



FORSCHUNGS- UND TESTZENTRUM FÜR
SOLARANLAGEN

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in Co-operation with



MANUAL FOR THE SOFTWARE TOOL DHWSCALE

Software for Extrapolating Performance Test Results of one Solar
Domestic Hot Water System tested to Systems of the same Type but
differing in Size

Version Number: V1.0

February 2008

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Introduction

This software can be used to extrapolate performance test results of a Solar Domestic Hot Water System (DHW system) obtained with the DST-method to other DHW systems of the same product line. The software is based upon the assumption that within a product line the solar fraction f_{sol} is a function of the collector area and store volume only. The equation used for the mathematical description of this assumption is as follows:

$$f_{sol}(Ac, V_{sto}) = a_1 \cdot Ac^2 + a_2 \cdot V_{sto}^2 + a_3 \cdot Ac \cdot V_{sto} + a_4 \cdot Ac + a_5 \cdot V_{sto} + a_6 + a_7 \cdot Ac^2 \cdot V_{sto} + a_8 \cdot Ac \cdot V_{sto}^2$$

The parameters $a_1 \dots a_8$ have been previously calculated with the simulation program TRNSYS for a thermosiphon system at the location of Athens. Further information about the mathematical model of this tool can be obtained from [1].

Using the software

General

The calculation software is based on Microsoft EXCEL and therefore it is required that EXCEL is installed. The software has been developed with Microsoft EXCEL 2003 but is also running under Microsoft EXCEL 2000.

In order to run the tool you have to set the macro security of EXCEL to low. After starting the calculation tool the spreadsheet named "user" appears. This is the only folder the user has to work with.

Input Data

The following parameters have to be entered by the user in the section named "Input":

1. **Hot Water Demand:** Choose one of the following hot water demands: 110 l/d, 200 l/d or 300 l/d
2. **Number of Systems Tested:** Enter the number of systems tested with the DST-test. All the systems have to belong to the same product line. For each system tested fill out one line in the table "**Specification of the System tested (DST)**"

3. **Specification of the system:** In this table you have to enter the information of the system you have tested with the DST-Method. The important values are the aperture collector area (A_c), the store volume (V_{sto}) calculated from the thermal heat capacity of the store determined by the DST test as well as the solar fraction resulting from the annual system simulation performed for the corresponding boundary conditions.

It is important that the number of systems you define in the table match the number of systems you define as input data in "number of systems tested".

You can now start the calculation by clicking the button "Start Calculation".

Results:

If the calculation was successful you will find the following information in the section "Results":

- **Parameter specification:** In this table you will find the values of $a_1 \dots a_8$ describing the equation

$$f_{sol}(A_c, V_{sto}) = a_1 \cdot A_c^2 + a_2 \cdot V_{sto}^2 + a_3 \cdot A_c \cdot V_{sto} + a_4 \cdot A_c + a_5 \cdot V_{sto} + a_6 + a_7 \cdot A_c^2 \cdot V_{sto} + a_8 \cdot A_c \cdot V_{sto}^2$$

- **Discrepancy:** In this table, in the column named "Delta", the discrepancy between the value of f_{sol} calculated with this tool and the value of f_{sol} obtained with the DST-test is listed (absolute value in %). You will also find the value of the DST-test you have entered (column $f_{sol, measured}$) and the value of f_{sol} calculated with this tool
- **System to be extrapolated:** Here you can specify the system for that you want to determine f_{sol} based on an extrapolation and/or interpolation from the DST-test results. The system has to be defined by entering the collector area (A_c) and the storage volume (V_{sto}). With the equation described above f_{sol} will be computed automatically. Please note, that the tool has been developed for small to medium size DHW-systems. You can only extrapolate the results within a certain range. For realistic results the collector area has to be in the range of 2...8 m² and the storage volume in the range of 0.2...0.6 m³.

- **Tabular Overview:** In this table values of f_{sol} are displayed over a wide range of collector area sizes and storage volumes for further DHW systems of the same product line as the system tested. The figure next to the table illustrates the system behaviour in dependency of the collector area and storage volume.

For further questions or any remarks, please contact the persons mentioned at the cover page.

February 2008
Stuttgart, Germany