The Pocket Professional™

Mechanical Engineering Reference Pac

Owner's Manual

SPARCOM®

Edition 1 March, 1991

Reorder Number 11063-1A

Notice

For warranty information, see Appendix A.

This manual and any examples contained in it are provided "as is" and are subject to change without notice. **Sparcom makes no warranty of any kind with regard to this manual, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose.** Sparcom shall not be liable for any errors or for incidental or consequential damages in connection with the furnishing, performance, or use of this manual or the examples.

Sparcom Corporation
897 N.W. Grant
Corvallis, OR 97330 U.S.A.

Printing History
Edition 1 March, 1991 MFG. No. 11063-1A

Table of Contents

Chapter 1: Getting Started

Welcome 1
Installing and Removing the Pocket Professional 1
To Install the Card 1
To Remove the Card 2
Accessing the Reference Pac 3
Using the Main Menu 4
Moving Around the Screen 5
Viewing Items Too Wide for the Display 5
Changing the Font Size 6
Example: Using the Reference Pac 6
Managing Units 7
Using the Search Mode 8
Using the Print Function 8
Blank Entries 9
ASCII Table 9
Summary of Functions 11

Chapter 2: Reference Library

Constants Library 13
Universal Constants 13
Magnetic Constants 14
Mechanical and Thermal Constants 14
Solids and Liquids 14
Mechanical Properties 14
Elastic Properties 17
Composition of Metals 18
Properties of Liquids 21
Gases and Vapors 22
Air - Enthalpy and Psi Functions 22
Critical Data for Various Gases 22
Viscosity (μ) at One Atmosphere 22
Saturation Temperature 23
Saturated Gas Properties 23
Thermal Properties 24
Thermal Conductivity 24
Specific Heat 26
Fuels and Combustion 27
ASTM Classification of Coals 27
Byproduct Fuels 28

Heat Values of Petroleum Oils 28
Gasoline Specifications (ASTM D439) 28
Aviation Gasoline Specifications Mil-G-5572E 29
Diesel Fuel Specifications 29
Liquefied Petroleum Gas Specifications 30
Flammability Limits in Air 30
Comparison of Fuels 30
Heats of Combustion 31
Products of Combustion 31
Flame Temperature 31
Refrigerants 31
Environmental Control 32
Reference Formulas 33

Appendix A: Warranty and Service

Pocket Professional Support 35
Limited One-Year Warranty 35
If the Card Requires Service 36
Environmental Limits 36

Appendix B: References

. 37

Appendix C: Menu Structure

Appendix D: Questions and Answers

. 42

Chapter 1
Getting Started

In This Chapter

- ☐ Welcome
- ☐ Installing and Removing the Pocket Professional
- ☐ Using the Main Menu
- ☐ Using the Reference Library
- ☐ Summary of Functions

Welcome

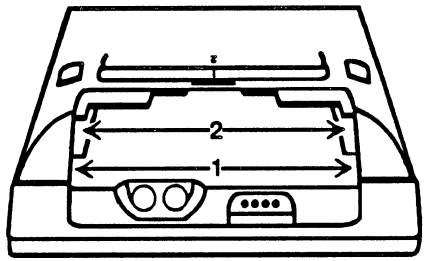
Sparcom's Pocket Professional software is the first of its kind; developed to provide speed, efficiency and portability to students and professionals in the technical fields. The Pocket Professional™ Mechanical Engineering Reference Pac instantly transforms the HP 48SX calculator into an electronic handbook, containing over 100 tables of data commonly used by mechanical engineers. The information is organized into an eight-category menu tree with topics and subtopics listed in an easy-to-use "browser" menu format.

