0	0
1968	12.7	0	12.7	13.6	19.1	19.1	762.7	4202	0	0	0
1998	12.7	0	12.7	13.5	19	19	764.5	4206	0	0	0

2028	12.7	0	12.7	13.5	18.7	18.7	761.1	3922	0	0	0
2058	12.6	0	12.6	13.5	18.4	18.4	762.7	3740	0	0	0
2088	12.7	0	12.7	13.5	18.5	18.5	765.6	3856	0	0	0
2118	12.8	0	12.8	13.4	18.5	18.5	764.2	3843	0	0	0
2148	12.8	0	12.8	13.4	18.5	18.5	761.6	3882	0	0	0
2178	12.7	0	12.7	13.4	18.3	18.3	764.2	3747	0	0	0
2208	12.6	0	12.6	13.4	18	18	765.1	3573	0	0	0
2239	12.6	0	12.6	13.4	17.9	17.9	762.9	3442	0	0	0
2273	12.3	0	12.3	13.3	17.8	17.8	763.9	3398	0	0	0
2303	12.3	0	12.3	13.3	17.6	17.6	763	3276	0	0	0
2337	12.3	0	12.3	13.3	17.5	17.5	763.3	3162	0	0	0
2367	12.3	0	12.3	13.3	17.4	17.4	764.3	3106	0	0	0
2398	12.3	0	12.3	13.3	17.3	17.3	763	3056	0	0	0
2428	12.3	0	12.3	13.3	17.1	17.1	763.8	2914	0	0	0
2458	12.4	0	12.4	13.3	16.9	16.9	763.7	2812	0	0	0
2488	12.5	0	12.5	13.2	16.9	16.9	764.3	2802	0	0	0
2518	12.6	0	12.6	13.2	16.9	16.9	765	2788	0	0	0
2548	12.6	0	12.6	13.2	16.7	16.7	763.5	2639	0	0	0
2582	12.5	0	12.5	13.2	16.6	16.6	763.3	2561	0	0	0
2613	12.5	0	12.5	13.2	16.5	16.5	765.4	2554	0	0	0
2643	12.6	0	12.6	13.2	16.4	16.4	763.9	2498	0	0	0
2673	12.6	0	12.6	13.2	16.4	16.4	760.2	2431	0	0	0
2707	12.6	0	12.6	13.2	16.3	16.3	764.1	2415	0	0	0
2737	12.6	0	12.6	13.1	16.2	16.2	766.2	2357	0	0	0
2767	12.6	0	12.6	13.1	16.1	16.1	763.9	2283	0	0	0
2797	12.4	0	12.4	13.1	16	16	762.4	2229	0	0	0
2828	12.4	0	12.4	13.1	15.9	15.9	764.1	2127	0	0	0
2858	12.5	0	12.5	13.1	15.8	15.7	762.2	2031	0	0	0
2888	12.5	0	12.5	13.1	15.7	15.7	762.4	2006	0	0	0
2918	12.2	0	12.2	13.1	15.7	15.7	763.5	2016	0	0	0
2948	12.2	0	12.2	13.1	15.7	15.7	759.6	1989	0	0	0
2978	12.3	0	12.3	13	15.6	15.6	763.5	1970	0	0	0
3008	12.2	0	12.2	13	15.6	15.6	766.4	1963	0	0	0
3038	12.2	0	12.2	13	15.5	15.5	759.1	1885	0	0	0
3068	12.2	0	12.2	13	15.3	15.3	761.7	1771	0	0	0
3098	12.4	0	12.4	13	15.3	15.3	766.4	1766	0	0	0
3133	12.4	0	12.4	13	15.2	15.2	763.8	1687	0	0	0
3167	12.5	0	12.5	13	15.2	15.2	762.5	1666	0	0	0
3197	12.4	0	12.4	12.9	15.2	15.1	766.1	1683	0	0	0
3227	12.4	0	12.4	12.9	15.1	15.1	762.9	1663	0	0	0
3257	12.3	0	12.3	12.9	15	15	764	1622	0	0	0
3288	12.3	0	12.3	12.9	15	15	764.8	1593	0	0	0
3318	12.3	0	12.3	12.9	14.9	14.9	763.1	1535	0	0	0
3348	12.3	0	12.3	12.9	14.8	14.8	763.8	1477	0	0	0
3378	12.3	0	12.3	12.9	14.8	14.8	764.1	1477	0	0	0
3408	12.3	0	12.3	12.8	14.8	14.8	763.5	1456	0	0	0
3438	12.3	0	12.3	12.8	14.8	14.7	765.1	1464	0	0	0
3468	12.3	0	12.3	12.8	14.7	14.7	763.1	1448	0	0	0
3498	12.2	0	12.2	12.8	14.7	14.7	762.3	1438	0	0	0
3528	12.2	0	12.2	12.8	14.7	14.7	764.3	1441	0	0	0
3563	12.2	0	12.2	12.8	14.6	14.6	762.8	1418	0	0	0
3593	12.2	0	12.2	12.7	14.6	14.6	761.6	1390	0	0	0
3623	12.2	0	12.2	12.7	14.5	14.5	764	1370	0	0	0
3653	12.1	0	12.1	12.7	14.5	14.5	761.9	1353	0	0	0
3683	12.1	0	12.1	12.7	14.4	14.4	763.1	1321	0	0	0
3713	12.1	0	12.1	12.7	14.4	14.4	764.3	1293	0	0	0
3743	12	0	12	12.7	14.3	14.3	762.2	1281	0	0	0
3773	12.1	0	12.1	12.6	14.3	14.3	763.5	1266	0	0	0
3804	12	0	12	12.6	14.2	14.2	764	1227	0	0	0
3834	11.9	0	11.9	12.6	14.2	14.2	761.5	1205	0	0	0
3864	11.8	0	11.8	12.6	14.2	14.2	761.2	1181	0	0	0
3894	11.7	0	11.7	12.6	14.1	14.1	765.3	1169	0	0	0
3924	11.6	0	11.6	12.6	14.2	14.2	763.4	1198	0	0	0

3954	11.7	0	11.7	12.6	14.1	14.1	758.3	1185	0	0	0
3984	11.8	0	11.8	12.6	14.1	14.1	763.3	1160	0	0	0
4014	11.9	0	11.9	12.6	14	14	765.3	1144	0	0	0
4044	11.8	0	11.8	12.5	14	14	761.3	1129	0	0	0
4074	11.8	0	11.8	12.5	14	14	760.3	1118	0	0	0
4109	11.8	0	11.8	12.5	14	14	762.4	1104	0	0	0
4139	11.8	0	11.8	12.5	13.9	13.9	760.7	1078	0	0	0
4169	11.9	0	11.9	12.5	13.9	13.9	761.3	1061	0	0	0
4199	11.9	0	11.9	12.5	13.9	13.9	762.3	1058	0	0	0
4234	12.1	0	12.1	12.5	13.8	13.8	761.6	1037	0	0	0
4264	12.2	0	12.2	12.5	13.8	13.8	761.4	1037	0	0	0
4294	12.1	0	12.1	12.5	13.8	13.8	760.8	1013	0	0	0
4324	12.2	0	12.2	12.4	13.7	13.7	761.8	978	0	0	0
4354	12.3	0	12.3	12.4	13.7	13.7	760.7	946	0	0	0
4388	12.2	0	12.2	12.4	13.7	13.7	760.3	965	0	0	0
4418	12.1	0	12.1	12.4	13.7	13.7	762.3	981	0	0	0
4448	12.1	0	12.1	12.4	13.7	13.6	761.1	945	0	0	0
4479	12.1	0	12.1	12.4	13.6	13.6	762.4	917	0	0	0
4509	11.9	0	11.9	12.4	13.5	13.5	762.8	881	0	0	0
4539	12	0	12	12.4	13.5	13.5	761	856	0	0	0
4569	11.9	0	11.9	12.4	13.5	13.5	761.6	834	0	0	0
4599	12	0	12	12.4	13.5	13.5	763.1	855	0	0	0
4629	12.1	0	12.1	12.4	13.5	13.5	762.5	858	0	0	0
4659	12.1	0	12.1	12.4	13.4	13.5	763.4	837	0	0	0
4689	12	0	12	12.3	13.5	13.5	762.5	850	0	0	0
4720	12	0	12	12.3	13.5	13.5	761	855	0	0	0
4750	12	0	12	12.3	13.4	13.4	763.6	843	0	0	0
4780	12.2	0	12.2	12.3	13.4	13.4	761.4	819	0	0	0
4810	12.2	0	12.2	12.3	13.4	13.4	760.2	801	0	0	0
4840	12.2	0	12.2	12.3	13.3	13.3	762.5	787	0	0	0
4870	12.2	0	12.2	12.3	13.3	13.3	759.9	761	0	0	0
4900	12.2	0	12.2	12.3	13.3	13.3	757.3	740	0	0	0
4930	12.1	0	12.1	12.3	13.3	13.3	764.8	738	0	0	0
5707	12.1	0	12.1	12.3	13.2	13.2	34.31	32.39	0	0	0
13695	13	0	13	12.4	12.6	12.59	0	0	0	0	0
21360	12.8	15	12.8	12.5	12.5	12.55	0	0	0	0.01263	0
27608	13.8	103	13.8	13.2	13.7	13.73	0	0	0	0.004417	0
30721	14.1	107	14.1	14.8	15.3	15.3	0	0	0	0.00787	0
30902	12.6	16.5	12.6	18.6	15.7	15.67	114	-335.8	0	0	0
33856	11.9	105	11.9	19.4	15.4	15.4	5.321	-21.69	0	0.01016	0
37799	13.4	257	13.4	14.5	13.7	13.68	0	0	0	0.006214	0
38075	16.6	577	16.6	17	19.1	19.13	77.22	166.1	0	0.02355	0
41055	16.5	416	16.5	17.4	19.4	19.35	0	0	0	0.09628	0
45041	14	260	14	17.8	19	18.99	0	0	0	0.09992	0
45300	13.2	93.7	13.2	18.4	25.5	25.51	86.04	621.3	0	0.03977	0
49647	12.6	221	12.6	17.1	18.9	18.89	0	0	0	0.0591	0
52305	13.1	193	13.1	17.4	17.4	17.43	0	0	0	0.08307	0
52486	13.1	106	13.1	18.6	25.8	25.79	114.4	839.8	0	0	0
54851	13.2	120	13.2	18.8	25.6	25.6	7.668	51.42	0	0.04846	0
59494	13.8	207	13.8	17.9	18.9	18.88	0	0	0	6.461E-4	0
59675	14.9	295	14.9	17.1	25.6	25.66	114.8	994.4	0	0	0
62500	14.1	124	14.1	17.2	25.6	25.6	5.622	46.68	0	0.159	0
69618	11.2	45.5	11.2	18	17.8	17.8	0	0	0	0.04253	0
77388	11.1	5.84	11.1	17.5	16.8	16.77	0	0	0	0	0
85335	10.4	0	10.4	17.1	16.3	16.29	0	0	0	0	0
93302	10.4	0	10.4	16.9	16.1	16.09	0	0	0	0	0
101236	10	0	10	16.7	15.9	15.92	0	0	0	0	0
109126	9.94	4.61	9.94	16.9	16.7	16.7	0	0	0	0	0
116163	10.5	50.2	10.5	16.7	16.5	16.46	0	0	0	0	0
117080	11.3	144	11.3	16.8	17.3	17.27	0	0	0	0	0
117261	11.8	188	11.8	16.8	23	23.04	115.2	731.8	0	0	0
119132	12.3	242	12.3	15.8	23.2	23.2	9.786	72.07	0	0	0
123700	13.5	281	13.5	18.9	20.1	20.09	0	0	0	0.00197	0

