Engineering Software

P.O. Box 1180, Germantown, MD 20875
Phone: (301) 540-3605
Fax: (301) 540-3605
E-Mail: engware@aol.com
Web Site: http://members.aol.com/engware

Gas Dynamics 1.1 - Help

Program Description

Claim Sheet

How to Use the Program

Properties

Temperature - Pressure

Enthalpy - Pressure

Entropy - Pressure

Power Cycles

Carnot

Brayton

Power (Ideal)
Power (Real)
Propulsion (Ideal)
Propulsion (Real)

Power Cycle Components/Processes

Compression
Isentropic (Ideal)
Isentropic (Real)
Isothermal

Combustion
Coal/Oil
Gas

Expansion
Isentropic (Ideal)
Isentropic (Real)
Isothermal

Compressible Flow

Velocity of Sound

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P.O. Box 1180, Germantown, MD 20875
Phone: **(301) 540-3605**
Fax: **(301) 540-3605**
E-Mail: **engware@aol.com**
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Program Description

Engineering Software has developed a new Windows based software package, **Gas Dynamics**, that quickly and reliably calculates thermodynamic and transport properties of gaseous, liquid and solid species, analyzes power cycles, power cycle components/processes and compressible flow.

This software package should prove to be a good tool for those who are involved at various levels with design, operation and management of power and propulsion 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 **engware@aol.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

Power Cycles
Carnot
Brayton (Power and Propulsion)

Power Cycle Components/Processes
Compression
Combustion (Coal/Oil/Gas)
Expansion

Compressible Flow
Velocity of Sound
Mach Number
Properties (Stagnation and Static)
Nozzle
Normal Shock
Diffuser
Thrust

Hardware Requirements and Software Compatibility
80386 or higher microprocessor
4 MB RAM
4 - 8 MB available on hard drive
IBM compatible systems:
Microsoft Windows 3.X, Windows 95,
Windows 98 and Windows NT

Distributed with 3.5 Diskettes and/or on CD ROM
Free Technical and Product Support
30 Day Money Back Guarantee

Trademarks: All product names, company names and
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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 specie consideration
Ideal gas approach is used (pv=RT)
Specific heat is not constant
Coefficients describing thermodynamic and transport properties were obtained from the NASA Lewis Center in Cleveland, OH -- such coefficients conform with the standard reference temperature of 298.15 K (77 F) and the JANAF tables

Power Cycles
Single specie consideration -- fuel mass flow rate ignored and its impact on the properties of the working fluid
Basic equations hold (continuity, energy and momentum equations)
Specific heat is constant

Power Cycle Components/Processes
Single specie consideration
Basic equations hold (continuity, energy and momentum equations)
Specific heat is constant

Compressible Flow
Single specie consideration
Basic equations hold (continuity, energy and momentum equations)
Specific heat is constant

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How to Use the Program

In each section, subsection of the **Gas Dynamics** 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:

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P.O. Box 1180
Germantown, MD 20875
Phone: (301) 540-3605
FAX: (301) 540-3605
E-Mail: engware@aol.com
http://members.aol.com/engware

Name:
Title:
Company/Organization:
Street Address:
City:
State:
Zip:
Phone:
Fax:
E-Mail:

Gas Dynamics

Quality:

Usefulness:

Possible areas of improvement:

Other suggestions:

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- 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,
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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 H2O(S), H2O(L) and H2O(G) are available.   The accuracy of the available H2O 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 specie for assigned temperature and pressure.

Input Values:
Specie, 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 specie.

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 specie for assigned enthalpy and pressure.

Input Values:
Specie, 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 specie.

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
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Properties: Entropy - Pressure

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

Input Values:
Specie, 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 specie.

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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Coefficients

For each reaction specie, the thermodynamic functions specific heat, enthalpy and entropy as functions of temperature are given in the form of least squares coefficients as follows:

$$Cp/R = A1 + A2*T + A3*T^2 + A4*T^3 + A5*T^4 \qquad [/]$$

$$H/(R*T) = A1 + A2*T/2 + A3*T^2/3 + A4*T^3/4 + A5*T^4/5$$
$$+ A6/T \qquad [/]$$

$$S/R = A1*lnT + A2*T + A3*T^2/2 + A4*T^3/3 + A5*T^4/4$$
$$+ A7 \qquad [/]$$

For each specie, two sets of coefficients are included for two adjecent temperature intervals, 273 to 1,000 K and 1,000 to 5,000 K.   The data have been constrained to be equal at 1,000 K.

Running: Coefficients

STEP 1
Select the desired specie or go with the default specie.

STEP 2
Read and/or print the coefficients for the calculation of the physical
properties for the chosen specie.

STEP 3
When done with Steps 1 through 2, click on the Exit button to go back to
the Main menu.

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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
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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
When done with Steps 1 through 3, click on the Exit button to go back to
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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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Phone: (301) 540-3605
Fax: (301) 540-3605
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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.

Power Cycles

This section provides analysis of a few power cycles (Carnot, Brayton, Rankine, Otto, Diesel, Magnetohydrodynamics and Fuel Cell).

Power Cycles: Carnot

This subsection provides analysis of the Carnot cycle.