Installing and Removing the Pocket Professional

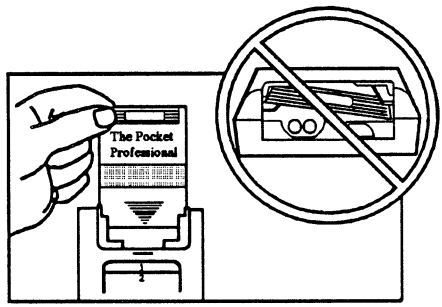
The HP 48SX has two ports for installing plug-in cards. You can install your Mechanical Engineering Reference Pac in either port. Be sure to **turn off the calculator** while installing or removing the card. Otherwise, user memory may be erased.

To Install the Card

1. Turn off the calculator. Do not press [ON] until you have completed the installation procedure.
2. Remove the port cover. Press against the grip lines and push forward. Lift the cover to expose the two plug-in ports.



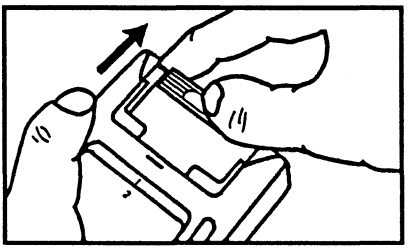
3. Select either empty port for the Pocket Professional card.
4. Position the card just outside the slot. Point the triangular arrow on the card toward the calculator port opening, as shown below.
5. Slide the card firmly into the slot. After you first feel resistance, push the card about 1/4 inch further, until it is fully seated.



6. Replace the port cover.

To Remove the Card

1. Turn the calculator off. Do not press [ON] until you have completed the procedure.
2. Remove the port cover. Press against the card's grip and slide the card out of the port.

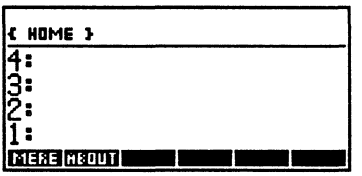


3. Replace the port cover.

Accessing the Reference Pac

After you turn your calculator [ON], there are three ways to start the Mechanical Engineering Reference Pac.

First Method: Press [↩] [LIBRARY] to display all libraries available to the HP 48SX. Press the MEREF "softkey" (the corresponding blank menu key on the top row of the HP 48SX keyboard) to start the Mechanical Engineering Reference Pac.



Pressing the second softkey available at this level, ABOUT, displays the revision number of the software. Pressing the [ATTN] key exits the revision screen and returns you to the above screen.

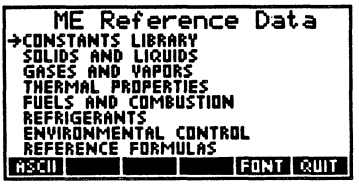
Second Method: Type in the letters MEREF (using alpha entry mode, as described in the *HP 48SX Owner's Manual*) and press [ENTER].

Third Method: Add the command "MEREF" to the CST (custom) menu (for more information, refer to Chapter 15 of the *HP-48SX Owner's Manual,* "Customizing the Calculator"). After the command has been added, press

CST, then press MERE to start the Mechanical Engineering Reference application.

Using the Main Menu

After you start the Mechanical Engineering Reference Pac, the main menu screen appears:



The main menu lists the main categories of the entire mechanical engineering reference database in a "browser" menu format. "Browser" refers to the ability to use the cursor keys (▲, ▼) to move the pointer to the menu item you wish to select and press ENTER to call that information to the screen. The row of "softkeys" along the bottom of the screen give you options that relate to the information on any given screen. A summary of the softkeys used throughout the Mechanical Engineering Reference Pac is given at the end of this chapter.

A description of the main categories and softkeys shown above follows:

Constants Library	Over 21 constants commonly used by mechanical engineers
Solids and Liquids	Mechanical, elastic and thermodynamic data of selected materials
Gases and Vapors	Critical data, saturated temperature and pressure of gases
Thermal Properties	Thermal conductivities and specific heats of selected materials
Fuels and Combustion	Specifications of selected fuels and products of combustion

Refrigerants	Specifications of refrigerants, superconductors and cryogenic properties
Envirnomental Control	Comparison of eight SO_2 control systems
Reference Formulas	Formulas for moments of inertia, standard numbers
ASCII	Displays the ASCII characters 0 - 255, their hexadecimal, decimal, octal, and binary equivalents, plus the complete character set supported by the HP48SX
FONT	Toggles between small and large display font size
QUIT	Exits the Mechanical Engineering Reference Pac. Pressing ATTN performs the same function

Each category above contains several topics. Many topics contain additional subtopics. The contents of each topic and subtopic are described in detail in Chapter 2.