124311	14	328	14	18.9	21.5	21.45	0	0	0	0	0.01015	0
124591	14.5	358	14.5	16.1	27.8	27.82	76.04	901.7	0	0	0	0
129262	13.1	240	13.1	19.6	23.6	23.64	0	0	0	0.01749	0	0
131431	13.7	454	13.7	22.1	24.4	24.42	0	0	0	0.6291	0	0
131711	13.3	168	13.3	17.8	32.2	32.24	75.87	1108	0	0.1789	0	0
134365	14.3	643	14.3	21.5	29.2	29.19	0	0	0	0.5131	0	0
137798	14.8	444	14.8	24.1	27.3	27.32	0	0	0	0.4877	0	0
138702	14.7	244	14.7	25	27.5	27.53	0	0	0	0.9179	0	0
138883	14.3	150	14.3	19.1	37.5	37.48	114.9	2142	0	0.6652	0	0
141997	13.7	72.2	13.7	18.8	37.2	37.2	5.157	93.94	0	0.2293	0	0
145915	13.2	141	13.2	23.1	25.5	25.48	0	0	0	7.657E-4	0	0
146096	15.7	659	15.7	16.9	35.3	35.33	115	2143	0	0	0	0
147627	15.3	526	15.3	16.8	35.3	35.3	10.49	193.1	0	0.03919	0	0
152222	15.2	277	15.2	28	32.2	32.25	0	0	0	0.0765	0	0
159640	14.5	28.8	14.5	27.8	28.7	28.73	0	0	0	0.03624	0	0
167634	12.9	0	12.9	25.4	24.2	24.17	0	0	0	0.001514	0	0
175593	11.8	0	11.8	24.7	22.9	22.89	0	0	0	0.009323	0	0
183560	11.5	0	11.5	24.4	22.5	22.49	0	0	0	0	0	0
191469	9.72	1.52	9.72	23.6	20.6	20.65	0	0	0	0.006107	0	0
198640	9.56	43	9.56	22.7	19.5	19.46	0	0	0	0.02221	0	0
203439	10.6	101	10.6	22.7	20.9	20.92	0	0	0	0.009377	0	0
203715	9.99	101	9.99	17.2	31.6	31.56	77.55	1130	0	0.3315	0	0
207342	12.1	447	12.1	21.1	24.6	24.58	0	0	0	0.2388	0	0
210075	15.8	722	15.8	24.3	24.1	24.12	0	0	0	0.2296	0	0
210686	16	385	16	25.7	25.9	25.86	0	0	0	0.1031	0	0
210867	15.5	457	15.5	18.3	40.6	40.65	115.1	2616	0	0	0	0
212859	15.8	319	15.8	18.1	40.2	40.2	8.057	176.3	0	0.1464	0	0
216895	15.1	230	15.1	26.4	27.1	27.08	0	0	0	0.204	0	0
217807	17.1	977	17.1	24.6	27.2	27.22	0	0	0	0.4485	0	0
217988	17	524	17	17	41.6	41.56	115.1	2855	0	0.1011	0	0
219266	16.8	465	16.8	16.6	41.4	41.4	14.9	368.8	0	0.3074	0	0
221676	17.2	698	17.2	28.2	30.8	30.83	0	0	0	0.3531	0	0
224176	17.4	511	17.4	31.2	31.2	31.16	0	0	0	0.3074	0	0
225066	18.4	1010	18.4	28.5	32.5	32.47	0	0	0	0.7209	0	0
225247	19.4	936	19.4	17.6	47.9	47.93	115.1	3531	0	0.4807	0	0
226534	18.6	687	18.6	17.2	47.9	47.9	12.54	382.8	0	0.4779	0	0
229250	19.5	726	19.5	34.5	36.8	36.76	0	0	0	0.3162	0	0
232305	18.8	275	18.8	35.4	35.8	35.8	0	0	0	0.2913	0	0
232581	17.1	114	17.1	17.9	50.5	50.51	75.7	2497	0	0.04348	0	0
237668	17.3	214	17.3	35.1	39.6	39.57	0	0	0	0.004246	0	0
244504	16.9	62.6	16.9	36.7	34.7	34.67	0	0	0	0.02342	0	0
252462	15.5	0.64	15.5	36.4	33.8	33.79	0	0	0	0.001571	0	0
260351	14.5	0	14.5	35.9	33.4	33.4	0	0	0	0	0	0
268260	13.7	0	13.7	35.5	32.3	32.34	0	0	0	0	0	0
276120	12.9	0.98	12.9	34.9	31.4	31.43	0	0	0	0	0	0
283262	13.4	43.8	13.4	34.5	31.2	31.17	0	0	0	0.007561	0	0
289903	13.6	68.8	13.6	33.1	29.4	29.39	0	0	0	0.007785	0	0
290084	14	41.3	14	18.8	43.6	43.59	114.9	2876	0	0	0	0
292890	14.5	119	14.5	18.6	44	44	5.682	144.3	0	0.001105	0	0
296467	15.6	291	15.6	32.2	34.2	34.2	0	0	0	0.06556	0	0
297018	16	171	16	26.2	34.4	34.43	0	0	0	0.04791	0	0
297289	16.3	183	16.3	17.2	43.8	43.76	76.88	2061	0	0.1107	0	0
302713	15.9	177	15.9	30.8	33	33.03	0	0	0	0.05994	0	0
304285	17.1	389	17.1	30.3	29.3	29.33	0	0	0	0.08041	0	0
304466	18.4	388	18.4	18.6	43.5	43.5	114.7	2890	0	0.06851	0	0
306540	18.3	294	18.3	18.5	43.8	43.8	7.704	194.7	0	0.04537	0	0
311015	17.8	246	17.8	33.5	31.5	31.49	0	0	0	0.06664	0	0
311501	17.6	253	17.6	25.8	30.8	30.78	0	0	0	0.1173	0	0
311682	17.8	194	17.8	17.7	44	43.95	114.8	3051	0	0	0	0
313348	18	424	18	17	44.2	44.2	9.91	269.7	0	0.03289	0	0
316761	20	461	20	35.3	35.6	35.57	0	0	0	0.06273	0	0
318719	19.3	192	19.3	33.8	33.8	33.84	0	0	0	0.1543	0	0
318995	19.2	202	19.2	17.9	46.9	46.93	75.41	2210	0	0.04384	0	0

323682	20	264	20	34.4	37.4	37.42	0	0	0	0	0.01745	0
330190	19.6	84.7	19.6	37.3	35.7	35.7	0	0	0	0	0.1782	0
338134	16.9	2.56	16.9	36	33.2	33.21	0	0	0	0	0.02276	0
346103	14.9	0	14.9	34.5	30.9	30.86	0	0	0	0	0.04392	0
354026	14.7	0	14.7	33.9	30.1	30.14	0	0	0	0	0.06114	0
361935	14.5	0.107	14.5	33.1	29.2	29.19	0	0	0	0	0.1934	0
369641	15.5	13.2	15.5	31.7	26.8	26.77	0	0	0	0	0.3591	0
375337	16.7	152	16.7	31	26.3	26.33	0	0	0	0.87	0	
376249	18.1	324	18.1	27.6	27.3	27.28	0	0	0	1.07	0	
376431	19.2	498	19.2	19.3	41.6	41.56	114.4	2582	0	1.045	0	
378264	19.3	388	19.3	19	42	42	8.65	199.5	0	1.133	0	
381626	20.7	513	20.7	32.1	30.3	30.28	0	0	0	0.9322	0	
383477	20.7	265	20.7	32.2	32.2	32.23	0	0	0	0.3068	0	
383658	20.3	161	20.3	18	45.8	45.78	114.9	3224	0	1.298	0	
385931	20.7	231	20.7	17.2	45.7	45.7	7.056	200.6	0	0.316	0	
389353	21.7	348	21.7	33.8	32.4	32.36	0	0	0	0.9103	0	
390712	22.2	313	22.2	32.1	32.3	32.26	0	0	0	0.9678	0	
390984	21.9	188	21.9	18.1	46.1	46.13	76.66	2172	0	0.8765	0	
393690	21.9	306	21.9	31.8	36	36	0	0	0	0.7166	0	
397422	23.1	372	23.1	36.4	33.8	33.79	0	0	0	0.5091	0	
397908	22.9	282	22.9	32.4	33.7	33.7	0	0	0	0.9171	0	
398180	23.3	536	23.3	20.5	47.9	47.9	76.98	2140	0	0.9798	0	
400806	23.5	446	23.5	34.6	38.4	38.35	0	0	0	0.8783	0	
404215	23.2	399	23.2	38.1	35.2	35.16	0	0	0	1.008	0	
405093	22.5	265	22.5	37.4	34.8	34.75	0	0	0	0.8691	0	
405274	23.3	683	23.3	21.9	50.1	50.07	114.3	3276	0	1.335	0	
406970	22.9	442	22.9	20.2	50.2	50.2	9.394	281.4	0	1.571	0	
412541	21.6	162	21.6	37.7	34.8	34.78	0	0	0	0.8787	0	
420030	19.2	23.7	19.2	37	32.7	32.7	0	0	0	0.2973	0	
427985	17.9	0	17.9	36.2	31.3	31.3	0	0	0	0.3242	0	
435887	16.9	0	16.9	36	30.9	30.89	0	0	0	0.1535	0	
443846	16	0	16	34.8	29	29	0	0	0	0.5376	0	
451572	14.5	8.04	14.5	34.8	29.3	29.27	0	0	0	0.06419	0	
458361	15.9	65.6	15.9	33.8	28.1	28.09	0	0	0	0.3611	0	
462622	15.9	157	15.9	32.2	27.5	27.46	0	0	0	0.7051	0	
462803	15.8	299	15.8	19.3	44.2	44.2	114.8	2894	0	0.4983	0	
464624	17	377	17	17.7	44.7	44.7	8.888	240.6	0	0.4461	0	
467873	18.1	542	18.1	32.2	30.1	30.14	0	0	0	0.4688	0	
469861	19.5	688	19.5	32.8	31.3	31.27	0	0	0	0.5814	0	
470133	20	927	20	17.9	50	50.02	76.96	2505	0	0.3228	0	
472974	19.1	535	19.1	33.9	38.4	38.44	0	0	0	0.5338	0	
475539	18.9	509	18.9	37.7	34.8	34.81	0	0	0	0.4277	0	
477063	20.5	932	20.5	39.5	36.5	36.54	0	0	0	0.6841	0	
477339	20.1	483	20.1	22.3	56.2	56.13	78.01	2670	0	0.6025	0	
479705	20.8	888	20.8	38.2	44.5	44.46	0	0	0	0.528	0	
481862	21.3	1010	21.3	43.8	41.9	41.86	0	0	0	0.6309	0	
484212	21.4	897	21.4	46.5	43.3	43.27	0	0	0	0.8497	0	
484484	21.4	963	21.4	27.4	64.8	64.8	78.56	2966	0	0.4654	0	
486838	21.6	884	21.6	45.2	51.3	51.34	0	0	0	0.7367	0	
490354	20.6	452	20.6	51	46	45.99	0	0	0	0.6138	0	
491478	20.8	567	20.8	51	45.1	45.06	0	0	0	0.598	0	
491749	20.1	274	20.1	23.6	65.7	65.71	77.18	3303	0	0.6539	0	
497310	18.8	155	18.8	48.4	47.1	47.1	0	0	0	0.2969	0	
504374	17.2	47.5	17.2	49.1	43.7	43.7	0	0	0	0.09752	0	
512355	15.5	0.302	15.5	48.9	43.5	43.47	0	0	0	0.004511	0	
520321	14.4	0	14.4	48.5	43.1	43.06	0	0	0	0	0	0
528201	13.7	0	13.7	47.3	41.5	41.45	0	0	0	0.004594	0	
536070	13.1	0.539	13.1	47	41.4	41.4	0	0	0	0.003075	0	
541854	12.9	23.7	12.9	45.5	41.1	41.14	0	0	0	0	0	0
541976	12.6	55	12.6	20.3	57.7	57.69	112.9	4316	0	0	0	0
542006	12.8	59	12.8	19	58.5	58.5	528.7	20890	0	0	0	0
542037	12.8	61	12.8	15.7	58.5	58.5	583	24920	0	0	0	0
542067	12.9	64	12.9	10.6	58.5	58.5	577.8	27670	0	0	0	0

