ASIMPTOTE
Advanced SIMulation Programs for TOTal Energy systems

Cycle-Tempo

ASIMPTOTE
ADVANCED SIMULATION CAPABILITIES FOR THE ENERGY MARKET

Release **5**

Introduction

*A program for thermodynamic modeling
and optimization of energy conversion systems*

Preface

Welcome to Cycle-Tempo. Cycle-Tempo is a program for thermodynamic modeling and optimization of systems for the production of electricity, heat and refrigeration.

The objective of this manual is to provide Cycle-Tempo users with complete and quick answers to any questions that may arise while using the program. Despite the best efforts of the authors, it is possible that you may find the manual inadequate in certain aspects. If this is the case, we would greatly appreciate your suggestions for improvement. Please forward your comments to:

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What is Cycle-Tempo?

Cycle-Tempo is a program for the thermodynamic modeling and optimization of systems for the production of electricity, heat and refrigeration. Such systems often comprise various interconnected cycles each of which consists of (sometimes many) different apparatuses. These apparatuses are interconnected by pipes, thus forming a complex network of mass and energy flows.

The primary aim of Cycle-Tempo is to calculate the size of the relevant mass and energy flows in the system. The number of types of apparatuses, and the way in which they are interconnected may differ from case to case. Therefore, Cycle-Tempo leaves it up to you, the user, to enter the system configuration. The program contains a large number of models for apparatuses and pipes with which you can establish the desired system model yourself. This almost unlimited flexibility is a significant advantage over many existing programs in which the system configuration cannot be varied, or only to a limited extent.

With the graphical user interface for Cycle-Tempo, you can graphically and interactively build a system configuration on the screen, using a mouse and various palettes with apparatus and connection symbols. From the configuration you have drafted, you can open input dialogs to enter pressures, temperatures and compositions of working fluids.

Once you have established the system configuration on your screen, you can calculate this configuration by simply pressing a button. Error messages and calculation warnings are presented in a separate window. The program automatically processes calculation results into a complete collection of data that you need for detailed assessment of the properties of the modeled system. It calculates both energy values and exergy values. The calculation results can be viewed in user-friendly tables and can be placed directly into the drafted

process diagram. If a calculation is successful, you can interactively create Q, T and value diagrams of one or more heat-exchanging apparatuses, as well as state diagrams (Mollier and T, s diagrams) of (part of) the process. In the print preview, you can view the process diagram, with or without calculation results, the tables and the graphs, individually or simultaneously, and make a printout.

Fully object-oriented, the Cycle-Tempo user interface operates under MS-WINDOWS. MS-WINDOWS is very frequently used on computer systems, so many people are familiar with it. Operating Cycle-Tempo is easy and quick to learn since the procedure in the user interface is consistent with the MS-WINDOWS procedure.

The language used in the program is English and independent of the language version of MS-WINDOWS .

Hardware and software requirements

- Minimum hardware and software requirements for use of Cycle-Tempo are:
- Windows 98, ME, 2000, NT or XP
- An Intel Pentium II Processor or equivalent, 300 MHz or faster
- 64 MB of available random-access memory (RAM)
- 50 MB of available disk space
- A 256-color monitor capable of 800 x 600 pixel resolution (1024 x 768 pixel resolution recommended)
- A CD-ROM drive (either on local PC or available through your network)
- For a printer it is recommended to use an inkjet or a laser printer (either on local PC or available through your network)

Foreknowledge

In order to be able to make good use of the program, it is necessary that you have general knowledge of MS-WINDOWS , as well as knowledge of the thermodynamics for energy systems (university level) and of the design and operation of apparatuses and systems. Preferably, you should also have knowledge of load controls of systems.

The manual

The Cycle-Tempo manual consists of six parts, including this introduction. The other five parts are:

1. Cycle-Tempo Operation
2. Reference Guide
3. User Subroutines
4. Examples
5. Technical Notes

"Cycle-Tempo Operation" explains how the program is structured, how you can draw a diagram and how, in general, you can enter data into a specific part of the diagram. It also explains how you can make calculations and how you can print the results. Furthermore, it shows you how to create tables and diagrams (Q, T and value diagrams, T, s and Mollier diagrams), as well as how to print and file them.

The "Reference Guide" is useful for drafting the process diagram and selecting input parameters. It specifically contains brief information about the various parts and parameters required to specify a system. In order to facilitate searching, we have tried to limit the size of this book by making explanations as brief as possible. In addition to these things, the book describes the output of the program.

In the "User Subroutines" part, we have stated the additional requirements for the software, how to install it, and how to compile and link user subroutines. This section also explains how to state user subroutines in the diagram. It gives a detailed explanation of the various possibilities for user subroutines, as well as a detailed description of the parameter lists of the subroutines and a survey of available variables of apparatuses. Finally, it includes an

overview of program functions that can be opened from a user subroutine (including functions to calculate thermodynamic properties of working fluids).

The "Examples" part includes several examples of calculations using Cycle-Tempo, to help you draft a system model. We have tried to be of service to both starting and advanced users by including calculations of diverse degrees of complexity. The examples discuss practically every available facility of the program such as the application of user subroutines.

In order to make proper use of Cycle-Tempo, the user should have more information at his disposal than the manual offers. Knowledge of the calculation methodology and backgrounds of the available apparatus models and software for calculating substance properties is specifically important. Together with instructions on how to use Cycle-Tempo, this information is included in the "Technical Notes" part. We advise you to study at least Chapters 1 and 2 of this part of the manual so that you obtain good insight into the possibilities and, of course, also the limitations of Cycle-Tempo.

The manual uses the following fonts:

`Monospaced type`	This front represents text to be typed with the keyboard.
Keycap	This front is used to indicate that a certain key of the keyboard must be pressed, e.g., "Press *Del* to delete this character".
SMALL CAPITALS	Small capitals are used to state names of directories, files and programs.

Menu | Selection   Instead of using the phrase "Select Save command in the File menu", the manual uses the convention "Select File | Save".

When you see for example *Alt+F4*, this means that you hold down the *Alt* key and press *F4.*

When it concerns the operation of a mouse button, for example, "Click … using the mouse", this always refers to the left mouse button, unless indicated otherwise.

Installing Cycle-Tempo

The installation program of Cycle-Tempo and the examples stated in part Examples of the manual are supplied on CD. The files are stored in compressed form.

To install Cycle-Tempo:
▪ Insert the CD in the CD-ROM drive.
▪ Follow the instructions on the screen.

Another possibility is to first copy the contents of the CD to one directory on a hard disk; this may also be the hard disk of another computer in a network. Cycle-Tempo can then be installed from that specific directory by running SETUP.EXE.