Moving Around the Screen

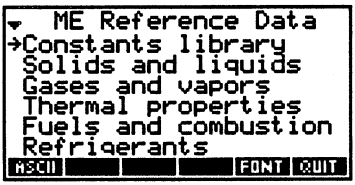
Use the ▲ and ▼ keys to move the pointing arrow up and down in the menu list. Pressing ◀ ▼ moves the pointer to the bottom of the screen, or pages down if the pointer is already there. Pressing ◀ ▲ moves the pointer to the top of the screen, or pages up if the pointer is already there. Pressing ▶ ▼ moves the pointer to the bottom of the list or ◀ ▲ moves to the top of the list.

Viewing Items Too Wide for the Display

If the text of a topic or subtopic is too wide to fit within the display, an ellipsis (...) appears at the end of the line. Pressing ▶ VISIT displays the entire entry. Pressing ATTN or ENTER returns the display to the beginning of the line.

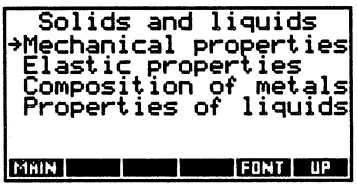
Changing the Font Size

Pressing FONT displays the information in a larger font. The font size stays large until you press FONT again:

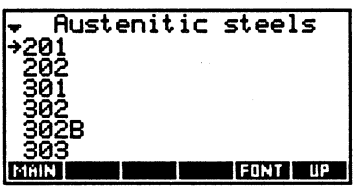


Example: Using the Reference Pac

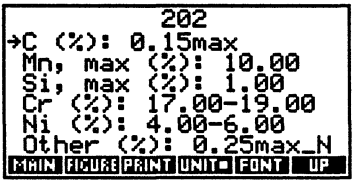
Suppose you need to know the carbon content of 202 stainless steel. At the main menu, move the pointer to SOLIDS AND LIQUIDS and press ENTER. The list of topics filed under the solids and liquids category appears:



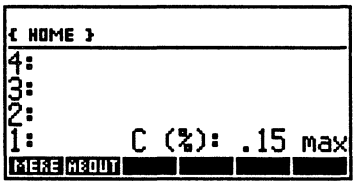
Move the pointer to COMPOSITION OF METALS and press ENTER to view the menu screen. Position the pointer at STAINLESS STEEL COMP (composition) and press ENTER to reach the next level. Select AUSTENITIC STEELS by pressing ENTER. The austenitic steels screen lists 22 austenitic steels by number:



Use the ▼ key to move the pointer to 202 and again press ENTER. The screen shows that the carbon composition is 0.15% maximum.



To put the carbon percentage figure on the calculator stack, press ENTER. To exit the Mechanical Engineering Reference Pac and return to the stack display, press ATTN. The following screen displays:



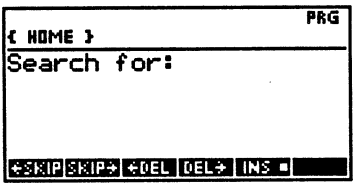
Use the "DTAG" command of the HP 48SX to remove the "C (%)" label. (Remember to remove "max.") You may proceed with your calculation or press MERE to re-enter the Mechanical Engineering Reference Pac.