542097	13	67	13	9.23	58.5	58.5	576.3	28380	0	0	0
542128	13	71	13	8.86	58.5	58.5	579	28730	0	0	0
542158	13	74	13	8.7	58.5	58.5	579.4	28840	0	0	0
542188	13	77	13	8.6	58.5	58.4	576.5	28740	0	0	0
542219	13.3	79	13.3	8.53	58.4	58.4	580	28940	0	0	0
542249	13.3	79	13.3	8.49	58.4	58.4	577.3	28800	0	0	0
542279	13.2	79	13.2	8.46	58.3	58.3	579	28870	0	0	0
542310	13.2	77	13.2	8.45	58.3	58.3	577.3	28770	0	0	0
542340	13.2	74	13.2	8.45	58.2	58.2	578.9	28810	0	0	0
542370	13.1	72	13.1	8.45	58.2	58.2	579.2	28830	0	0	0
542401	13.1	69	13.1	8.46	58.3	58.3	579.1	28840	0	0	0
542431	13	67	13	8.47	58.3	58.3	578.2	28820	0	0	0
542462	13	66	13	8.48	58.3	58.3	579.7	28890	0	0	0
545313	13.2	63.8	13.2	8.48	58.3	58.3	6.087	303.1	0	0	0
549103	14.7	214	14.7	18.4	40.3	40.27	0	0	0	0.02071	0
549225	15.9	385	15.9	15.4	56.2	56.18	112.9	4657	0	0.2754	0
549255	16.1	544	16.1	15.5	56.8	56.8	532.1	21970	0	0	0
549285	16.4	562	16.4	14.4	56.8	56.8	581.7	24620	0	0	0
549316	16.8	578	16.8	10.7	56.8	56.7	577.5	26600	0	0	0
549346	16.8	527	16.8	9.61	56.7	56.7	573.9	27040	0	0	0
549377	16.9	410	16.9	9.34	56.7	56.7	577.3	27350	0	0	0
549407	16.7	315	16.7	9.23	56.6	56.6	575.3	27240	0	0	0
549437	16.2	271	16.2	9.16	56.3	56.3	577.3	27200	0	0	0
549468	16	241	16	9.12	56.2	56.2	575.4	27110	0	0	0
549498	16.1	242	16.1	9.11	56.5	56.5	577.2	27330	0	0	0
549528	16.4	245	16.4	9.1	56.3	56.3	575.7	27190	0	0	0
549559	16	228	16	9.11	56.2	56.2	576.8	27150	0	0	0
549589	16	290	16	9.13	55.8	55.8	577	26940	0	0	0
549619	16.6	229	16.6	9.14	55.5	55.5	576.7	26730	0	0	0
549650	16.3	211	16.3	9.18	55.5	55.4	574.9	26600	0	0	0
549680	16	219	16	9.19	55.3	55.3	576.8	26590	0	0	0
549710	15.9	217	15.9	9.2	55.2	55.1	576.5	26490	0	0	0
551166	17	440	17	9.21	55	55	12.27	562.1	0	0.1747	0
554683	17.9	463	17.9	17.6	36.2	36.16	0	0	0	0.3436	0
556230	17.9	424	17.9	20.6	34.1	34.11	0	0	0	0.2765	0
556352	17.5	210	17.5	16	49.7	49.72	112.9	3858	0	0.1967	0
556382	17.3	203	17.3	16	49.8	49.8	529.2	17810	0	0.1	0
556413	17.3	208	17.3	15.3	49.7	49.7	586.1	20150	0	0	0
556443	17.2	221	17.2	11.6	49.4	49.4	576.8	21840	0	0	0
556473	17.2	237	17.2	10.5	49.1	49.2	579.9	22410	0	0	0
556504	17.4	265	17.4	10.3	49.6	49.6	577.4	22730	0	0	0
556534	17.3	418	17.3	10.2	48.7	48.7	580	22370	0	0	0
556565	17.7	1020	17.7	10.1	48.3	48.3	579.9	22170	0	0	0
556595	18.3	1030	18.3	10.1	47.2	47.2	577.7	21430	0	0	0
556625	18.6	1030	18.6	10.1	47.7	47.7	579.4	21800	0	0	0
556655	18.9	1030	18.9	10.1	47.7	47.7	578.5	21780	0	0	0
556686	19.1	1020	19.1	10.1	47.8	47.8	580.3	21880	0	0	0
556716	19.4	932	19.4	10.1	47.3	47.3	578.5	21530	0	0	0
556746	19.7	986	19.7	10.2	46.5	46.5	578.6	21000	0	0.1	0
556777	19.7	663	19.7	10.2	45.8	45.8	580.6	20680	0	0	0
556807	19.4	246	19.4	10.1	45.1	45.1	580	20310	0	0.6	0
556837	18.8	220	18.8	10.3	44.8	44.8	580.8	20090	0	0.4	0
557959	18.6	673	18.6	10.3	44.3	44.3	15.99	543.4	0	0.2669	0
559840	18.6	629	18.6	17.2	32.3	32.26	0	0	0	0.577	0
559961	19.2	918	19.2	14.5	42.8	42.77	113.1	3245	0	0.3223	0
559991	19.7	645	19.7	14.9	42.8	42.8	530.3	14670	0	0.1	0
560022	19.6	336	19.6	15.9	42.6	42.7	586.5	15710	0	0.3	0
560052	19.4	934	19.4	13	42.5	42.5	583.7	17210	0	0.5	0
560082	19.3	857	19.3	12.1	42.1	42.1	582.9	17470	0	0.7	0
560113	19.2	1040	19.2	11.9	42.4	42.4	582.9	17770	0	0.4	0
560143	19.2	831	19.2	11.8	42.5	42.5	584.5	17900	0	0.6	0
560174	19.3	795	19.3	11.8	41.5	41.5	583	17310	0	0.3	0
560204	19.3	936	19.3	11.8	41.3	41.3	583.9	17200	0	0.5	0

560234	19.4	1040	19.4	11.8	40.4	40.4	582.6	16680	0	0.8	0
560265	19.5	1030	19.5	11.8	40.5	40.5	583.3	16760	0	0.6	0
560295	19.7	977	19.7	11.8	41	41	584.1	17030	0	0.4	0
560325	19.6	647	19.6	11.9	40.9	40.9	583.5	16950	0	0	0
560356	19.4	1030	19.4	11.9	40.7	40.7	584.7	16850	0	0	0
560386	19.6	989	19.6	11.9	40.3	40.3	582.6	16530	0	0.4	0
560416	19.6	1040	19.6	12	39.8	39.8	583.3	16260	0	0.1	0
560447	19.7	1040	19.7	12	39.5	39.5	584.3	16070	0	0.1	0
561417	19.7	876	19.7	12	39.2	39.2	18.07	492.8	0	0.5611	0
563449	19	573	19	18.3	30.3	30.29	0	0	0	0.2754	0
563570	19.9	1120	19.9	15.5	39.5	39.5	112.9	2745	0	0.124	0
563601	20.2	1130	20.2	16	39.4	39.4	535.5	12430	0	0.3	0
563631	20.1	1130	20.1	17.5	39.4	39.4	588.7	12890	0	0	0
563661	20.2	1130	20.2	14.9	39.2	39.2	584.7	14230	0	0.3	0
563692	20.6	1140	20.6	14.2	38.7	38.7	587.7	14420	0	0.9	0
563722	20.2	1140	20.2	14	39	39	584.8	14640	0	0.5	0
563752	19.9	631	19.9	13.9	39.5	39.5	586.9	15040	0	0.6	0
563783	20	415	20	13.8	38.8	38.8	589.3	14680	0	1.3	0
563813	20.1	276	20.1	13.9	38.3	38.3	585	14290	0	0.4	0
563843	19.8	234	19.8	13.9	38	38	586.5	14170	0	0.6	0
563874	19.7	243	19.7	13.9	37.1	37.1	587	13640	0	0.1	0
563904	19.8	873	19.8	13.9	37.5	37.5	585.9	13800	0	0	0
563934	20.1	1130	20.1	14	37.8	37.8	586.8	13990	0	0.1	0
563964	20.2	1130	20.2	14	37.5	37.5	586.4	13770	0	0.4	0
563995	19.8	1110	19.8	14	37.6	37.6	586.7	13810	0	0.4	0
564025	19.7	319	19.7	14	37.4	37.4	585.8	13680	0	0	0
564056	19.6	570	19.6	14	36.7	36.7	588	13350	0	0	0
564995	20.2	899	20.2	13.9	36.5	36.5	18.78	424.5	0	0.2942	0
567270	20.8	930	20.8	21.4	31.2	31.22	0	0	0	0.412	0
569664	20.6	874	20.6	25.5	30.7	30.71	0	0	0	0.4474	0
570695	21.1	853	21.1	26.3	32.1	32.09	0	0	0	0.308	0
570817	21.5	932	21.5	19.3	44.2	44.24	112.2	2839	0	0.3721	0
570847	21.5	925	21.5	18.7	44.1	44.1	531.8	13430	0	0.5	0
570877	21.4	923	21.4	19.4	44	44	586.4	14460	0	0.3	0
570908	21.1	919	21.1	15.9	43.9	43.9	581.9	16330	0	2.7	0
570938	20.9	916	20.9	14.9	43.2	43.2	584.2	16580	0	0.2	0
570969	20.9	915	20.9	14.6	43.5	43.5	583.8	16850	0	0.2	0
570999	20.8	916	20.8	14.5	44.1	44.1	585.5	17310	0	0.5	0
571029	20.7	916	20.7	14.4	43.2	43.2	584	16760	0	0.6	0
571060	21.1	920	21.1	14.4	43	43	584.9	16680	0	1.1	0
571090	21.1	918	21.1	14.4	42.1	42.1	585.4	16190	0	0	0
571120	21	915	21	14.4	41.4	41.4	585.5	15760	0	0	0
571151	21	914	21	14.4	42	42.1	585.7	16180	0	0.1	0
571181	21.2	909	21.2	14.5	42.1	42.1	585.3	16210	0	0	0
571211	21.1	906	21.1	14.5	42.1	42.1	584.5	16120	0	0.6	0
571242	20.9	902	20.9	14.6	42	42	586.1	16060	0	0.3	0
571272	20.9	907	20.9	14.6	41.8	41.8	584.4	15910	0	0.4	0
571302	21	910	21	14.6	41.5	41.5	584.8	15740	0	0.1	0
572273	20.9	810	20.9	14.6	41.3	41.3	18.69	498.7	0	0.406	0
575335	20.4	595	20.4	24.8	33.6	33.63	0	0	0	0.2922	0
578336	20.4	623	20.4	29	32.7	32.67	0	0	0	0.1955	0
581460	20.1	438	20.1	31.3	33.5	33.48	0	0	0	0.1648	0
581581	19.8	319	19.8	20.5	42.9	42.89	112.2	2546	0	0	0
581612	20.2	315	20.2	19.9	43	43.1	533.8	12300	0	0	0
581642	20.4	314	20.4	19.6	42.9	42.9	584.8	13630	0	0.8	0
581672	19.9	313	19.9	15.9	42.9	42.9	583.1	15790	0	1.2	0
581703	19.9	312	19.9	14.9	42.8	42.8	579.6	16200	0	0.2	0
581733	19.8	311	19.8	14.6	42.5	42.5	582.9	16250	0	0	0
581763	19.8	308	19.8	14.5	42.9	42.9	584.4	16610	0	0.6	0
581794	19.8	305	19.8	14.5	42.8	42.8	583.2	16550	0	0.2	0
581824	19.6	305	19.6	14.4	42.7	42.7	584	16520	0	0.7	0
581854	19.2	303	19.2	14.4	42.5	42.5	581.1	16360	0	0.1	0
581885	18.8	301	18.8	14.4	42.3	42.3	584	16340	0	0	0