Input Values:
Heat Addition Temperature, Heat Rejection Temperature

Output Values:
Cycle Efficiency, Heat Rate

Assumptions:
Isentropic compression and expansion.   Heat addition and rejection
occur at constant temperature.   Specific heat is constant.

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Running   -   Power Cycles: Carnot

STEP 1
Enter the desired heat addition temperature value or go with the default
temperature value.

STEP 2
Enter the desired heat rejection temperature value or go with the default
temperature value.

STEP 3
Click on the Calculate button to start the calculation of the Carnot cycle
output values for the chosen input values.

STEP 4
When done with Steps 1 through 3, click on the Exit button to go back to
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Power Cycles: Brayton

This subsection provides analysis of the Brayton cycle for both power generation and propulsion applications.

Power Cycles: Brayton: Power (Ideal)

This subsection provides analysis of the Brayton cycle for the power generation application.

Input Values:
Working Fluid, Working Fluid Mass Flow Rate, Compressor Inlet Temperature, Compressor Inlet Pressure, Turbine Inlet Temperature, Turbine Inlet Pressure, Fuel HHV

Output Values:
Power Output, Fuel Consumption, Cycle Efficiency, Heat Rate

Assumptions:
Isentropic compression and expansion.   Ideal combustion, heat transfer. Fuel mass flow rate is ignored when calculating the gas turbine power output.   No pressure loss.   Specific heat is constant.

Running - Power Cycles: Brayton: Power (Ideal)

STEP 1
Select the desired specie (working fluid) or go with the default specie.

STEP 2
Enter the desired compressor inlet temperature value or go with the default temperature value.

STEP 3
Enter the desired compressor inlet pressure value or go with the default pressure value.

STEP 4
Enter the desired turbine inlet temperature value or go with the default temperature value.

STEP 5
Enter the desired turbine inlet pressure value or go with the default turbine inlet pressure value.

STEP 6
Enter the desired mass flow rate value or go with the default mass flow rate value.

STEP 7
Enter the desired fuel HHV value or go with the default fuel HHV value.

STEP 8
Click on the Calculate button to start the calculation of the Brayton cycle output values for the chosen input values.

STEP 9
When done with Steps 1 through 8, click on the Exit button to go back to the Main menu.

Power Cycles: Brayton: Power (Real)

This subsection provides analysis of the Brayton cycle for the power generation application.

Input Values:
Working Fluid, Working Fluid Mass Flow Rate, Compressor Inlet Temperature, Compressor Inlet Pressure, Turbine Inlet Temperature, Turbine Inlet Pressure, Fuel HHV, Compressor Isentropic Efficiency, Turbine Isentropic Efficiency, Combustor Efficiency

Output Values:
Power Output, Fuel Consumption, Cycle Efficiency, Heat Rate

Assumptions:
Isentropic compression and expansion.   Ideal combustion, heat transfer. Fuel mass flow rate is ignored when calculating the gas turbine power output.   No pressure loss.   Specific heat is constant.

Running - Power Cycles: Brayton: Power (Real)

STEP 1
Select the desired specie (working fluid) or go with the default specie.

STEP 2
Enter the desired compressor inlet temperature value or go with the
default temperature value.

STEP 3
Enter the desired compressor inlet pressure value or go with the default
pressure value.

STEP 4
Enter the desired turbine inlet temperature value or go with the default
temperature value.

STEP 5
Enter the desired turbine inlet pressure value or go with the default
turbine inlet pressure value.

STEP 6
Enter the desired mass flow rate value or go with the default mass flow
rate value.

STEP 7
Enter the desired fuel HHV value or go with the default fuel HHV value.

STEP 8
Enter the compressor isentropic efficiency value or go with the default
compressor isentropic efficiency value.

STEP 9
Enter the turbine isentropic efficiency value or go with the default
turbine isentropic efficiency value.

STEP 10
Enter the combustor efficiency value or go with the default combustor
efficiency value.

STEP 11
Click on the Calculate button to start the calculation of the Brayton cycle
output values for the chosen input values.

STEP 12
When done with Steps 1 through 11, click on the Exit button to go back
to the Main menu.

Power Cycles: Brayton: Propulsion (Ideal)

This subsection provides analysis of the Brayton cycle for the propulsion application.

Input Values:
Working Fluid, Working Fluid Mass Flow Rate, Compressor Inlet Temperature, Compressor Inlet Pressure, Turbine Inlet Temperature, Turbine Inlet Pressure, Fuel HHV

Output Values:
Thrust, Fuel Consumption

Assumptions:
Isentropic compression and expansion.   Ideal combustion, heat transfer. Fuel mass flow rate is ignored when calculating the gas turbine power output.   Ambient pressure is equal to compressor inlet pressure. No pressure loss.   Specific heat is constant.

Running   -   Power Cycles: Brayton: Propulsion (Ideal)

STEP 1
Select the desired specie (working fluid) or go with the default specie.

STEP 2
Enter the desired compressor inlet temperature value or go with the
default temperature value.

STEP 3
Enter the desired compressor inlet pressure value or go with the default
pressure value.

STEP 4
Enter the desired turbine inlet temperature value or go with the default
temperature value.