Managing Units

You can choose whether you want the Mechanical Engineering Reference Pac to display units on the screen or not by pressing the UNITS softkey. The UNITS softkey toggles between the unit and non-unit modes. A square in the units softkey box (UNITS) indicates that units will be displayed with all entries. When units are displayed, pressing ENTER places the entry onto the stack **with** units. When units are not displayed on the screen, units are not included when ENTER is pressed. (Exception: Values in the Constant's library will show units regardless of whether or not the units key is toggled on or off.) The Pocket Professional uses English units as the predominant set of units in this reference pac. Occasionally however, a table will be listed in SI units. Be aware that **using units usually increases the processing time for display.**

Using the Search Mode

In some cases, data lists can be long and it is tedious to search item by item using the cursor keys. You may press ◀ ▼ to jump to the bottom of the screen or ▶ ▼ to jump to the bottom of the list. You may also search the list for a particular entry, using the search mode, by pressing α. The following screen is displayed:



The calculator is now in alpha entry mode, as indicated by the alpha (α) annunciator at the very top of the screen. Alpha entry mode overrides the function of the standard keyboard. In alpha entry mode, each key that has a white capital letter printed to its lower right loses its original function and types that letter onto the command line when pressed. (See the *HP 48SX Owner's Manual*, "The Keyboard and Display," for a complete description of how the alpha mode operates). Type the first letter or letters of the name you want to search for, to create the *search string*, and press ENTER. **The search function is case-sensitive.**

The softkeys at the bottom of the screen (←SKIP, DEL→ INS) are command line editing keys which allow you to edit the search string. Their function is summarized in the next section.

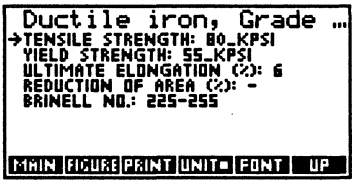
Using the Print Function

You can send data from the Mechanical Engineering Reference Pac directly to an infrared (IR) printer compatible with the HP 48SX via the infrared port. Follow the instructions in the printer manual regarding operating and positioning the printer relative to the HP 48SX. The print function is only available at the reference data level (the lowest level of the menu structure). After the printer is ready, you have the choice of sending the entire record of data or one field of that record to the printer.

When you press the PRINT softkey, the next screen asks you to select *all* or *field*. If you press the ALL softkey, the entire record prints out, regardless of which data items are currently shown and/or selected by the pointer on the screen. Pressing FIELD prints only the data item selected by the pointer.

Blank Entries

When a menu item displays a minus sign (-) after its name, it means that the item is being used as a placeholder in the database structure. The minus sign is not an indication of minus or zero as a value for that item. An example of one of these "blank" entries is shown below:

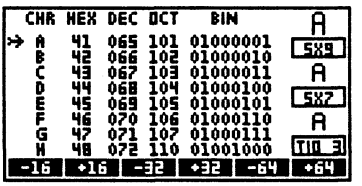


ASCII Table

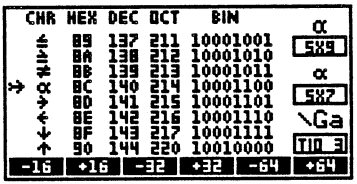
Pressing ASCII at the main menu enters the ASCII table function of the Mechanical Engineering Reference Pac. This function displays hexadecimal, octal, binary and ASCII equivalents for the decimal numbers 0 through 255.

Example:

Suppose you want to find the binary equivalent of the ASCII α character. Enter the ASCII Table by pressing ASCII at the main menu. This results in the screen below:



The first screen displays characters at decimal number 065 (although ASCII characters beginning at decimal 0 are available). Use the ▼ cursor key to scroll down the list until you find the α character (decimal 140). Look under the BIN heading to find the binary equivalent of α.



Since the search mode is not available in the ASCII table, you need to use the **-16**, **+16**, **-32**, **+32**, **-64**, **+64** softkeys to jump forward or backward 16, 32, or 64 characters at a time.

