Program for Steam and Water Data

STEAMDAT_97.XLA

Background

This program is developed for internal use in our company. However, we have been asked by some of our clients to make it public. Therefore we have decided to publish it for free general use. We have checked the result of the calculations thoroughly, but we will not take any responsibility in case there should be any errors.

The program is used in conjunction with EXCEL 5 or higher using the macro language VISUAL BASIC FOR APPLICATIONS. The program will not work with EXCEL 4 or older versions.

The program is including a number of functions for water and steam, both for thermodynamical and physical data. All the background material has been taken from the book "Properties of Water and Steam. Wolfgang Wagner and Alfred Kruse, Springer-Verlag, 1998."

The base for the data is "IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam". The data are valid for the temperature varying from 0 ºC to 800 ºC and the pressure from 0.006 bar(a) to 1000 bar(a). The data are in SI or SI derived units.

As pressure unit the bar absolute is used. The unit for energy is the kJ.

For thermal conductivity we have used data from a former book with 1967 equations corrected to be reasonably in accordance with the present book data.

The basic data have been used to calculate other derived units as Prandtl Number, isentropic exponent etc.

How to install the Program

(In the following the words in parenthesis are the Swedish equivalents).

The program should be copied to a hard disk or to a server. It could be preferable to have a separate directory to place the program in. In newer versions of Microsoft Office there is a standard directory called "Addlns" that is suitable to use.

Start the EXCEL program. From EXCEL use the "Tools" (Verktyg) on the menu. Then select "Add-lns" (Tillägg). Use the "Browse" (Bläddra) button and find the program. Mark the program and press the OK button. Now the program will be read into the computer memory. You will see it in the list of available Add-lns with a check sign.

Each time the EXCEL program after this is started, the STEAMDAT_97.XLA file will be automatically loaded. If you do not want to have the program loaded, go to the "Tools / Add-lns" (Verktyg / Tillägg) again. Mark the program in the Add-lns (Tillägg) list. The check sign by the program disappears. Next time EXCEL is started the STEAMDAT_97.XLA will not be loaded. When you want to load it, go the "Tools / Add-lns" (Verktyg / Tillägg) again and mark it. The check sign comes

How to use the Program

The functions are used as any other built in function in EXCEL. The simplest way is to use the function button "fx" on the tool bar. The STEAMDAT_97 functions are found under the "User Defined" (Anpassade) group.

To use the program set the cursor in the cell on the EXCEL spreadsheet where you want to have the function. Using the "fx" button find the function you want to use. Then use the "Next" button to get to the input dialog. For the input data you can either type in data or point on the cells where you have the data.

Most of the functions require two inputs. Only steam and water at saturation state require only one input. In the end of each function name there are letters showing which the necessary inputs are. The different variables units are as follows:

- Pressure   p   bar(a)
- Temperature   t   ºC
- Enthalpy   h   kJ/kg
- Entropy   s   kJ/kg.K
- Steam quality   x   - (0 = water, 1=steam)
- Specific volume   v   m3/kg
- Specific heat constant pressure   cp   kJ/kg.K
- Specific heat constant volume   cv   kJ/kg.K
- Heat conductivity   -   W/m.K
- Dynamic viscosity   -   Pa.s = kg/s.m
- Isentropic exponent   kappa   -
- Prandtl No   Prandtl   -
- Sonic velocity   -   m/s
- Surface tension   -   N/m

A summary of the available functions is found in the program STEAMTEST_97.XLS.

In this program there are also examples how to use the functions. One example is a turbine stage. Another example is a steam pressure and temperature reducing valve. Understanding these examples requires a basic knowledge of thermodynamics.

For the isentropic exponent "Kappa" there are several functions. Two of these represent average values for both an increase and a decrease in pressure. Then there are also one function for only increasing pressure and one for only decreasing pressure. Especially near the saturation temperature there could be a large difference between the two values.

Some hints

When moving an EXCEL file between different computers we have discovered that there often are difficulties for a program to find the files linked to the program, for instance an XLA-file. Often EXCEL thinks that the linked program is placed in another location than where it is actually placed. Especially if you switch between working on the hard disk in a home computer and on a network in the office, there often are misunderstandings.

If the computer does not find the links it will ask if the links should be automatically updated. Answer no to this. Then under "Edit" (Redigera) go to "Links" (Länkar) and check the links indicated. If EXCEL looks for STEAMDAT_97.XLA in another directory than where it actually is, use "Change Source" (Ändra källa) and find the real location instead. When working with more complex EXCEL spreadsheets we strongly recommend using manual recalculation. The way of calculation is found under "Tools / Options / Calculation" (Verktyg / Alternativ / Beräkning). We also recommend marking iterative calculations.

If there is a risk that there could be an error somewhere while developing a spreadsheet program, always save a copy before a recalculation. If there should be some errors after the recalculation try to find the primary reason. Correct them. However, if there are too many errors then close the file and open the file you just saved. Then you have a file without the errors as a base for the continued work.

Do not mark recalculate before save (Beräkna och spara). If the file is automatically recalculated before you save it, also the saved copy will contain all possible errors.

During a development work it is often better to have only 1 iteration. If there are errors somewhere in the spreadsheet, the error spreading effect will be smaller.

Contacts:
Johan Nygaard (johan.nygaard@afconsult.com)
Lennart Delin (lennart.delin@afconsult.com)