STEP 5
Enter the desired turbine inlet pressure value or go with the default
turbine inlet pressure value.

STEP 6
Enter the desired mass flow rate value or go with the default mass flow
rate value.

STEP 7
Enter the desired fuel HHV value or go with the default fuel HHV value.

STEP 8
Click on the Calculate button to start the calculation of the Brayton cycle
output values for the chosen input values.

STEP 9
When done with Steps 1 through 8, click on the Exit button to go back to
the Main menu.

Power Cycles: Brayton: Propulsion (Real)

This subsection provides analysis of the Brayton cycle for the propulsion application.

Input Values:
Working Fluid, Working Fluid Mass Flow Rate, Compressor Inlet Temperature, Compressor Inlet Pressure, Turbine Inlet Temperature, Turbine Inlet Pressure, Fuel HHV, Compressor Isentropic Efficiency, Turbine Isentropic Efficiency, Combustor Efficiency

Output Values:
Thrust, Fuel Consumption

Assumptions:
Isentropic compression and expansion.   Ideal combustion, heat transfer. Fuel mass flow rate is ignored when calculating the gas turbine power output.   Ambient pressure is equal to compressor inlet pressure. No pressure loss.   Specific heat is constant.

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Running - Power Cycles: Brayton: Propulsion (Real)

STEP 1
Select the desired specie (working fluid) or go with the default specie.

STEP 2
Enter the desired compressor inlet temperature value or go with the
default temperature value.

STEP 3
Enter the desired compressor inlet pressure value or go with the default
pressure value.

STEP 4
Enter the desired turbine inlet temperature value or go with the default
temperature value.

STEP 5
Enter the desired turbine inlet pressure value or go with the default
turbine inlet pressure value.

STEP 6
Enter the desired mass flow rate value or go with the default mass flow
rate value.

STEP 7
Enter the desired fuel HHV value or go with the default fuel HHV value.

STEP 8
Enter the compressor isentropic efficiency value or go with the default
compressor isentropic efficiency value.

STEP 9
Enter the turbine isentropic efficiency value or go with the default
turbine isentropic efficiency value.

STEP 10
Enter the combustor efficiency value or go with the default combustor
efficiency value.

STEP 11
Click on the Calculate button to start the calculation of the Brayton cycle
output values for the chosen input values.

STEP 12
When done with Steps 1 through 11, click on the Exit button to go back
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Power Cycles: Rankine

This subsection provides analysis of the Rankine cycle.

Input Values:
Turbine Inlet Conditions (Temperature and Pressure), Steam Mass Flow Rate, Fuel HHV

Output Values:
Power Output, Fuel Consumption, Cycle Efficiency, Heat Rate

Assumptions:
Isentropic compression and expansion.   Ideal combustion and heat transfer.

Running - Power Cycles: Rankine

STEP 1
Select the desired steam turbine inlet conditions (temperature and pressure values) or go with the default selection.

STEP 2
Enter the steam mass flow rate value or go with the default steam mass flow rate value.

STEP 3
Enter the desired fuel HHV value or go with the default fuel HHV value.

STEP 4
Click on the Calculate button to start the calculation of the Rankine cycle output values 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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Power Cycles: Otto

This subsection provides analysis of the Otto cycle.

Input Values:
Working Fluid, Ambient Temperature, Ambient Pressure, Compression
Ratio, Combustion Temperature, Number of Resolutions, Fuel HHV
Number of Cylinders, Cylinder Stroke, Stroke to Diameter Ratio

Output Values:
Compression Temperature, Compression Pressure, Combustion Pressure,
Exhaust Temperature, Exhaust Pressure, Cycle Efficiency, Working Fluid
Mass Flow Rate, Heat Rate, Power Output, Fuel Consumption

Assumptions:
Specific heat is constant. Four stroke engine.

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Running   -   Power Cycles: Otto

STEP 1
Select the desired specie (working fluid) or go with the default selection.

STEP 2
Enter the desired ambient temperature value or go with the default
temperature value.

STEP 3
Enter the desired ambient pressure value or go with the default
pressure value.

STEP 4
Enter the desired compression ratio (volumetric) value or go with the
default compression ratio value.

STEP 5
Enter the desired combustion temperature value or go with the default
temperature value.

STEP 6
Enter the desired number of resolutions value or go with the default
number of resolutions value.

STEP 7
Enter the desired fuel HHV value or go with the default fuel HHV value.

STEP 8
Enter the desired number of cylinders value or go with the default number
of cylinders value.

STEP 9
Enter the desired cylinder stroke value or go with the default cylinder
stroke value.

STEP 10
Enter the desired stroke to diameter value or go with the default stroke
to diameter value.

STEP 11
Click on the Calculate button to start the calculation of the Otto cycle
output values for the chosen input values.

STEP 12
When done with Steps 1 through 11, click on the Exit button to go back
to the Main menu.

Power Cycles: Diesel

This subsection provides analysis of the Diesel cycle.