581915	18.9	298	18.9	14.4	42	42	581.8	16060	0	0	0
581945	19	293	19	14.4	41.6	41.6	583.4	15880	0	0.1	0
581976	19.1	290	19.1	14.4	41.7	41.7	581.5	15870	0	0	0
582006	19.1	288	19.1	14.4	41.8	41.8	583.5	15970	0	0.4	0
582037	19.2	285	19.2	14.4	41.7	41.7	583.8	15940	0	0	0
582067	19.2	283	19.2	14.4	41.9	41.9	582.4	16010	0	0.4	0
584160	19.3	218	19.3	14.5	41.7	41.7	8.355	227.5	0	0.1141	0
591514	17.4	31.1	17.4	23.3	30.4	30.39	0	0	0	0.02804	0
599398	13.8	0	13.8	22.2	26.5	26.5	0	0	0	0.00307	0
607280	12	0	12	22.6	25.5	25.45	0	0	0	0	0
615270	10.9	0	10.9	22.6	23.3	23.31	0	0	0	0	0
623141	9.97	2.4	9.97	22.5	21.8	21.76	0	0	0	0	0
628321	11	38.3	11	22.3	21.9	21.94	0	0	0	0.01222	0
628443	12.6	57.7	12.6	18.4	33.6	33.64	112.2	1747	0	0	0
628473	12.5	58	12.5	18.7	34	34	530.5	8132	0	0.1	0
628503	12.5	58	12.5	16.8	34	34	586.1	10110	0	0	0
628534	12.7	58	12.7	12.9	34	34	584.8	12360	0	0	0
628564	12.9	59	12.9	11.8	34	34	583.8	12940	0	0	0
628594	13.7	59	13.7	11.6	33.9	33.9	584.9	13060	0	0	0
628625	13	60	13	11.4	33.8	33.8	582	13010	0	0	0
628655	12.8	60	12.8	11.4	34	34	583.4	13170	0	0.4	0
628685	12.7	60	12.7	11.3	33.9	34	582.2	13160	0	0.4	0
628716	12.7	61	12.7	11.3	34	34	583.3	13240	0	0	0
628746	12.8	61	12.8	11.3	34	34	582.4	13240	0	0	0
628776	13.1	61	13.1	11.3	33.9	33.9	582.3	13180	0	0	0
628807	12.9	61	12.9	11.3	33.8	33.8	583.2	13160	0	0	0
628837	12.7	61	12.7	11.3	33.7	33.7	582.5	13070	0	0	0
628867	12.8	61	12.8	11.3	33.5	33.5	582.2	12960	0	0	0
628898	13.6	61	13.6	11.3	33.4	33.4	583.6	12900	0	0	0
628928	13.6	61	13.6	11.3	33.3	33.3	582.8	12790	0	0	0
631445	14	94.9	14	11.4	33.3	33.3	7.178	157.1	0	0.05193	0
635449	15.6	282	15.6	16.3	24.9	24.88	0	0	0	0.352	0
635571	16.1	416	16.1	16.2	32.3	32.32	112.5	1840	0	0.8041	0
635601	15.8	421	15.8	16.9	32.5	32.5	530.1	8223	0	0.6	0
635631	16.1	422	16.1	16.8	32.5	32.5	586.9	9185	0	0.1	0
635662	16.3	424	16.3	13.5	32.4	32.4	582	11000	0	0.9	0
635692	16.1	426	16.1	12.6	32.3	32.3	583.3	11460	0	0.4	0
635723	16.2	428	16.2	12.4	32.1	32.1	582.7	11470	0	0.3	0
635753	16.9	430	16.9	12.3	32.2	32.2	584.2	11640	0	0	0
635783	18	433	18	12.2	32.3	32.3	581.8	11700	0	0	0
635814	17.8	435	17.8	12.2	32.3	32.3	583.5	11720	0	0.5	0
635844	17.2	437	17.2	12.2	32.3	32.3	583.3	11690	0	2.1	0
635874	16.5	438	16.5	12.2	32.1	32.1	582.7	11590	0	1.1	0
635905	16.2	441	16.2	12.2	31.9	31.9	584.2	11480	0	0.7	0
635935	16.1	443	16.1	12.2	31.4	31.3	582.4	11140	0	1.8	0
635965	16	445	16	12.3	31	31	583.3	10950	0	0.5	0
635996	15.9	447	15.9	12.3	31.1	31.1	582.9	10980	0	0	0
636026	16.3	449	16.3	12.3	31.3	31.3	583.2	11050	0	0.2	0
636056	16.2	450	16.2	12.3	31.3	31.3	583.8	11100	0	1.5	0
637421	16.6	494	16.6	12.4	31.3	31.3	13.22	250.6	0	0.5979	0
640394	17.6	623	17.6	17.7	26.1	26.08	0	0	0	0.4011	0
642699	18.4	768	18.4	20.4	27.3	27.3	0	0	0	0.4551	0
642820	18.6	829	18.6	17.3	37	37.01	112.3	2239	0	0.5702	0
642851	18.5	833	18.5	17.5	36.7	36.7	534.9	10130	0	1.1	0
642881	18.5	834	18.5	17.8	36.5	36.5	588.2	11000	0	1	0
642912	18.6	835	18.6	14.4	36.5	36.5	584.6	12950	0	1.8	0
642942	18.6	837	18.6	13.4	36.1	36.1	583.4	13270	0	1	0
642972	18.5	837	18.5	13.2	35.2	35.2	584.4	12890	0	1.7	0
643003	18.2	837	18.2	13.1	36.4	36.4	584.8	13650	0	1.1	0
643033	18.2	839	18.2	13.1	36.8	36.8	584.4	13850	0	1	0
643063	18.3	839	18.3	13	35.6	35.6	584.7	13220	0	0.8	0
643094	18.3	839	18.3	13	35.3	35.3	585.7	13030	0	1.1	0
643124	18.4	840	18.4	13	34.9	34.9	584.4	12810	0	1.3	0

643154	18.6	842	18.6	13	34.2	34.2	584.7	12410	0	0.5	0
643185	18.6	844	18.6	13	33.8	33.8	584.3	12170	0	0	0
643215	18.5	847	18.5	13	34.4	34.4	584.9	12530	0	0.2	0
643245	18.6	848	18.6	13	34.5	34.5	584.4	12580	0	0	0
643276	18.8	849	18.8	13	34.5	34.5	584.6	12550	0	0	0
643306	19.2	850	19.2	13.1	34.3	34.3	584.7	12430	0	0	0
644246	19.1	871	19.1	13.1	34.3	34.3	19.24	407.8	0	0.1284	0
646309	19.2	920	19.2	19.4	32.1	32.07	0	0	0	0.6666	0
646431	21.6	951	21.6	16.4	39.4	39.45	112.3	2614	0	0.07459	0
646461	22	951	22	16.6	38.9	38.9	534.9	11790	0	0	0
646492	22.3	951	22.3	17.8	38.9	38.9	586.2	12320	0	0	0
646522	21.5	951	21.5	14.9	38.8	38.8	584.1	13910	0	0	0
646552	21.2	953	21.2	14.1	38	38	583.3	13970	0	0	0
646583	21.7	954	21.7	13.9	37.9	37.9	584.4	13990	0	0	0
646613	22	953	22	13.9	39	39.1	584.1	14710	0	0.9	0
646643	22	952	22	13.8	38.1	38.1	584.4	14200	0	0.1	0
646674	21.6	950	21.6	13.8	37.3	37.3	584.6	13740	0	0	0
646704	21.7	952	21.7	13.8	37.3	37.3	586.4	13740	0	0	0
646734	22.2	953	22.2	13.8	36.4	36.4	586.6	13210	0	0.2	0
646765	21.6	950	21.6	13.8	35.8	35.8	586.4	12880	0	0	0
646795	21.5	950	21.5	13.8	36.7	36.7	585.6	13370	0	0	0
646825	21	951	21	13.9	36.6	36.6	584.3	13260	0	0	0
646856	20.5	957	20.5	13.9	36.5	36.5	585.4	13240	0	0	0
646886	19.9	956	19.9	13.9	36.4	36.4	585.2	13130	0	0	0
646916	19.9	950	19.9	13.9	36.1	36.1	585.3	12940	0	0	0
647796	19.9	964	19.9	14	35.7	35.7	20.64	447.4	0	0.9715	0
649919	20.2	985	20.2	21	34.3	34.31	0	0	0	0.5172	0
650041	23.2	991	23.2	17.2	41.3	41.24	112.4	2728	0	0.02459	0
650071	22.1	992	22.1	17.3	40.8	40.8	532.7	12390	0	0.2	0
650102	21.7	994	21.7	18.6	40.6	40.6	587.8	12940	0	0.9	0
650132	21	992	21	15.8	40.5	40.5	584.6	14480	0	0.2	0
650162	21	990	21	14.9	39.7	39.7	584.9	14490	0	0	0
650193	20.8	990	20.8	14.8	39.9	39.9	585.4	14710	0	0.3	0
650223	20.9	987	20.9	14.7	40.8	40.8	585.5	15270	0	2.2	0
650253	20.8	987	20.8	14.7	39.6	39.6	586.4	14640	0	2.1	0
650284	20.8	990	20.8	14.7	39.1	39.1	584.8	14290	0	0.9	0
650314	21	989	21	14.6	38.8	38.8	586	14140	0	0.5	0
650345	21	988	21	14.6	37.7	37.7	585	13490	0	2	0
650375	20.8	988	20.8	14.6	38	38	585.8	13660	0	0.8	0
650405	20.4	987	20.4	14.7	38.4	38.4	585	13930	0	0.1	0
650436	20.4	990	20.4	14.7	38.3	38.3	586.1	13840	0	0	0
650466	20.5	990	20.5	14.7	38.3	38.3	585.7	13810	0	0.6	0
650496	20.5	991	20.5	14.8	38	38	585.6	13570	0	0.1	0
650527	20.6	988	20.6	14.8	37.6	37.6	586.9	13360	0	0	0
651437	21.5	980	21.5	14.8	37.4	37.4	19.31	435.1	0	0.3682	0
653620	22.5	991	22.5	23.8	36	35.98	0	0	0	0.2294	0
655925	22.5	918	22.5	29.3	37.7	37.7	0	0	0	0.1531	0
657046	24.1	899	24.1	30.8	39	39	0	0	0	0.06994	0
657168	23.4	711	23.4	20.4	47.1	47.08	112.3	3035	0	0.2213	0
657198	23.8	848	23.8	19.1	46.8	46.8	531.6	14620	0	0.4	0
657228	23.4	854	23.4	19.9	46.7	46.7	584.4	15670	0	0	0
657259	23.2	819	23.2	16.3	46.6	46.6	581.8	17600	0	0.1	0
657289	23.2	847	23.2	15.3	45.8	45.8	582.6	17790	0	0	0
657319	23.5	839	23.5	15.1	46.4	46.4	582.3	18230	0	0.1	0
657350	23.7	826	23.7	15	46.4	46.4	581	18280	0	0.5	0
657380	23.6	778	23.6	14.9	45.8	45.8	584.4	18010	0	0.1	0
657410	23.4	704	23.4	14.9	45.4	45.4	581.5	17750	0	0	0
657441	23.4	596	23.4	14.9	44.4	44.4	583	17220	0	0	0
657471	23.6	621	23.6	14.9	44	44	583.7	17020	0	0	0
657502	23.2	615	23.2	14.9	44.8	44.8	582.4	17420	0	0.5	0
657532	22.6	580	22.6	14.9	44.6	44.6	583	17300	0	0	0
657562	22.4	589	22.4	14.9	44.6	44.6	582.8	17290	0	0	0
657593	22.1	476	22.1	14.9	44.3	44.3	582.3	17120	0	0.3	0

657623	21.7	568	21.7	15	44.3	44.3	582.5	17090	0	0	0
657653	21.6	574	21.6	15	44	44	583.6	16960	0	0.1	0
658624	23.2	832	23.2	15	43.7	43.7	18.62	533.9	0	0.1405	0
661353	24.3	718	24.3	26.7	38.2	38.22	0	0	0	0.1075	0
664809	23.7	490	23.7	33.7	39.8	39.76	0	0	0	0.03247	0
667812	22.5	190	22.5	34	38.2	38.23	0	0	0	0.008059	0
667933	22.3	173	22.3	21.1	44.6	44.58	112.3	2668	0	0	0
667964	22.6	171	22.6	20.4	44.7	44.7	526.8	12700	0	0	0
667994	22.8	155	22.8	20	44.5	44.5	583.8	14340	0	0	0
668024	23.2	154	23.2	16.1	44.6	44.6	580	16530	0	0	0
668055	23.6	162	23.6	14.9	44.4	44.4	581.9	17140	0	0	0
668085	23.3	164	23.3	14.7	44.2	44.2	580.3	17100	0	0	0
668115	23	162	23	14.6	44.6	44.6	581.5	17410	0	0	0
668146	22.9	158	22.9	14.6	44.4	44.4	579.8	17290	0	0	0
668176	23	154	23	14.5	44.2	44.2	581.6	17280	0	0	0
668207	22.7	154	22.7	14.5	44.1	44.1	580.6	17190	0	0	0
668237	22.6	152	22.6	14.5	43.9	43.9	581.2	17060	0	0	0
668267	22.8	150	22.8	14.5	43.4	43.4	579.9	16770	0	0	0
668297	22.8	148	22.8	14.5	43.2	43.2	581.9	16680	0	0	0
668328	22.4	143	22.4	14.6	43.4	43.4	581.9	16800	0	0	0
668358	22.5	139	22.5	14.6	43.3	43.3	580.5	16680	0	0	0
668388	22.7	139	22.7	14.6	43.5	43.5	580.6	16790	0	0	0
668419	23.1	139	23.1	14.6	43.5	43.5	582.6	16840	0	0	0
671029	22.2	107	22.2	14.7	43.2	43.2	6.678	190.6	0	0.01057	0
678502	20.6	22.7	20.6	24.5	32.4	32.39	0	0	0	0.002034	0
686380	19.2	0	19.2	25.3	30.8	30.82	0	0	0	0	0
694375	18.4	0	18.4	25.8	29.6	29.61	0	0	0	0	0
702365	17.2	0	17.2	25.9	27.8	27.76	0	0	0	0	0
710235	16.5	0.831	16.5	26	26.8	26.8	0	0	0	0	0
714628	16.4	29.4	16.4	25.8	26.3	26.28	0	0	0	0	0
714750	17.2	59	17.2	20.7	35.5	35.55	112.5	1707	0	0	0
714780	17.2	63	17.2	20.2	35.9	35.9	531.7	8358	0	0	0
714811	17.4	65	17.4	17.4	35.9	35.9	583	10800	0	0.1	0
714841	17.5	66	17.5	13.1	35.9	35.9	581.4	13250	0	0	0
714872	17.5	68	17.5	11.9	35.9	35.9	583.1	13970	0	0	0
714902	17.5	70	17.5	11.6	35.7	35.7	582.2	14040	0	0	0
714932	17.5	71	17.5	11.5	35.7	35.7	581.1	14070	0	0	0
714963	17.6	73	17.6	11.4	35.8	35.8	582.1	14200	0	0	0
714993	17.5	75	17.5	11.4	35.9	35.8	583.3	14270	0	0	0
715023	17.4	76	17.4	11.4	35.9	35.9	581.4	14280	0	0	0
715054	17.5	77	17.5	11.3	35.9	35.9	582.4	14280	0	0	0
715084	17.5	78	17.5	11.3	35.8	35.8	582.2	14210	0	0	0
715114	17.5	79	17.5	11.3	35.6	35.6	581.6	14140	0	0	0
715145	17.5	81	17.5	11.3	35.5	35.5	583.6	14120	0	0	0
715175	17.5	81	17.5	11.3	35.3	35.3	581.8	13970	0	0	0
715205	17.6	83	17.6	11.3	35.2	35.2	582.9	13900	0	0	0
715236	17.6	84	17.6	11.3	35.1	35.1	582.2	13840	0	0	0
717753	18.5	121	18.5	11.4	35.2	35.2	6.94	165.2	0	0.009535	0
721879	19.9	240	19.9	19.6	26.6	26.63	0	0	0	0.04493	0
722000	23.1	352	23.1	17.8	34.2	34.23	112.4	1876	0	0.02479	0
722030	22.2	382	22.2	17.9	34.4	34.4	529.8	8693	0	0	0
722061	22.7	534	22.7	17.3	34.3	34.3	586.7	9995	0	0	0
722091	23.3	514	23.3	13.7	34.3	34.3	585.5	12100	0	0	0
722122	23.4	487	23.4	12.7	34.2	34.2	585.3	12570	0	0	0
722152	23.4	279	23.4	12.4	34	34	585.6	12650	0	0	0
722182	22.7	452	22.7	12.3	34.2	34.2	584.8	12790	0	0	0
722213	22.5	544	22.5	12.3	34.3	34.3	585	12910	0	0	0
722243	22.3	538	22.3	12.2	34.3	34.3	586.1	12910	0	0.2	0
722273	22.2	511	22.2	12.2	34.2	34.2	586.9	12890	0	0.4	0
722304	22	312	22	12.2	34	34	584.3	12720	0	0	0
722334	22.2	468	22.2	12.2	33.6	33.6	585.7	12490	0	0	0
722365	22.1	290	22.1	12.3	33	33	584.4	12140	0	0	0
722395	22.5	543	22.5	12.3	33.1	33.1	586	12230	0	0	0

