

# **Engineering Software**

P.O. Box 1180, Germantown, MD 20875

Phone: (301) 540-3605

FAX: (301) 540-3605

E-Mail: info@engineering-4e.com

Web Site: http://www.engineering-4e.com

## **Physical Properties and Steam Approximations 1.1 - Tutorial**

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## **Program Description**

**Engineering Software** has developed a new Windows based software package, **Physical Properties and Steam Approximations**, that quickly and reliably calculates thermodynamic and transport properties of gaseous, liquid and solid species and steam approximations.

This software package should prove to be a good tool for those who are involved at various levels with design, operation and management of energy conversion systems. It should provide you with the opportunity to more quickly and effectively do your work, explore more options, save time and give more confidence in carrying out your calculations.

To get a free evaluation copy of the program, place an order, find out more about how you can profit or benefit from this software package, please send an e-mail to **[info@engineering-4e.com](mailto:info@engineering-4e.com)** or call **(301) 540-3605**.

### **Thermodynamic and Transport Properties**

Temperature and Pressure (270 K < T < 5,000 K)

Enthalpy and Pressure

Entropy and Pressure

### **Steam Approximations**

Saturated Area (Temperature and Pressure Dependent)

Superheated Area

### **Hardware Requirements and Software Compatibility**

80486 or higher microprocessor

16 MB RAM

10 MB available on hard drive

IBM compatible systems:

Microsoft® Windows 98®, Windows 2000®, Windows ME®,

Windows XP® and Windows Vista®

Note: Required Microsoft® Office 2007® (Microsoft® Access 2007®) for Windows Vista operating system!

Distributed on CD ROM

Free Technical and Product Support

30 Day Money Back Guarantee

Trademarks: All product names, company names and service marks are trademarks or registered trademarks of their respective companies.

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## **Claim Sheet**

**Engineering Software** products allow quick and reliable calculation of thermodynamic and transport properties of gaseous, liquid and solid species, contain coefficients for the calculation of physical properties, steam approximations for both saturated and superheated areas, analyze power cycles, power cycle components/processes and compressible flow.

The aforementioned engineering calculations are valid under the following assumptions:

### **Thermodynamic and Transport Properties**

Single species consideration

Ideal gas approach is used ( $pV=RT$ )

Specific heat is not constant

Coefficients describing thermodynamic and transport properties were obtained from the NASA Glenn Research Center at Lewis Field in Cleveland, OH -- such coefficients conform with the standard reference temperature of 298.15 K (77 F) and the JANAF tables

### **Power Cycles**

Single species consideration -- fuel mass flow rate ignored and its impact on the properties of the working fluid

Basic equations hold (continuity, momentum and energy equations)

Specific heat is constant

### **Power Cycle Components/Processes**

Single species consideration

Basic equations hold (continuity, momentum and energy equations)

Specific heat is constant

### **Compressible Flow**

Single species consideration

Basic equations hold (continuity, momentum and energy equations)

Specific heat is constant

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## **How to Use the Program**

In each section, subsection of the **Physical Properties and Steam Approximations** program, the user needs to change one or more input values in order to calculate a new case. Input values are in boxes with white background and can be changed by clicking on each individual box or even by using the arrow keys and changing the current value. Output values cannot be modified, changed by the user and they are in boxes with black background.

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## **Limited Warranty**

This software package is sold **AS IS**, without warranty as to its performance. The entire risk (as to) the quality and of the performance of this computer software program is assumed by the user.

However, to the original purchaser only, **Engineering Software** warrants the medium on which the program is recorded to be free from defects in materials and faulty workmanship under normal use and service for a period of thirty (30) days from the date of purchase. If during this period a defect on the medium should occur, the medium may be returned to **Engineering Software** or to an authorized **Engineering Software** distributor, and **Engineering Software** will replace the medium without charge to you. Your sole and exclusive remedy in the event of a defect is expressly limited to replacement of the medium as provided above.

If the failure of the medium, in the judgment of **Engineering Software** resulted from accident, abuse, or misapplication of the medium, then **Engineering Software** shall have no responsibility to replace the medium under the terms of this warranty.

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### **Suggestion/Evaluation Form**

Please FAX or Mail This Suggestion/Evaluation Form To:

#### **Engineering Software**

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Name:

Title:

Company/Organization:

Street Address:

City:

State:

Zip:

Phone:

FAX:

E-Mail:

#### **Physical Properties and Steam Approximations**

Quality:

Usefulness:

Possible areas of improvement:

Other suggestions:

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## **License Agreement**

This software is the property of **Engineering Software** and is protected by federal copyright law. While **Engineering Software** continues to own the software, you will have certain rights to use the software after your acceptance of this license. Your rights and obligations with respect to the use of this software are as follows:

You may:

- use one copy of the software on a single computer,
- make one copy of the software for backup purposes, and
- use the software on a network, provided that you have a licensed copy of the software for each computer that can access the software over the network

You may not:

- copy the documentation which accompanies the software,
- sublicense, rent or lease any portion of the software, and
- reverse engineer, decompile, disassemble, modify, translate, make any attempt to discover the source code of the software, or create derivative works from the software

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## **Properties**

This section provides physical properties of available species for assigned two state values such as: temperature and pressure, enthalpy and pressure, and entropy and pressure. Physical properties are given in both U.S. customary and International units.