Input Values:
Working Fluid, Ambient Temperature, Ambient Pressure, Compression Ratio, Cut-Off Ratio, Number of Resolutions, Fuel HHV, Number of Cylinders, Cylinder Stroke, Stroke to Diameter Ratio

Output Values:
Compression Temperature, Compression Pressure, Combustion Temperature, Combustion Pressure, Exhaust Temperature, Exhaust Pressure, Cycle Efficiency, Working Fluid Mass Flow Rate, Heat Rate, Power Output, Fuel Consumption

Assumptions:
Specific heat is constant.   Four stroke engine.

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Running   -   Power Cycles: Diesel

STEP 1
Select the desired specie (working fluid) or go with the default selection.

STEP 2
Enter the desired ambient temperature value or go with the default
temperature value.

STEP 3
Enter the desired ambient pressure value or go with the default
pressure value.

STEP 4
Enter the desired compression ratio (volumetric) value or go with the
default compression ratio value.

STEP 5
Enter the desired cut-off ratio (volumetric) value or go with the default
cut-off ratio value.

STEP 6
Enter the desired number of resolutions value or go with the default
number of resolutions value.

STEP 7
Enter the desired fuel HHV value or go with the default fuel HHV value.

STEP 8
Enter the desired number of cylinders value or go with the default number
of cylinders value.

STEP 9
Enter the desired cylinder stroke value or go with the default cylinder
stroke value.

STEP 10
Enter the desired stroke to diameter ratio value or go with the default stroke to
diameter ratio value.

STEP 11
Click on the Calculate button to start the calculation of the Diesel cycle
output values for the chosen input values.

STEP 12
When done with Steps 1 through 11, click on the Exit button to go back
to the Main menu.

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Fax: (301) 540-3605
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Web Site: http://members.aol.com/engware

Power Cycles: Magnetohydrodynamics

This subsection provides analysis of the Magnetohydrodynamics cycle.

Input Values:
Working Fluid, Inlet Stagnation Temperature, Inlet Stagnation Pressure, Velocity, Conductivity, Loading Parameter, Magnetic Field Strength, Channel Length, Mobility

Output Values:
Inlet Static Temperature, Inlet Static Pressure, Inlet Mach Number, Induced Voltage Field, Current Density, Hall Voltage, Outlet Static Temperature, Outlet Static Pressure, Outlet Mach Number, Outlet Stagnation Temperature, Outlet Stagnation Pressure, Specific Work Output, Enthalpy Extraction

Assumptions:
Specific heat, velocity, conductivity, mobility, induced voltage field, Hall voltage and magnetic field strength are constant.

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Fax: (301) 540-3605
E-Mail: engware@aol.com
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Running   - Power Cycles: Magnetohydrodynamics

STEP 1
Select the desired specie (working fluid) or go with the default selection.

STEP 2
Enter the desired inlet stagnation temperature value or go with the default
temperature value.

STEP 3
Enter the desired inlet stagnation pressure value or go with the default
pressure value.

STEP 4
Enter the desired velocity value or go with the default velocity value.

STEP 5
Enter the desired conductivity value or go with the default conductivity value.

STEP 6
Enter the desired loading parameter value or go with the default loading
parameter value.

STEP 7
Enter the desired magnetic field strength value or go with the default
magnetic field strength value.

STEP 8
Enter the desired channel length value or go with the default channel
length value.

STEP 9
Enter the desired mobility value or go with the default mobility value.

STEP 10
Click on the Calculate button to start the calculation of the
Magnetohydrodynamics cycle output values for the chosen input values.

STEP 11
When done with Steps 1 through 10, click on the Exit button to go back
to the Main menu.

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Fax: (301) 540-3605
E-Mail: engware@aol.com
Web Site: http://members.aol.com/engware

Power Cycles: Fuel Cell

This subsection provides analysis of the Fuel Cell cycle.

Input Values:
Fuel, Fuel Inlet Temperature, Oxidant (O2) Inlet Temperature,
Fuel Flow Rate, Product Outlet Temperature

Output Values:
Oxidant Flow Rate, Fuel Cell Voltage, Power, Fuel Cell Efficiency

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Phone: (301) 540-3605
Fax: (301) 540-3605
E-Mail: engware@aol.com
Web Site: http://members.aol.com/engware

Running   -   Power Cycles: Fuel Cell

STEP 1
Select the desired fuel (working fluid) or go with the default selection.

STEP 2
Enter the desired fuel inlet temperature or go with the default
temperature value.

STEP 3
Enter the desired oxidant inlet temperature value or go with the default
temperature value.

STEP 4
Enter the desired fuel flow rate or go with the default fuel flow rate
value.

STEP 5
Enter the desired product outlet temperature value or go with the default
temperature value.

STEP 6
Click on the Calculate button to start the calculation of the Fuel Cell cycle
output values for the chosen input values.

STEP 7
When done with Steps 1 through 6, click on the Exit button to go back to
the Main menu.

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Fax: (301) 540-3605
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Power Cycle Components/Processes

This section provides analysis of power cycle components/processes
(compression, combustion, expansion, heat transfer and mixing).

Power Cycle Components/Processes: Compression

This subsection provides analysis of compression.

Power Cycle
        Components/Processes:
        Compression: Isentropic (Ideal)

This subsection provides analysis of isentropic compression.

Input Values:
Working Fluid (Specie), Working Fluid Mass Flow Rate, Inlet
Temperature, Inlet Pressure, Outlet Pressure

Output Values:
Power Input, Outlet Temperature

Assumptions:
Isentropic compression.   Specific heat is constant.