722425	22.5	548	22.5	12.3	33.3	33.3	585.8	12300	0	0	0
722456	22.4	540	22.4	12.3	33.5	33.5	584.8	12410	0	0.1	0
722486	22.2	544	22.2	12.3	33.5	33.5	586.1	12440	0	0.1	0
723790	24.6	523	24.6	12.4	33.3	33.4	13.92	292.3	0	0.004601	0
726762	25.2	634	25.2	20.7	29.7	29.75	0	0	0	0.2318	0
729006	27.2	631	27.2	24.5	31.5	31.55	0	0	0	0.09643	0
729128	27.5	487	27.5	19.1	38.5	38.49	111.9	2192	0	0.07541	0
729158	27.9	475	27.9	18.7	38.1	38.1	534.6	10290	0	0.5	0
729188	27.3	455	27.3	18.5	37.9	37.9	589.9	11460	0	0.2	0
729219	27	431	27	14.6	37.9	37.9	584.8	13620	0	0	0
729249	27.3	393	27.3	13.6	37.5	37.5	587.1	14080	0	0.8	0
729280	27.2	361	27.2	13.3	36.8	36.8	584.6	13710	0	0	0
729310	26.6	339	26.6	13.2	37.9	37.9	586.7	14480	0	0.2	0
729340	26.4	324	26.4	13.2	38	38	586	14530	0	0	0
729371	26.2	313	26.2	13.1	36.9	36.9	585.7	13930	0	0	0
729401	26.2	297	26.2	13.1	36.8	36.8	586.7	13910	0	0.4	0
729431	25.7	281	25.7	13.1	36.1	36.1	585.6	13480	0	0.3	0
729462	25.6	269	25.6	13.1	35.4	35.4	587.3	13100	0	0.8	0
729492	25.9	259	25.9	13.1	35.2	35.2	586	12950	0	0.4	0
729522	25.8	254	25.8	13.1	35.9	35.9	588.5	13380	0	0	0
729553	26.1	251	26.1	13.2	35.9	35.8	586.9	13320	0	0	0
729583	26.5	248	26.5	13.2	35.8	35.8	585	13240	0	0.1	0
729613	26.1	248	26.1	13.2	35.7	35.7	587.3	13190	0	0.4	0
731373	26.1	297	26.1	13.3	35.6	35.6	10.31	230.2	0	0.05011	0
732616	26.1	588	26.1	21.1	31.2	31.22	0	0	0	0.07056	0
732738	27.9	773	27.9	17.4	35.9	35.88	112	2084	0	0.09836	0
732768	27.7	801	27.7	17.6	35.6	35.6	534.9	9500	0	0	0
732799	27.3	834	27.3	18.4	35.4	35.4	586.5	9985	0	0.2	0
732829	26.8	857	26.8	15.3	35.5	35.5	585.8	11850	0	0.4	0
732859	26.5	789	26.5	14.4	35.1	35.1	583.6	12090	0	0	0
732890	27.2	718	27.2	14.2	34.8	34.8	585.6	12070	0	0	0
732920	28	700	28	14.1	35.3	35.3	585.2	12420	0	0	0
732950	28.7	789	28.7	14.1	35.7	35.7	586.7	12670	0	0	0
732981	28.2	706	28.2	14.1	35	35	585.2	12240	0	0	0
733011	27.2	647	27.2	14.1	34.8	34.7	587.6	12160	0	0	0
733042	27.5	645	27.5	14.1	34.5	34.5	586.7	12020	0	0	0
733072	27.9	626	27.9	14.1	34	34	584.3	11640	0	0	0
733102	28	664	28	14.1	33.6	33.6	586.4	11420	0	0.8	0
733133	27.9	755	27.9	14.1	34.1	34.1	585.4	11700	0	0	0
733163	27.4	772	27.4	14.1	34.2	34.2	585.5	11720	0	0	0
733193	27.1	760	27.1	14.2	34.1	34.1	585.7	11670	0	0	0
733224	27.3	754	27.3	14.2	34.2	34.2	586.4	11710	0	0	0
734164	28	923	28	14.2	33.9	33.9	18.69	368.5	0	0.1448	0
736226	28.1	465	28.1	22.4	34.9	34.91	0	0	0	0.1779	0
736347	28.8	259	28.8	18.2	37.1	37.13	112	2130	0	0.1256	0
736378	28.8	271	28.8	18.3	36.5	36.5	531.6	9543	0	0	0
736408	28.3	264	28.3	19.2	36.4	36.4	584.7	10030	0	0	0
736438	28.2	262	28.2	16.1	36.4	36.4	585.5	11880	0	0	0
736469	28.7	268	28.7	15.2	35.8	35.8	583.9	12020	0	0	0
736499	28.8	283	28.8	15	35.3	35.3	586.4	11900	0	0	0
736530	28.2	319	28.2	14.9	36.1	36.1	583.5	12380	0	0	0
736560	28.5	592	28.5	14.8	36.4	36.4	587.1	12630	0	0	0
736590	28.1	615	28.1	14.8	35.3	35.3	584.5	11940	0	0	0
736621	29.3	904	29.3	14.8	34.9	34.9	587.5	11810	0	0	0
736651	29.6	749	29.6	14.8	34.4	34.4	584.9	11450	0	0	0
736681	30.1	446	30.1	14.9	33.7	33.7	585.2	11010	0	0	0
736712	29.9	508	29.9	14.9	33.4	33.3	586.4	10810	0	0	0
736742	29.8	471	29.8	14.9	34	34	585.7	11170	0	0	0
736772	30.2	599	30.2	15	33.8	33.8	586.6	11070	0	0	0
736803	30	563	30	15	33.7	33.7	584.6	10950	0	0	0
736833	29.3	494	29.3	15	33.7	33.7	587.1	10970	0	0	0
738925	28.2	211	28.2	15.1	33.3	33.3	8.416	153.2	0	0.04355	0
741624	28.3	384	28.3	25	32.1	32.1	0	0	0	0.03942	0

743474	29.4	719	29.4	27.2	32.7	32.74	0	0	0	0.5105	0
743595	29.4	407	29.4	21.4	37.3	37.3	112.2	1800	0	0.4248	0
743625	29	619	29	20.8	36.7	36.8	530.4	8341	0	0.3	0
743656	28.9	451	28.9	20.5	36.6	36.6	584.5	9389	0	0.3	0
743686	29	469	29	16.5	36.5	36.5	583.4	11640	0	1.3	0
743717	29.1	451	29.1	15.4	36.2	36.2	584.4	12140	0	1.4	0
743747	29	609	29	15.2	35.2	35.2	585.7	11720	0	0.9	0
743777	28.9	979	28.9	15	36.1	36.1	584.1	12270	0	0	0
743808	29	812	29	15	36.9	36.9	583.9	12820	0	0	0
743838	29.5	1010	29.5	14.9	36	36	582.9	12290	0	1	0
743868	29.9	1010	29.9	14.9	35.1	35.2	583.8	11800	0	1.6	0
743899	29.8	1030	29.8	14.9	35	35	585	11720	0	2.3	0
743929	29.8	997	29.8	14.9	34.2	34.2	582.9	11250	0	1.7	0
743959	29.7	719	29.7	14.9	33.7	33.7	585.4	10990	0	0.6	0
743990	29.6	378	29.6	15	33.8	33.8	584.5	11030	0	1	0
744020	29.4	350	29.4	15	34.3	34.3	584.2	11290	0	0.6	0
744050	29.1	326	29.1	15	34.3	34.3	584.8	11310	0	0.3	0
744081	28.9	299	28.9	15	34.5	34.5	582.8	11370	0	0.5	0
745507	28.5	468	28.5	15.1	34.4	34.4	12.32	237.1	0	0.6095	0
748205	29.4	733	29.4	27.3	33.4	33.35	0	0	0	0.8586	0
752118	27.8	337	27.8	30.1	32.9	32.9	0	0	0	0.5109	0
754241	27.5	352	27.5	30	32.6	32.61	0	0	0	0.4341	0
754362	27.3	317	27.3	23	38.6	38.58	134.5	2117	0	0.2983	0
754393	27.2	359	27.2	23.2	38.6	38.6	624.8	9520	0	0.4	0
754423	27.4	354	27.4	23.9	38.3	38.3	696	10060	0	0	0
754453	27.5	310	27.5	23.9	38.4	38.4	704.3	10190	0	0	0
754484	27.5	314	27.5	23.5	38.2	38.2	710.9	10410	0	0.8	0
754514	27.5	348	27.5	22.7	37.4	37.4	714.5	10520	0	0.2	0
754544	27.5	350	27.5	21.4	38	38	715	11830	0	0	0
754575	27.6	347	27.6	20.2	38.1	38.2	719.4	12880	0	0.2	0
754605	27.5	344	27.5	19.4	38.2	38.2	720.9	13510	0	0.1	0
754635	27.4	339	27.4	18.9	37.6	37.7	717.6	13440	0	0	0
754666	27.4	338	27.4	18.6	37.5	37.5	721.9	13610	0	0	0
754696	27.5	338	27.5	18.5	37.5	37.5	719.4	13680	0	0	0
754726	27.4	337	27.4	18.4	37.2	37.2	721.8	13620	0	0	0
754757	27.5	330	27.5	18.3	36.6	36.6	727	13310	0	0	0
754787	27.5	329	27.5	18.3	36.5	36.5	724.1	13180	0	0.8	0
754817	27.3	326	27.3	18.2	36.7	36.7	723.5	13330	0	0.4	0
754848	27.3	322	27.3	18.2	36.4	36.4	724.6	13140	0	0.3	0
754878	27.4	318	27.4	18.2	36.2	36.2	725.1	13020	0	0.1	0
754909	27.4	315	27.4	18.2	35.9	35.9	723.2	12800	0	0.1	0
754939	27.3	309	27.3	18.2	35.8	35.7	719.6	12620	0	0.5	0
754969	27.3	307	27.3	18.2	35.9	35.9	732.4	12990	0	0	0
754999	27.2	305	27.2	18.1	35.9	35.9	730.9	12970	0	0.5	0
755030	27.2	302	27.2	18	35.7	35.7	726	12820	0	0.3	0
755060	27.1	298	27.1	17.9	35.7	35.7	734.3	13030	0	0	0
755090	27.3	283	27.3	17.8	35.5	35.5	733.9	12980	0	0	0
755121	27.3	229	27.3	17.6	35.2	35.2	730.6	12880	0	0	0
755151	27.2	280	27.2	17.4	35.1	35.1	734.2	12940	0	0.4	0
755182	27.2	279	27.2	17.2	34.9	34.9	729.3	12890	0	0.8	0
755212	27.1	278	27.1	17	34.8	34.8	733.6	13020	0	0	0
755242	27.2	276	27.2	16.9	34.5	34.5	731.2	12920	0	0.3	0
755273	27.2	275	27.2	16.7	34.5	34.6	731.9	13070	0	0.5	0
755303	27.2	272	27.2	16.6	34.3	34.3	731.5	12950	0	0	0
755333	27.3	270	27.3	16.4	33.8	33.8	731.4	12730	0	0	0
755364	27.2	268	27.2	16.4	33.8	33.8	731.4	12790	0	0.2	0
755394	27.3	265	27.3	16.3	33.4	33.4	732.8	12560	0	0.1	0
755424	27.1	260	27.1	16.2	33.2	33.2	730.9	12450	0	0.3	0
755455	27.1	255	27.1	16.1	32.8	32.8	729.8	12190	0	0.1	0
755485	27.3	251	27.3	16	32.8	32.7	729.7	12180	0	0.2	0
755515	27.2	248	27.2	16	32.3	32.3	737.4	12040	0	0.5	0
755546	27.2	247	27.2	15.9	31.8	31.8	733.3	11660	0	0.9	0
755576	27.2	246	27.2	15.8	31.8	31.8	732.6	11710	0	0.1	0