Note: Physical properties for H<sub>2</sub>O(S), H<sub>2</sub>O(L) and H<sub>2</sub>O(G) are available. The accuracy of the available H<sub>2</sub>O properties is only good for the purpose of combustion calculation. Therefore, this indicates that steam table calculations are not available.

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### **Properties: Temperature - Pressure**

This subsection provides physical properties of the selected species for assigned temperature and pressure.

Input Values:

Species, Temperature, Pressure

Output Values:

Physical Properties

Assumptions:

Specific heat is not constant

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## **Running - Properties: Temperature - Pressure**

### **STEP 1**

Select the desired specie or go with the default species.

### **STEP 2**

Enter the desired temperature value or go with the default temperature value.

### **STEP 3**

Enter the desired pressure value or go with the default pressure value.

### **STEP 4**

Click on the Calculate button to start the calculation of the physical properties for the chosen input values.

### **STEP 5**

When done with Steps 1 through 4, click on the Exit button to go back to the Main menu.

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### **Properties: Enthalpy - Pressure**

This subsection provides physical properties of the selected species for assigned enthalpy and pressure.

Input Values:

Species, Enthalpy, Pressure

Output Values:

Physical Properties

Assumptions:

Specific heat is not constant

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## **Running - Properties: Enthalpy - Pressure**

### **STEP 1**

Select the desired specie or go with the default species.

### **STEP 2**

Enter the desired enthalpy value or go with the default enthalpy value.

### **STEP 3**

Enter the desired pressure value or go with the default pressure value.

### **STEP 4**

Click on the Calculate button to start the calculation of the physical properties for the chosen input values.

### **STEP 5**

When done with Steps 1 through 4, click on the Exit button to go back to the Main menu.

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### **Properties: Entropy - Pressure**

This subsection provides physical properties of the selected species for assigned entropy and pressure.

Input Values:

Species, Entropy, Pressure

Output Values:

Physical Properties

Assumptions:

Specific heat is not constant

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## **Running - Properties: Entropy - Pressure**

### **STEP 1**

Select the desired specie or go with the default species.

### **STEP 2**

Enter the desired entropy value or go with the default entropy value.

### **STEP 3**

Enter the desired pressure value or go with the default pressure value.

### **STEP 4**

Click on the Calculate button to start the calculation of the physical properties for the chosen input values.

### **STEP 5**

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### **Steam Approximations**

This section deals with steam approximations, steam table calculations are available for both saturated and superheated areas.

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### **Steam Approximations: Saturated Area**

This subsection deals with steam approximations for the saturated area, steam table calculations are available for the saturated area only. In this case, steam approximations are either temperature or pressure dependent.

Input Values:

Saturated Steam Temperature and Pressure, Steam Quality

Output Values:

Saturated Steam Physical Properties

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### **Running - Steam Approximations: Saturated Area: Temperature Dependent**

#### **STEP 1**

Enter the desired saturated steam temperature value or go with the default temperature value.

#### **STEP 2**

Enter the desired steam quality or go with the default steam quality value.

#### **STEP 3**

Click on the Calculate button to start the calculation of the steam properties for the chosen input values.

#### **STEP 4**

When done with Steps 1 through 3, click on the Exit button to go back to the Main menu.

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### **Running - Steam Approximations: Saturated Area: Pressure Dependent**

#### **STEP 1**

Enter the desired saturated steam pressure value or go with the default pressure value.

#### **STEP 2**

Enter the desired steam quality or go with the default steam quality value.

#### **STEP 3**

Click on the Calculate button to start the calculation of the steam properties for the chosen input values.

#### **STEP 4**

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### **Steam Approximations: Superheated Area**

This subsection deals with steam approximations for the superheated area, steam table calculations are available for the superheated area only.

Input Values:

Superheated Steam Temperature and Pressure

Output Values:

Superheated Steam Physical Properties

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### **Running - Steam Approximations: Superheated Area**

#### **STEP 1**

Enter the desired superheated steam temperature value or go with the default temperature value.

#### **STEP 2**

Enter the desired superheated steam pressure value or go with the default pressure value.

#### **STEP 3**

Click on the Calculate button to start the calculation of the steam properties for the chosen input values.

#### **STEP 4**

When done with Steps 1 through 3, click on the Exit button to go back to the Main menu.