Running   -   Power Cycle
Components/Processes:
Compression: Isentropic (Ideal)

STEP 1
Select the desired specie or go with the default specie.

STEP 2
Enter the desired compressor inlet temperature value or go with the
default temperature value.

STEP 3
Enter the desired compressor inlet pressure value or go with the default
pressure value.

STEP 4
Enter the desired compressor outlet pressure value or go with the default
pressure value.

STEP 5
Enter the desired compressor mass flow rate value or go with the default
mass flow rate value.

STEP 6
Click on the Calculate button to start the calculation of compressor outlet
temperature and power input values for the chosen input values.

STEP 7
When done with Steps 1 through 6, click on the Exit button to go back to
the Main menu.

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Power Cycle
Components/Processes:
Compression: Isentropic (Real)

This subsection provides analysis of isentropic compression.

Input Values:
Working Fluid (Specie), Working Fluid Mass Flow Rate, Inlet
Temperature, Inlet Pressure, Outlet Pressure, Compressor
Isentropic Efficiency

Output Values:
Power Input, Outlet Temperature

Assumptions:
Isentropic compression.   Specific heat is constant.

Running   -   Power Cycle
            Components/Processes:
            Compression: Isentropic (Real)

STEP 1
Select the desired specie or go with the default specie.

STEP 2
Enter the desired compressor inlet temperature value or go with the
default temperature value.

STEP 3
Enter the desired compressor inlet pressure value or go with the default
pressure value.

STEP 4
Enter the desired compressor outlet pressure value or go with the default
pressure value.

STEP 5
Enter the desired compressor mass flow rate value or go with the default
mass flow rate value.

STEP 6
Enter the desired compressor isentropic efficiency value or go with the
default compressor isentropic efficiency value.

STEP 7
Click on the Calculate button to start the calculation of compressor outlet
temperature and power input values for the chosen input values.

STEP 8
When done with Steps 1 through 7, click on the Exit button to go back to
the Main menu.

Power Cycle
        Components/Processs:
        Compression: Isothermal

This subsection provides analysis of isothermal compression.

Input Values:
Working Fluid (Specie), Working Fluid Mass, Inlet/Outlet Temperature,
Inlet Pressure, Outlet Pressure

Output Values:
Inlet Volume, Outlet Volume, Outlet Density

Assumptions:
Isothermal compression

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Fax: (301) 540-3605
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Web Site: http://members.aol.com/engware

Running - Power Cycle
Components/Processes:
Compression: Isothermal

STEP 1
Select the desired specie or go with the default specie.

STEP 2
Enter the desired compressor inlet temperature value or go with the
default temperature value.

STEP 3
Enter the desired compressor inlet pressure value or go with the default
pressure value.

STEP 4
Enter the desired compressor outlet pressure value or go with the default
pressure value.

STEP 5
Enter the desired compressor mass value or go with the default
mass value.

STEP 6
Click on the Calculate button to start the calculation of compressor outlet
values for the chosen input values.

STEP 7
When done with Steps 1 through 6, click on the Exit button to go back to
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Fax: (301) 540-3605
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Power Cycle Components/Processes: Combustion

This subsection provides analysis of combustion.

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Phone: (301) 540-3605
Fax: (301) 540-3605
E-Mail: engware@aol.com
Web Site: http://members.aol.com/engware

Power Cycle
Components/Processes:
Combustion: Coal/Oil

This subsection provides analysis of the combustion process when coal or oil are considered as the fuel.

Input Values:
Fuel Composition, Fuel Temperature, Oxidant Composition, Oxidant Temperature, Oxidant to Fuel Ratio

Output Values:
Fuel HHV, Fuel Enthalpy, Oxidant Enthalpy, Stoichiometry, Flame Temperature, Combustion Gas Composition

Assumptions:
Complete combustion.   No gas dissociation.   No heat loss.
Specific heat is not constant.

Running   -   Power Cycle
Components/Processes: Combustion:
Coal/Oil

STEP 1
Enter the desired fuel (coal or oil) composition or go with the default fuel composition.
Note: If you decide to change the fuel composition, click on the Normalize button to normalize the fuel composition for you.

STEP 2
Enter the desired oxidant composition or go with the default oxidant composition.
Note: If you decide to change the oxidant composition, click on the Normalize button to normalize the oxidant composition for you. Furthermore, click on the fuel Normalize button one more time to calculate the new stoichiometry value for you.

STEP 3
Enter the desired fuel temperature value or go with the default temperature value.

STEP 4
Enter the desired oxidant temperature (preheat) value or go with the default temperature value.

STEP 5
Enter the desired oxidant to fuel ratio (> 1) or go with the default oxidant to fuel ratio.

STEP 6
Click on the Calculate button to start the calculation of combustion gas composition and flame temperature value for the chosen input values.

STEP 7
When done with Steps 1 through 6, click on the Exit button to go back to the Main menu.

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Fax: (301) 540-3605
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Power Cycle
Components/Processes:
Combustion: Gas

This subsection provides analysis of the combustion process when gas
is considered as the fuel.