755606	27.4	245	27.4	15.7	31.2	31.2	734.3	11350	0	0	0
755637	27.4	246	27.4	15.7	30.8	30.8	732.7	11070	0	0.1	0
755667	27.3	246	27.3	15.6	30.4	30.4	730.4	10820	0	1	0
755698	27.1	242	27.1	15.5	30.1	30.1	732.6	10700	0	0	0
755728	27.2	245	27.2	15.4	29.8	29.8	729.6	10490	0	0	0
755758	27.2	243	27.2	15.3	29.1	29.1	733	10080	0	0.5	0
755789	27.2	241	27.2	15.3	28.6	28.6	735.9	9783	0	0.1	0
755819	27.2	239	27.2	15.2	28.1	28.1	733.5	9458	0	0	0
755849	27.3	238	27.3	15.1	27.9	27.9	732.9	9377	0	0.3	0
755880	27	235	27	15.1	27.5	27.5	736.3	9193	0	0.5	0
755910	27.1	232	27.1	15	27.3	27.3	730.4	8978	0	0.1	0
755940	27.2	230	27.2	14.9	26.4	26.4	734	8450	0	0	0
755971	27.5	232	27.5	14.9	26.2	26.2	731.9	8262	0	0	0
756001	27.5	236	27.5	14.8	26.2	26.2	716.8	8173	0	0	0
756031	27.6	238	27.6	14.8	26	26	703.2	7887	0	0.3	0
756062	27.4	238	27.4	14.7	25.2	25.2	725	7637	0	0	0
756092	27.3	237	27.3	14.7	24.9	24.9	730	7473	0	0	0
756122	27.5	207	27.5	14.6	24.8	24.8	725	7377	0	0	0
756153	27.5	200	27.5	14.6	24.3	24.3	728.4	7119	0	0.4	0
756183	27.4	218	27.4	14.5	23.9	23.9	727.5	6841	0	0.9	0
756214	27.1	213	27.1	14.5	23.6	23.6	725	6620	0	0	0
756244	27.1	200	27.1	14.4	23.3	23.3	729.5	6491	0	0	0
756274	27.1	171	27.1	14.4	23.1	23	726	6295	0	1.1	0
756305	27	198	27	14.3	22.9	22.9	727	6235	0	0.4	0
756335	27.1	199	27.1	14.3	22.8	22.8	725.5	6155	0	0.2	0
756365	27	196	27	14.2	22.6	22.6	725.5	6052	0	0.1	0
756395	26.8	192	26.8	14.2	22.4	22.4	722.2	5943	0	0.1	0
756426	26.9	191	26.9	14.2	22.1	22.1	727.4	5777	0	0.7	0
756456	26.9	155	26.9	14.1	21.8	21.8	721.9	5539	0	0.6	0
756487	26.8	185	26.8	14.1	21.5	21.5	720.1	5296	0	1	0
756517	26.7	185	26.7	14.1	21.3	21.3	722	5189	0	0.1	0
756547	26.8	186	26.8	14	21	21	719.7	5013	0	0.8	0
756578	26.9	180	26.9	14	20.7	20.7	720.7	4843	0	0	0
756608	26.8	183	26.8	14	20.6	20.6	730.2	4835	0	0	0
756638	26.5	138	26.5	13.9	20.5	20.5	727.6	4773	0	0	0
756668	26.8	179	26.8	13.9	20.6	20.6	731.7	4909	0	0.4	0
756699	26.9	184	26.9	13.9	20.3	20.3	736.2	4733	0	0.2	0
756729	26.7	184	26.7	13.8	20	20	731.2	4498	0	0.8	0
756760	26.8	183	26.8	13.8	19.8	19.8	730.3	4390	0	0.2	0
756790	26.9	181	26.9	13.8	19.8	19.8	734.2	4399	0	0	0
756821	26.9	179	26.9	13.8	19.5	19.5	729.6	4151	0	0.1	0
756851	26.9	176	26.9	13.8	19.2	19.2	736.3	4038	0	0	0
756882	26.8	173	26.8	13.7	19.2	19.2	734.6	3979	0	0	0
756912	26.8	170	26.8	13.7	19.1	19.1	733.5	3937	0	0	0
756943	26.9	166	26.9	13.7	18.9	18.9	728.9	3765	0	0	0

\End SDHWPRE 2.6 Jun 97 @Copyright InSitu

QRR2STO4.D3

* All integral/mean values (except for time) exclude the skip time
* Integral time [d] 3.043
* Skipped time [d] 0.250
* Integral load [MJ] 37.415
* Mean load [W] 142.313
* Integral load (CRL*DT) [MJ] 37.361
* Integral load capacitance [MJ/K] 2.762
* Integral load volume [l] 659.284
* Mean load volume [l/d] 216.665
* Mean load capacitance [W/K] 10.507
* Mean cold water temperature [$^{\circ}$ C] 14.986
* Mean load temp. difference [K] 13.544
* Integral auxiliary energy [MJ] 0.000
* Integral solar irradiance [MJ/m ²] 30.553
* Mean solar irradiance [W/m ²] 116.213

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* Mean collector ambient temperature      [°C]    10.831
* Mean store ambient temperature        [°C]    16.730
* Mean wind speed                      [m/s]   0.048
\DataMode,Mean
\Skip,21600
\Value,DaySum,           1
\Value,Declination,     21.82564
\DefineChannel,Time,1[s],Sample,'time'
\DefineChannel,Tca,1[°C],Mean,'collector ambient temperature'
\DefineChannel,Ictot,1[W/m²],Mean,'hemispherical irradiance in collector plane'
\DefineChannel,Tsa,1[°C],Mean,'store ambient temperature'
\DefineChannel,Tcw,1[°C],Mean,'cold water temperature'
\DefineChannel,Ts,1[°C],Mean,'hot water temperature'
\DefineChannel,Tl,1[°C],Mean,'hot water temperature'
\DefineChannel,C1,1[W/K],Mean,'load capacitance rate'
\DefineChannel,Pnet,1[W],Mean,'net system power'
\DefineChannel,Paux,1[W],Mean,'auxiliary heater thermal power'
\DefineChannel,wc,1[m/s],Mean,'air velocity in collector plane'
\DefineChannel,Pcp,1[W],Mean,'collector loop pump power'
\UseChannels,Time,Tca,Ictot,Tsa,Tcw,Ts,Tl,C1,Pnet,Paux,wc,Pcp
*Time Tca Ictot Tsa Tcw Ts Tl C1 Pnet Paux wc Pcp
\TimeStep,1
\DefineChannel,Time,1[s],Sample,'time'
\DefineChannel,T_ca,[°C],Mean,'collector ambient temperature'
\DefineChannel,Gt_e,[W/m²],Mean,'irradiance on collector plane times Kac'
\DefineChannel,T_sa,[°C],Mean,'store ambient temperature'
\DefineChannel,T_cw,[°C],Mean,'cold water temperature'
\DefineChannel,T_S,[°C],Mean,'store outlet temperature'
\DefineChannel,T_L,[°C],Mean,'temperature delivered to the user'
\DefineChannel,dC_S,[W/K],Mean,'load capacitance rate through the store'
\DefineChannel,P_net,[W],Mean,'net system power (delivered minus aux)'
\DefineChannel,P_aux,[W],Mean,'auxiliary power'
\DefineChannel,v_wind,[m/s],Mean,'wind velocity in collector plane'
\DefineChannel,P_cp,[W],Mean,'collector pump power'
\UseChannels,Time,T_ca,Gt_e,T_sa,T_cw,T_S,T_L,dC_S,P_net,P_aux,v_wind,P_cp
*Time T_ca Gt_e T_sa T_cw T_S T_L dC_S P_net P_aux
v_wind P_cp
0
32 11.8 0 11.8 19.5 34.5 34.5 635.7 11050 0 0 0
67 11.9 0 11.9 18.5 36 36 777.8 13580 0 0 0
97 11.8 0 11.8 20.1 36 36 776.4 12320 0 0 0
127 11.7 0 11.7 19.8 36 36 775.2 12550 0 0 0
157 11.7 0 11.7 19.3 35.7 35.7 774.6 12710 0 0 0
191 11.8 0 11.8 18.7 35.6 35.6 773.8 13150 0 0 0
226 11.8 0 11.8 18 35.8 35.8 776.4 13800 0 0 0
260 11.7 0 11.7 17.6 35.8 35.8 774.6 14100 0 0 0
294 11.8 0 11.8 17.4 35.7 35.7 773 14190 0 0 0
324 11.7 0 11.7 17.3 35.8 35.8 775 14370 0 0 0
359 11.8 0 11.8 17.2 35.9 35.9 774.2 14470 0 0 0
393 11.9 0 11.9 17.2 35.9 35.9 774.7 14480 0 0 0
423 11.7 0 11.7 17.2 35.8 35.8 774.5 14390 0 0 0
458 11.6 0 11.6 17.3 35.7 35.7 774.7 14260 0 0 0
488 11.5 0 11.5 17.4 35.6 35.6 775.8 14130 0 0 0
522 11.5 0 11.5 17.5 35.5 35.5 774 13960 0 0 0
556 11.4 0 11.4 17.5 35.4 35.4 774.4 13830 0 0 0
591 11.5 0 11.5 17.5 35.3 35.3 780.8 13850 0 0 0
625 11.6 0 11.6 17.5 35.2 35.2 771.4 13610 0 0 0
655 11.6 0 11.6 17.5 35.1 35.1 772.9 13620 0 0 0
690 11.5 0 11.5 17.4 35.1 35.1 777.2 13710 0 0 0
724 11.5 0 11.5 17.3 35 35 772.1 13640 0 0 0
758 11.5 0 11.5 17.1 34.9 34.9 777.4 13800 0 0 0
793 11.5 0 11.5 17 34.8 34.8 775.3 13840 0 0 0