Input Values:
Fuel Composition, Fuel Temperature, Oxidant Composition, Oxidant
Temperature, Oxidant to Fuel Ratio

Output Values:
Fuel HHV, Fuel Enthalpy, Oxidant Enthalpy, Stoichiometry, Flame
Temperature, Combustion Gas Composition

Assumptions:
Complete combustion.   No gas dissociation.   No heat loss.
Specific heat is not constant.

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Running   -   Power Cycle
Components/Processes:
Combustion: Gas

STEP 1
Enter the desired fuel (gas) composition or go with the default fuel composition.
Note: If you decide to change the fuel composition, click on the Normalize button to normalize the fuel composition for you.

STEP 2
Enter the desired oxidant composition or go with the default oxidant composition.
Note: If you decide to change the oxidant composition, click on the Normalize button to normalize the oxidant composition for you. Furthermore, click on the fuel Normalize button one more time to calculate the new stoichiometry value for you.

STEP 3
Enter the desired fuel temperature value or go with the default temperature value.

STEP 4
Enter the desired oxidant temperature (preheat) value or go with the default temperature value.

STEP 5
Enter the desired oxidant to fuel ratio (> 1) or go with the default oxidant to fuel ratio.

STEP 6
Click on the Calculate button to start the calculation of combustion gas composition and flame temperature value for the chosen input values.

STEP 7
When done with Steps 1 through 6, click on the Exit button to go back to the Main menu.

Power Cycle Components/Processes: Expansion

This subsection provides analysis of expansion.

Power Cycle
Components/Processes:
Expansion: Isentropic (Ideal)

This subsection provides analysis of isentropic expansion.

Input Values:
Working Fluid (Specie), Working Fluid Mass Flow Rate, Inlet Temperature, Inlet Pressure, Outlet Pressure

Output Values:
Outlet Temperature, Power Output

Assumptions:
Isentropic expansion.   Specific heat is constant.

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Running   -   Power Cycle
           Components/Processes:
           Expansion: Isentropic (Ideal)

STEP 1
Select the desired specie (working fluid) or go with the default specie.

STEP 2
Enter the desired turbine/expander inlet temperature value or go with the
default temperature value.

STEP 3
Enter the desired turbine/expander inlet pressure value or go with the
default pressure value.

STEP 4
Enter the desired turbine/expander outlet pressure value or go with the
default pressure value.

STEP 5
Enter the desired turbine/expander mass flow rate value or go with the
default mass flow rate value.

STEP 6
Click on the Calculate button to start the calculation of turbine/expander
outlet temperature and power output values for the chosen input values.

STEP 7
When done with Steps 1 through 6, click on the Exit button to go back to
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Fax: **(301) 540-3605**
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Power Cycle
Components/Processes:
Expansion: Isentropic (Real)

This subsection provides analysis of isentropic expansion.

Input Values:
Working Fluid (Specie), Working Fluid Mass Flow Rate, Inlet
Temperature, Inlet Pressure, Outlet Pressure, Turbine Isentropic
Efficiency

Output Values:
Outlet Temperature, Power Output

Assumptions:
Isentropic expansion.   Specific heat is constant.

Running   -   Power Cycle
            Components/Processes:
            Expansion: Isentropic (Real)

STEP 1
Select the desired specie (working fluid) or go with the default specie.

STEP 2
Enter the desired turbine/expander inlet temperature value or go with the
default temperature value.

STEP 3
Enter the desired turbine/expander inlet pressure value or go with the
default pressure value.

STEP 4
Enter the desired turbine/expander outlet pressure value or go with the
default pressure value.

STEP 5
Enter the desired turbine/expander mass flow rate value or go with the
default mass flow rate value.

STEP 6
Enter the desired turbine/expander isentropic efficiency value or go with
the default turbine/expander isentropic efficiency value.

STEP 7
Click on the Calculate button to start the calculation of turbine/expander
outlet temperature and power output values for the chosen input values.

STEP 8
When done with Steps 1 through 7, click on the Exit button to go back to
the Main menu.

Power Cycle
        Components/Processs:
        Expansion: Isothermal

Input Values:
Working Fluid (Specie), Working Fluid Mass, Inlet/Outlet Temperature,
Inlet Pressure, Outlet Pressure

Output Values:
Inlet Volume, Outlet Volume, Outlet Density

Assumptions:
Isothermal expansion

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Fax: (301) 540-3605
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Running   -   Power Cycle
**   Components/Processes:**
**   Expansion: Isothermal**

STEP 1
Select the desired specie or go with the default specie.

STEP 2
Enter the desired turbine inlet temperature value or go with the
default temperature value.

STEP 3
Enter the desired turbine inlet pressure value or go with the default
pressure value.

STEP 4
Enter the desired turbine outlet pressure value or go with the default
pressure value.

STEP 5
Enter the desired turbine mass value or go with the default
mass value.

STEP 6
Click on the Calculate button to start the calculation of turbine outlet
values for the chosen input values.

STEP 7
When done with Steps 1 through 6, click on the Exit button to go back to
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Power Cycle Components/Processes: Heat Transfer

This subsection provides analysis of heat transfer.