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827	11.6	0	11.6	16.8	34.7	34.7	774.4	13870	0	0	0
861	11.5	0	11.5	16.7	34.6	34.6	776.9	13900	0	0	0
896	11.5	0	11.5	16.6	34.3	34.3	773.9	13750	0	0	0
930	11.5	0	11.5	16.4	34	34	778.4	13670	0	0	0
960	11.6	0	11.6	16.3	33.7	33.7	775.2	13460	0	0	0
995	11.5	0	11.5	16.3	33.3	33.3	776.1	13210	0	0	0
1029	11.4	0	11.4	16.2	32.7	32.7	776.9	12840	0	0	0
1063	11.4	0	11.4	16.1	32.4	32.4	777.8	12730	0	0	0
1098	11.4	0	11.4	16	31.8	31.8	778	12330	0	0	0
1132	11.4	0	11.4	15.9	31.4	31.4	776.5	12060	0	0	0
1162	11.5	0	11.5	15.8	30.7	30.7	778.8	11590	0	0	0
1196	11.5	0	11.5	15.8	30.3	30.3	777.4	11260	0	0	0
1226	11.6	0	11.6	15.7	29.4	29.4	777.8	10680	0	0	0
1261	11.5	0	11.5	15.7	28.5	28.5	779	9993	0	0	0
1295	11.5	0	11.5	15.6	28.3	28.3	776.6	9854	0	0	0
1325	11.4	0	11.4	15.5	27.6	27.6	774.6	9348	0	0	0
1355	11.4	0	11.4	15.4	27.2	27.2	775.4	9140	0	0	0
1390	11.5	0	11.5	15.4	26.6	26.6	775.1	8715	0	0	0
1424	11.4	0	11.4	15.3	26	26	769.2	8189	0	0	0
1458	11.5	0	11.5	15.3	25.4	25.4	776.4	7853	0	0	0
1493	11.4	0	11.4	15.2	24.9	24.9	776.6	7537	0	0	0
1523	11.4	0	11.4	15.1	24.3	24.3	770.9	7058	0	0	0
1557	11.3	0	11.3	15.1	24.1	24.1	775	7028	0	0	0
1592	11.5	0	11.5	15	23.5	23.6	773.5	6601	0	0	0
1622	11.6	0	11.6	15	23.5	23.5	771.9	6603	0	0	0
1656	11.4	0	11.4	14.9	23.3	23.3	775.7	6496	0	0	0
1686	11.4	0	11.4	14.9	22.7	22.7	772.3	6066	0	0	0
1721	11.4	0	11.4	14.8	22.3	22.2	774.8	5737	0	0	0
1755	11.5	0	11.5	14.8	22	22	776.4	5590	0	0	0
1789	11.5	0	11.5	14.8	21.9	21.8	773.8	5481	0	0	0
1824	11.5	0	11.5	14.7	21.8	21.8	776.9	5470	0	0	0
1854	11.5	0	11.5	14.7	21.3	21.3	776.4	5120	0	0	0
1888	11.5	0	11.5	14.6	20.8	20.8	774.6	4771	0	0	0
1918	11.5	0	11.5	14.6	20.7	20.7	776.6	4704	0	0	0
1953	11.4	0	11.4	14.6	20.6	20.6	774.3	4660	0	0	0
1987	11.5	0	11.5	14.5	20.4	20.4	772.7	4535	0	0	0
2017	11.5	0	11.5	14.5	20.3	20.3	774.8	4455	0	0	0
2051	11.5	0	11.5	14.5	19.8	19.8	773.3	4134	0	0	0
2081	11.5	0	11.5	14.4	19.5	19.5	773.9	3912	0	0	0
2116	11.5	0	11.5	14.4	19.5	19.5	773.3	3922	0	0	0
2146	11.4	0	11.4	14.4	19.3	19.3	773.6	3783	0	0	0
2176	11.3	0	11.3	14.4	19	19	769.2	3575	0	0	0
2206	11.4	0	11.4	14.4	19	19	775.4	3598	0	0	0
2236	11.4	0	11.4	14.3	18.9	18.9	775.5	3577	0	0	0
2270	11.4	0	11.4	14.3	18.7	18.7	769.9	3397	0	0	0
2305	11.5	0	11.5	14.3	18.8	18.8	772.3	3475	0	0	0
2339	11.3	0	11.3	14.3	18.5	18.5	773	3294	0	0	0
2374	11.3	0	11.3	14.3	18.3	18.3	770.5	3152	0	0	0
2404	11.3	0	11.3	14.2	18.2	18.2	770.4	3065	0	0	0
2434	11.6	0	11.6	14.2	18.1	18.1	774	3015	0	0	0
2468	11.4	0	11.4	14.2	18	18	774.5	2948	0	0	0
2502	11.3	0	11.3	14.2	17.9	17.9	772.7	2873	0	0	0
2533	11.4	0	11.4	14.2	17.8	17.8	772.2	2792	0	0	0
2567	11.3	0	11.3	14.1	17.7	17.7	773.5	2755	0	0	0
2601	11.4	0	11.4	14.1	17.7	17.7	770.6	2726	0	0	0
2636	11.4	0	11.4	14.1	17.5	17.5	773.2	2596	0	0	0
2670	11.4	0	11.4	14.1	17.4	17.4	773.7	2541	0	0	0
2700	11.4	0	11.4	14.1	17.2	17.2	772.1	2415	0	0	0
2730	11.3	0	11.3	14.1	17.1	17.1	773.9	2358	0	0.2	0
2760	11.2	0	11.2	14.1	17	17	772.1	2263	0	0	0
2795	11.2	0	11.2	14	16.9	16.9	774.3	2226	0	0	0
2825	11.2	0	11.2	14	16.9	16.9	775.4	2242	0	0	0
2859	11.3	0	11.3	14	16.9	16.9	773.4	2252	0	0	0

2893	11.3	0	11.3	14	16.8	16.8	772.9	2155	0	0	0
2928	11.4	0	11.4	14	16.6	16.6	775.3	2056	0	0	0
2958	11.4	0	11.4	14	16.6	16.6	775.6	2010	0	0	0
2988	11.3	0	11.3	14	16.5	16.5	773.8	1946	0	0	0
3022	11.3	0	11.3	13.9	16.5	16.5	772.1	1949	0	0	0
3052	11.3	0	11.3	13.9	16.4	16.4	776.3	1883	0	0	0
3082	11.4	0	11.4	13.9	16.3	16.3	773	1791	0	0	0
3117	11.4	0	11.4	13.9	16.2	16.2	771.8	1763	0	0	0
3147	11.3	0	11.3	13.9	16.2	16.2	774.4	1760	0	0	0
3181	11.3	0	11.3	13.9	16.1	16.1	772.7	1730	0	0	0
3216	11.2	0	11.2	13.9	16.1	16.1	774	1675	0	0.1	0
3250	11.3	0	11.3	13.9	16	16	774.1	1619	0	0	0
3284	11.3	0	11.3	13.9	15.9	15.9	771.7	1576	0	0	0
3319	11.3	0	11.3	13.9	15.8	15.9	771.9	1535	0	0	0
3353	11.3	0	11.3	13.8	15.8	15.8	772.6	1514	0	0	0
3387	11.4	0	11.4	13.8	15.7	15.7	770.4	1464	0	0	0
3422	11.4	0	11.4	13.8	15.7	15.7	769.9	1412	0	0	0
3456	11.3	0	11.3	13.8	15.7	15.7	777.5	1421	0	0	0
3490	11.3	0	11.3	13.8	15.6	15.6	773	1385	0	0	0
3525	11.2	0	11.2	13.8	15.5	15.5	770.7	1335	0	0	0
3559	11.2	0	11.2	13.8	15.5	15.5	774.1	1340	0	0	0
3593	11.2	0	11.2	13.8	15.5	15.5	771.5	1351	0	0	0
3628	11.3	0	11.3	13.8	15.5	15.5	774.6	1308	0	0	0
3658	11.2	0	11.2	13.8	15.4	15.4	772.7	1234	0	0	0
3692	11.2	0	11.2	13.8	15.3	15.3	772.2	1173	0	0	0
3722	11.2	0	11.2	13.8	15.2	15.2	772.7	1140	0	0	0
3757	11.3	0	11.3	13.7	15.2	15.2	772.6	1108	0	0	0
3787	11.2	0	11.2	13.7	15.2	15.2	773.4	1098	0	0	0
3817	11.2	0	11.2	13.7	15.1	15.1	773.8	1079	0	0.3	0
3851	11.1	0	11.1	13.7	15.1	15.1	773.3	1068	0	0	0
3881	11.2	0	11.2	13.7	15.1	15.1	774.4	1036	0	0	0
3916	11.2	0	11.2	13.7	15.1	15.1	773.7	1041	0	0	0
3950	11.2	0	11.2	13.7	15.1	15.1	773.3	1056	0	0	0
3980	11.2	0	11.2	13.7	15	15	774.2	1023	0	0.1	0
4015	11.2	0	11.2	13.7	15	15	775.1	1041	0	0	0
4045	11.2	0	11.2	13.7	15	15	773.9	1022	0	0	0
4079	11.2	0	11.2	13.7	15	15	773.7	1002	0	0	0
4114	11.2	0	11.2	13.7	14.9	14.9	774.1	952	0	0	0
4144	11.3	0	11.3	13.7	14.8	14.8	773.7	893	0	0	0
4178	11.2	0	11.2	13.7	14.8	14.8	772.3	881	0	0	0
4212	11.2	0	11.2	13.7	14.8	14.8	773.6	875	0	0	0
4242	11.2	0	11.2	13.7	14.8	14.8	776.2	865	0	0	0
4273	11.2	0	11.2	13.7	14.7	14.7	771	827	0	0	0
4303	11.2	0	11.2	13.6	14.6	14.6	770.1	765	0	0	0
4337	11.2	0	11.2	13.6	14.6	14.6	773.1	773	0	0	0
4367	11.2	0	11.2	13.6	14.6	14.6	769.4	765	0	0	0
4401	11.3	0	11.3	13.6	14.6	14.6	774.9	758	0	0	0
4436	11.3	0	11.3	13.6	14.6	14.6	773.8	786	0	0.1	0
4466	11.2	0	11.2	13.6	14.6	14.6	768.4	787	0	0	0
4496	11.2	0	11.2	13.6	14.6	14.6	772.9	758	0	0	0
4526	11.2	0	11.2	13.6	14.6	14.6	772.5	738	0	0	0
4556	11.2	0	11.2	13.6	14.5	14.5	772.3	722	0	0	0
4591	11.2	0	11.2	13.6	14.5	14.5	772.2	710	0	0	0
4621	11.2	0	11.2	13.6	14.5	14.5	772.6	706	0	0	0
4655	11.2	0	11.2	13.6	14.5	14.5	771.4	676	0	0	0
4685	11.3	0	11.3	13.6	14.4	14.5	772	668	0	0	0
4715	11.4	0	11.4	13.6	14.4	14.4	772.3	657	0	0	0
4750	11.2	0	11.2	13.6	14.4	14.4	772	673	0	0.1	0
4780	11.2	0	11.2	13.6	14.4	14.4	770.8	666	0	0	0
4814	11.2	0	11.2	13.6	14.4	14.4	772.2	659	0	0	0
4849	11.2	0	11.2	13.6	14.4	14.4	772.5	643	0	0	0
6604	11.2	0	11.2	13.6	14.3	14.4	13.21	10.46	0	0.007066	0
14496	11	0	11	12.2	11.4	11.42	0	0	0	0.00778	0

22089	10.9	19.5	10.9	11.9	11	10.97	0	0	0	0.004122	0
28291	12.6	108	12.6	12.4	11.9	11.89	0	0	0	0.01769	0
30650	14	212	14	13.9	13.9	13.87	0	0	0	0.0476	0
30930	14.2	204	14.2	18.1	16.9	16.85	75.36	-94.93	0	0.01071	0
34600	14.3	227	14.3	16.7	15.9	15.9	0	0	0	0.06842	0
37850	15.8	372	15.8	16.6	17.4	17.37	0	0	0	0.2031	0
38130	16	368	16	18.6	23	23.04	75.63	343	0	0.03214	0
40571	16.3	594	16.3	18.2	20.5	20.52	0	0	0	0.3215	0
42858	18.6	928	18.6	19.6	22.3	22.29	0	0	0	0.2161	0
45094	17.9	443	17.9	22.1	25.4	25.39	0	0	0	0.09114	0
45378	15.4	163	15.4	19.7	34.7	34.7	75.69	1149	0	0.1063	0
49724	15.3	241	15.3	21.2	26.9	26.92	0	0	0	0.04093	0
52307	16.4	452	16.4	22.6	24.5	24.53	0	0	0	0.1315	0
52561	17.2	313	17.2	19.5	34.5	34.47	85.59	1299	0	0.05984	0
58279	15.1	149	15.1	22.8	25.5	25.5	0	0	0	0.05637	0
59530	13.6	98.4	13.6	21.6	21.1	21.08	0	0	0	0.01103	0
59784	13.7	93.3	13.7	19	33.4	33.4	85.17	1242	0	0	0
65385	14.9	158	14.9	22.9	25.4	25.39	0	0	0	0.001714	0
72868	14.5	25.2	14.5	24.4	22.8	22.8	0	0	0	0.005239	0
80761	13.4	0	13.4	23.5	20.9	20.91	0	0	0	0	0
88650	12.7	0	12.7	23.2	20.4	20.39	0	0	0	0	0
96550	12.3	0	12.3	23	20	20.03	0	0	0	0	0
104426	11.8	0.188	11.8	22.8	19.8	19.82	0	0	0	0	0
111628	12.1	40.1	12.1	22.3	19.1	19.11	0	0	0	0	0
116785	14.8	206	14.8	22.6	20.2	20.17	0	0	0	0.01805	0
117069	17.7	376	17.7	18.7	28.9	28.9	10.11	117.9	0	0.04401	0
117323	17.7	409	17.7	18.6	31	31	73.78	917.4	0	0	0
120895	18.1	457	18.1	23.2	26	25.97	0	0	0	0.03127	0
123744	19.7	671	19.7	26.1	26.8	26.79	0	0	0	0.02131	0
124251	20.2	632	20.2	27.4	28.5	28.48	0	0	0	0.0572	0
124535	20	573	20	20	40.6	40.65	75.51	1584	0	0.01056	0
127771	19.7	528	19.7	27.2	34.7	34.68	0	0	0	0.01721	0
130342	19.5	575	19.5	31.2	33.5	33.54	0	0	0	0.01447	0
131438	20.3	698	20.3	32.8	34.5	34.53	0	0	0	0.01223	0
131718	20.4	685	20.4	21.6	46.5	46.52	77.25	1946	0	0	0
134289	20.8	771	20.8	32.2	41.8	41.79	0	0	0	0.01536	0
136756	20.6	494	20.6	36.7	38.9	38.9	0	0	0	0.0321	0
138647	21.4	609	21.4	38.7	39.5	39.5	0	0	0	0.05272	0
138927	21.5	348	21.5	23.1	52.1	52.09	79.39	2325	0	0.01107	0
143226	20.6	318	20.6	38	43.2	43.19	0	0	0	0.003861	0
145895	20.9	291	20.9	40	38.3	38.29	0	0	0	0.08112	0
146153	20.7	258	20.7	21.2	51.1	51.14	85.95	2613	0	0.1326	0
151445	20.3	189	20.3	37.9	38.6	38.58	0	0	0	0.1301	0
158268	19.2	63	19.2	39.2	34.9	34.86	0	0	0	0.06823	0
166191	17.5	0.0748	17.5	38.3	33.6	33.61	0	0	0	0.0219	0
174092	16.5	0	16.5	37.6	32.9	32.94	0	0	0	0.01874	0
181980	16.2	0	16.2	37.3	32.7	32.67	0	0	0	0.0204	0
189868	16	0	16	36.8	32.1	32.06	0	0	0	0.1019	0
197619	15.5	11.7	15.5	35.7	30.3	30.27	0	0	0	0.09791	0
204925	6.86	35.5	16.6	35.5	30.4	30.43	0	0	0	0.1254	0
212918	0	0	18.8	35.7	31.5	31.53	0	0	0	0.0858	0
220899	0	0	18.9	35.5	31.2	31.21	0	0	0	0.0875	0
228894	0	0	21.1	35.9	32.5	32.51	0	0	0	0.1332	0
236881	0	0	20.8	35.4	31.6	31.59	0	0	0	0.1335	0
244826	0	0	19.6	34.9	30.8	30.77	0	0	0	0.03318	0
252722	0	0	18.3	34.2	29.6	29.65	0	0	0	0.01249	0
260610	0	0	17.6	33.9	29.6	29.58	0	0	0	0.001521	0
268503	0	0	16.9	33.6	29.6	29.6	0	0	0	0.001571	0
276490	0	0	15.7	32.6	27.6	27.59	0	0	0	0.001565	0
280872	0	0	16.3	31.5	27.3	27.31	0	0	0	6.846E-4	0
281031	0	0	18.3	20.5	40.8	40.83	135.6	2814	0	0	0
281061	0	0	18.7	21.7	41.3	41.3	606.1	11870	0	0	0
281096	0	0	18.6	21.7	41.3	41.3	695.6	13590	0	0.1	0

281126	0	0	18.4	21.3	41.2	41.2	705.6	14060	0	0	0
281160	0	0	18.8	20.6	41.2	41.2	703.7	14480	0	0	0
281194	0	0	18.7	19.8	41.2	41.2	707.1	15150	0	0	0
281224	0	0	19.1	19.1	41.2	41.2	712.7	15740	0	0	0
281259	0	0	18.8	18.6	41.2	41.2	708.5	15990	0	0	0
281293	0	0	19	18.2	41.1	41.1	716.7	16460	0	0	0
281323	0	0	18.7	17.8	41.2	41.2	714	16670	0	0.1	0
281358	0	0	18.7	17.6	41.2	41.2	712.6	16820	0	0	0
281388	0	0	18.9	17.4	41.2	41.2	713.8	17000	0	0.1	0
281418	0	0	18.9	17.3	41.2	41.2	699.2	16750	0	0	0
281452	0	0	18.9	17.1	41.2	41.2	706.7	17030	0	0	0
281482	0	0	19.2	17	41.2	41.2	711.6	17230	0	0	0
281517	0	0	19.2	16.9	41.2	41.2	724.8	17600	0	0	0
281547	0	0	19.7	16.8	41.1	41.1	727.7	17710	0	0	0
281581	0	0	19.7	16.7	41.1	41	724.5	17660	0	0	0
281611	0	0	20.1	16.6	41	41	721	17590	0	0	0
281646	0	0	20.3	16.4	40.9	40.9	725.7	17770	0	0	0
281676	0	0	19.9	16.2	40.9	40.9	726.3	17890	0	0	0
281710	0	0	19.1	16	40.9	40.9	723.2	17960	0	0	0
281740	0	0	19	15.8	40.9	40.9	724.1	18140	0	0	0
281770	0	0	18.9	15.6	40.8	40.8	720.5	18170	0	0	0
281805	0	0	18.9	15.4	40.8	40.8	725.7	18400	0	0	0
281839	0	0	19.7	15.3	40.8	40.8	727.9	18560	0	0	0
281873	0	0	19.9	15.2	40.7	40.7	721.5	18460	0	0	0
281908	0	0	19.6	15	40.7	40.7	727.6	18680	0	0	0
281938	0	0	19.7	14.9	40.7	40.7	724.1	18620	0	0	0
281972	0	0	21	14.8	40.6	40.6	723.7	18620	0	0	0
282007	0	0	21.5	14.8	40.4	40.4	727.2	18660	0	0	0
282037	0	0	20.4	14.7	40.2	40.2	724.1	18490	0	0	0
282071	0	0	20	14.6	40	40.1	723.4	18410	0	0	0
282105	0	0	19.8	14.5	39.9	39.9	727.2	18450	0	0	0
282140	0	0	20.5	14.4	39.5	39.5	726	18170	0	0	0
282174	0	0	20.1	14.4	39.1	39.1	725.3	17940	0	0.1	0
282208	0	0	20.4	14.3	38.5	38.5	726	17600	0	0.1	0
282239	0	0	19.9	14.2	38	38	727.8	17300	0	0	0
282273	0	0	19.7	14.2	37.4	37.4	724.7	16820	0	0	0
282303	0	0	20	14.1	36.5	36.5	723.5	16210	0	0	0
282337	0	0	19.8	14.1	36	36	729.4	15950	0	0	0
282372	0	0	20.3	14	35	35	729	15290	0	0	0
282402	0	0	20	14	34.2	34.2	727.2	14680	0	0	0
282436	0	0	19.8	13.9	33.4	33.4	722.3	14050	0	0	0
282471	0	0	20	13.9	32.5	32.5	731.2	13590	0	0	0
282505	0	0	20.1	13.9	31.6	31.6	728.3	12910	0	0	0
282535	0	0	20.3	13.8	30.4	30.4	734.8	12170	0	0.2	0
282565	0	0	20	13.8	29.9	29.9	737.6	11870	0	0	0
282600	0	0	21.2	13.8	29	29	731.7	11130	0	0	0
282630	0	0	20.6	13.7	28.3	28.3	729.3	10620	0	0	0
282664	0	0	20.2	13.7	27.6	27.6	732.6	10160	0	0	0
282694	0	0	20.5	13.7	27.1	27.1	731.4	9849	0	0	0
282724	0	0	20.1	13.6	26.1	26.2	730.1	9132	0	0	0
282754	0	0	20	13.6	25.5	25.5	729.6	8690	0	0	0
282784	0	0	20.6	13.6	25.3	25.3	713.9	8334	0	0	0
282819	0	0	21.3	13.6	24.3	24.3	704.8	7524	0	0	0
282853	0	0	21.5	13.6	23.6	23.6	705.2	7078	0	0	0
282883	0	0	21.6	13.6	23.4	23.4	707.5	6944	0	0	0
282918	0	0	20.9	13.5	22.8	22.8	715.6	6617	0	0	0
282948	0	0	21.3	13.5	22.6	22.6	724.1	6546	0	0	0
282982	0	0	21.5	13.5	22.1	22.1	722	6187	0	0	0
283012	0	0	20.8	13.5	21.6	21.6	722.9	5860	0	0	0
283042	0	0	19.9	13.5	21.1	21.2	725.6	5573	0	0	0
283077	0	0	19.5	13.4	20.8	20.8	725.3	5341	0	0	0
283107	0	0	20.4	13.4	20.5	20.5	726	5155	0	0	0
283137	0	0	21.4	13.4	20.3	20.3	721.9	5006	0	0	0

283171	0	0	20.4	13.4	20.1	20.1	725	4845	0	0	0
283206	0	0	20.2	13.4	19.7	19.7	724.9	4590	0	0.2	0
283236	0	0	20	13.4	19.3	19.3	702.1	4180	0	0	0
283266	0	0	21.3	13.3	19.3	19.3	704.2	4190	0	0	0
283296	0	0	21.4	13.3	19	19	728.8	4123	0	0	0
283330	0	0	20.3	13.3	18.6	18.6	734.5	3882	0	0	0
283365	0	0	20.6	13.3	18.4	18.4	730.6	3726	0	0.1	0
283399	0	0	21.2	13.3	18.4	18.4	732.4	3747	0	0	0
283429	0	0	21.3	13.3	18	18	729.4	3465	0	0	0
283459	0	0	20.8	13.3	17.9	17.9	728.3	3356	0	0	0
283493	0	0	21.3	13.3	17.7	17.7	730.2	3240	0	0	0
283524	0	0	20.9	13.2	17.5	17.5	728	3111	0	0	0
283558	0	0	21.1	13.2	17.4	17.4	722.7	3008	0	0	0
283588	0	0	21.4	13.2	17.2	17.2	731.4	2896	0	0	0
283618	0	0	22.5	13.2	17	17	707.6	2685	0	0	0
283653	0	0	22.1	13.2	16.9	16.9	710.5	2610	0	0	0
283683	0	0	22.9	13.2	16.9	16.9	701.1	2546	0	0	0
283713	0	0	21.7	13.2	16.8	16.8	712.9	2556	0	0	0
283747	0	0	21.9	13.2	16.7	16.7	727.9	2521	0	0	0
283777	0	0	21.8	13.2	16.7	16.7	718.1	2494	0	0	0
283812	0	0	22	13.2	16.5	16.5	700.4	2302	0	0	0
283846	0	0	20.8	13.2	16.4	16.4	705.2	2215	0	0	0
283880	0	0	21.3	13.2	16.3	16.3	723.7	2247	0	0	0
283911	0	0	21.2	13.2	16.2	16.2	722.8	2159	0	0	0
283945	0	0	21.4	13.2	16.1	16.1	719.7	2115	0	0.1	0
283979	0	0	20.8	13.2	16.1	16.1	726.4	2107	0	0	0
284014	0	0	20.6	13.2	16	16	722.4	2009	0	0.3	0
284048	0	0	20.5	13.2	15.9	15.9	719	1959	0	0	0
284082	0	0	20.3	13.2	15.8	15.8	722.6	1903	0	0	0
284112	0	0	21.7	13.1	15.7	15.7	726.8	1872	0	0	0
284147	0	0	21.8	13.1	15.6	15.6	703.3	1756	0	0	0
284177	0	0	22.1	13.1	15.5	15.5	710.5	1745	0	0	0
284207	0	0	21.4	13.1	15.4	15.4	721.1	1701	0	0	0
284241	0	0	21.6	13	15.3	15.3	715.7	1633	0	0	0
284276	0	0	21.9	13	15.3	15.3	712.7	1597	0	0	0
284310	0	0	22.1	13	15.3	15.3	701	1624	0	0	0
284344	0	0	21.4	13	15.3	15.3	726.6	1658	0	0	0
284374	0	0	21.6	13	15.2	15.2	722.9	1623	0	0	0
284405	0	0	22.4	13	15.1	15.1	725.4	1550	0	0	0
284439	0	0	22.7	13	15	15	725.5	1502	0	0	0
284473	0	0	21.6	12.9	15	15	726.7	1504	0	0	0
284503	0	0	22.7	12.9	15	15	727.3	1493	0	0	0
284538	0	0	21.6	12.9	14.9	14.9	724.1	1429	0	0	0
\End SDHWPRE 2.6 Jun 97 @Copyright InSitu											

QRR2sys.df

FileName,E:\tmp\QAiSTRR2\Data\QRR2sys
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Model,Aux,off
Model,DrawOffMix,On
Model,LoadHeatExchanger,Off
Model,SolarStratification,On
Model,WindCollector,Off
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TimeBase,3600
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Read,QRR2sol3.d3,Skip=Data
Read,QRR2sto4.d3,Skip=Data
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Init,13.0
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FilterConst,4,1.2E5
NumOfLocMin,10

Precision, 1

*

Fit