Input Values:
Hot Working Fluid (Specie), Hot Working Fluid Mass Flow Rate, Hot
Working Fluid Inlet Temperature, Hot Working Fluid Outlet Temperature,
Cold Working Fluid (Specie), Cold Working Fluid Mass Flow Rate, Cold
Working Fluid Inlet Temperature

Output Values:
Cold Working Fluid Outlet Temperature

Assumptions:
Ideal heat transfer -- no losses

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Fax: (301) 540-3605
E-Mail: engware@aol.com
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Running   -   Power Cycle
Components/Processes: Heat Transfer

STEP 1
Select the desired hot specie (hot working fluid) or go with the default specie.

STEP 2
Enter the desired hot working fluid mass flow rate or go with the default mass flow rate value.

STEP 3
Enter the desired hot working fluid inlet temperature value or go with the default temperature value.

STEP 4
Enter the desired hot working fluid outlet temperature value or go with the default temperature value.

STEP 5
Select the desired cold specie (cold working fluid) or go with the default specie.

STEP 6
Enter the desired cold working fluid mass flow rate or go with the default mass flow rate value.

STEP 7
Enter the desired cold working fluid inlet temperature value or go with the default temperature value.

STEP 8
Click on the Calculate button to start the calculation of heat transfer outlet values for the chosen input values.

STEP 9
When done with Steps 1 through 8, click on the Exit button to go back to the Main menu.

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Power Cycle Components/Processes: Mixing

This subsection provides analysis of mixing.

Input Values:
Inlet Working Fluids (Species), Inlet Working Fluids Mass Flow Rate, Inlet
Working Fluids Temperature, Outlet Working Fluids (Species), Outlet Working
Fluids Mass Flow Rate

Output Values:
Outlet Working Fluids Temperature   --   Mixing Temperature

Assumptions:
Ideal mixing -- no losses

Running - Power Cycle
Components/Processes: Mixing

STEP 1
Select the desired inlet species (inlet working fluids) or go with the default
species.

STEP 2
Enter the desired inlet working fluids mass flow rate values or go with the default
mass flow rate values.

STEP 3
Enter the desired inlet working fluids inlet temperature values or go with the
default temperature values.

STEP 4
Enter the desired hot working fluid outlet temperature value or go with the
default temperature value.

STEP 5
Select the desired outlet species (outlet working fluid) or go with the default
species.

STEP 6
Enter the desired outlet working fluids mass flow rate values or go with the default
mass flow rate values.

STEP 7
Click on the Calculate button to start the calculation of mixing outlet
values for the chosen input values.

STEP 8
When done with Steps 1 through 7, click on the Exit button to go back to
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Fax: (301) 540-3605
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Web Site: http://members.aol.com/engware

Compressible Flow

This section provides analysis of compressible flow.

Compressible Flow: Velocity of Sound

This section provides analysis of velocity of sound.

Input Values:
Working Fluid, Temperature

Output Values:
Velocity of Sound

Assumptions:
Specific heat is constant

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Fax: (301) 540-3605
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Running   -   Compressible Flow: Velocity of Sound

STEP 1
Select the desired working fluid (specie) or go with the default value.

STEP 2
Enter the desired temperature value or go with the default temperature value.

STEP 3
Click on the Calculate button to start the calculation of velocity of sound value 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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Phone: **(301) 540-3605**
Fax: **(301) 540-3605**
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Web Site: **http://members.aol.com/engware**

Compressible Flow: Mach Number

This subsection provides analysis of Mach Number.

Input Values:
Working Fluid, Temperature, Velocity

Output Values:
Mach Number

Assumptions:
Specific heat is constant

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Running   -   Compressible Flow: Mach Number

STEP 1
Select the desired working fluid (specie) or go with the default value.

STEP 2
Enter the desired temperature value or go with the default temperature
value.

STEP 3
Enter the desired velocity value or go with the default velocity value.

STEP 4
Click on the Calculate button to start the calculation of Mach number
value for the chosen input values.

STEP 5
When done with Steps 1 through 4, click on the Exit button to go back to
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Fax: **(301) 540-3605**
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Compressible Flow: Properties

This subsection provides analysis od stagnation and static properties in
the case of compressible flow.

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Phone: (301) 540-3605
Fax: (301) 540-3605
E-Mail: engware@aol.com
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Compressible Flow: Properties: Stagnation

This subsection provides analysis of stagnation properties.

Input Values:
Working Fluid, Static Temperature, Velocity

Output Values:
Stagnation Temperature, Stagnation Pressure

Assumptions:
Specific heat is constant

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Fax: (301) 540-3605
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Running   -   Compressible Flow:
Properties: Stagnation

STEP 1
Select the desired working fluid (specie) or go with the default value.

STEP 2
Enter the desired static temperature value or go with the default static
temperature value.

STEP 3
Enter the desired static pressure value or go with the default static
pressure value.

STEP 4
Enter the desired velocity value or go with the default velocity value.

STEP 5
Click on the Calculate button to start the calculation of stagnation
temperature and stagnation pressure values for the chosen input values.

STEP 6
When done with Steps 1 through 5, click on the Exit button to go back to
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Compressible Flow: Properties: Static

This subsection provides analysis of static properties.

Input Values:
Working Fluid, Stagnation Temperature, Velocity

Output Values:
Static Temperature, Static Pressure

Assumptions:
Specific heat is constant

Running   -   Compressible Flow: Properties: Static

STEP 1
Select the desired working fluid (specie) or go with the default value.

STEP 2
Enter the desired stagnation temperature value or go with the default
stagnation temperature value.

STEP 3
Enter the desired stagnation pressure value or go with the default
stagnation pressure value.

STEP 4
Enter the desired velocity value or go with the default velocity value.

STEP 5
Click on the Calculate button to start the calculation of static
temperature and static pressure values for the chosen input values.

STEP 6
When done with Steps 1 through 5, click on the Exit button to go back to
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Fax: (301) 540-3605
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Compressible Flow: Nozzle

This subsection provides analysis of nozzle.

Input Values:
Working Fluid, Stagnation Temperature, Stagnation Pressure, Velocity

Output Values:
Static Temperature, Static Pressure, Mach Number

Assumptions:
Specific heat is constant

Running - Compressible Flow: Nozzle

STEP 1
Select the desired working fluid (specie) or go with the default value.

STEP 2
Enter the desired stagnation temperature value or go with the default
stagnation temperature value.

STEP 3
Enter the desired stagnation pressure value or go with the default
stagnation pressure value.

STEP 4
Enter the desired velocity value or go with the default velocity value.

STEP 5
Click on the Calculate button to start the calculation of Mach number,
stagnation temperature and stagnation pressure values for the chosen
input values.

STEP 6
When done with Steps 1 through 5, click on the Exit button to go back to
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Fax: (301) 540-3605
E-Mail: engware@aol.com
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Compressible Flow: Normal Shock

This subsection provides analysis of normal shock.

Input Values:
Working Fluid, Inlet Stagnation Temperature, Inlet Stagnation
Pressure, Inlet Velocity

Output Values:
Inlet Static Temperature, Inlet StaticPressure, Inlet Mach Number
Outlet Stagnation Temperature, Outlet Stagnation Pressure, Outlet
Velocity, Outlet Static Temperature, Outlet Static Pressure, Outlet Mach
Number

Assumptions:
Specific heat is constant

Running   -   Compressible Flow: Normal Shock

STEP 1
Select the desired working fluid (specie) or go with the default selection.

STEP 2
Enter the desired inlet stagnation temperature value or go with the
default inlet stagnation temperature value.

STEP 3
Enter the desired inlet stagnation pressure value or go with the default
inlet stagnation pressure value.

STEP 4
Enter the desired inlet velocity value or go with the default velocity
value.

STEP 5
Click on the Calculate button to start the calculation of inlet Mach
number, inlet static temperature, inlet static pressure, outlet Mach
number, outlet velocity, outlet static temperature, and outlet static
pressure values for the chosen input values.

STEP 6
When done with Steps 1 through 5, click on the Exit button to go back to
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Fax: **(301) 540-3605**
E-Mail: **engware@aol.com**
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Compressible Flow: Diffuser

This subsection provides analysis of diffuser.

Input Values:
Working Fluid, Static Temperature, Static Pressure, Velocity

Output Values:
Mach Number, Stagnation Temperature, Stagnation Pressure

Assumptions:
Specific heat is constant

Running   -   Compressible Flow: Diffuser

STEP 1
Select the desired working fluid (specie) or go with the default value.

STEP 2
Enter the desired static temperature value or go with the default static temperature value.

STEP 3
Enter the desired static pressure value or go with the default static pressure value.

STEP 4
Enter the desired velocity value or go with the default velocity value.

STEP 5
Click on the Calculate button to start the calculation of Mach number, stagnation temperature and stagnation pressure values for the chosen input values.

STEP 6
When done with Steps 1 through 5, click on the Exit button to go back to the Main menu.

Engineering Software

P.O. Box 1180, Germantown, MD 20875
Phone: **(301) 540-3605**
Fax: **(301) 540-3605**
E-Mail: **engware@aol.com**
Web Site: **http://members.aol.com/engware**

Compressible Flow: Thrust

This subsection provides analysis of thrust.

Input Values:
Working Fluid, Working Fluid Mass Flow Rate, Stagnation Temperature, Stagnation Pressure, Velocity, Ambient Pressure

Output Values:
Static Temperature, Static Pressure, Mach Number, Thrust

Assumptions:
Specific heat is constant

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Fax: (301) 540-3605
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Running   -   Compressible Flow: Thrust

STEP 1
Select the desired working fluid (specie) or go with the default selection.

STEP 2
Enter the desired stagnation temperature value or go with the default
stagnation temperature value.

STEP 3
Enter the desired stagnation pressure value or go with the default
stagnation pressure value.

STEP 4
Enter the desired velocity value or go with the default velocity value.

STEP 5
Enter the desired mass flow rate value or go with the default mass flow
rate value.

STEP 6
Enter the desired ambient pressure value or go with the default ambient
pressure value.

STEP 7
Click on the Calculate button to start the calculation of Mach number,
static temperature, static pressure and thrust values for the chosen
input values.

STEP 8
When done with Steps 1 through 7, click on the Exit button to go back to
the Main menu.