The HP48SX Character Set

The top two boxes at the far right of the ASCII listing display the selected character in the HP 48SX small (5X7) and medium (5X9) fonts. The third box displays the I/O character and translate code setting required to download data from a personal computer to the HP 48SX. (See the *HP 48SX Owner's Manual* for complete instructions.)

Summary of Functions

ALL	Prints an entire record in list form to an IR printer.
FIELD	Prints only the menu item selected by the pointer to an IR printer.
FIGURE	This function appears in all Pocket Professional software pacs. The Mechanical Engineering Reference Pac does not contain figures.
FONT	Toggles the display font between small and large size.
MAIN	Moves to the main menu of the Mechanical Engineering Reference Pac.
PRINT	Allows you to print a data field or the entire record of data to an IR printer.
QUIT	Exits the Mechanical Engineering Reference Pac.
UNITS	Toggles between unit and non-unit modes. The Pocket Professional uses English and Systeme Internationale d'Unites (SI) units.
UP	Moves up one level in the menus.
ENTER	Moves to the category, topic, or sub-topic pointed to by the arrow or puts the entry pointed to by the arrow on the calculator stack.
ATTN	Exits the Mechanical Engineering Reference Pac.
α	Initiates a case sensitive search for a specific entry.
↩ ▼	Moves to the bottom of the screen or pages down.
↩ ▲	Moves to the top of the screen or pages up.
↪ ▲	Moves the pointer to the top of the list.
↪ ▼	Moves the pointer to the bottom of the list.

	Displays remaining data (a screen width at a time) on the screen for entries too wide for the screen. If the topic is too long to fit within the display, an ellipsis (...) is displayed on the right of the screen.
	Moves the cursor to the beginning of the current word.
	Moves the cursor to the beginning of the next word.
	Deletes all the characters in the current word to the left of the cursor.
	Deletes all the characters from the cursor's current position to the first character of the next word.
	Toggles between insert and typeover modes.

Chapter 2
Reference Library

In This Chapter

The Mechanical Engineering Reference Library consists of reference data commonly used by mechanical engineers. All entries are listed under the eight main categories below. Within each category are several topics and subtopics.

- ☐ Constants Library
- ☐ Solids and Liquids
- ☐ Gases and Vapors
- ☐ Thermal Properties
- ☐ Fuels and Combustion
- ☐ Refrigerants
- ☐ Environmental Control
- ☐ Reference Formulas

Because the size of the calculator screen is limited, the names of constants and properties are usually abbreviated throughout the reference pac. This chapter includes "translations" of these abbreviations where appropriate.

Constants Library

The Constants Library offers you immediate access to 21 constants commonly used in mechanical engineering. Constants are in English or SI units and are listed under the three categories below:

Universal Constants

R	Universal gas constant
NA	Avogadro's number
Vm	Molar volume
StdT	Standard temperature
StdP	Standard pressure
εo	Permittivity of vacuum
c	Velocity of light

h	Planck's constant
k	Boltzmann's constant

Magnetic Constants

$\mu 0$	Permeability of free space
$\phi 0$	Magnetic flux quantum
F	Faraday constant
μE	Electron magnetic moment
μP	Proton magnetic moment

Mechanical and Thermal Constants

G	Gravitational constant
g	Acceleration due to gravity
ρH_2O	Density of water at 20 °C
nH_2O	Refractive index of water at 20 °C
CpH_2O	Heat capacity of water at 20 °C
HfH_2O	Heat of fusion of water
HvH_2O	Heat of vaporization of water

Solids and Liquids

The solids and liquids category includes reference data on the following mechanical engineering topics:

- Mechanical Properties
- Elastic Properties
- Composition of Metals
- Properties of Liquids

Mechanical Properties

This topic lists the following mechanical properties for a wide variety of solids and liquids.

Specific Gravity of Materials
Brinell Hardness for Steels
Mechanical Props at Room Temp
Superalloys
Various Metals and Properties
Static Friction Coefficients

Sound Velocity Values

Specific Gravity of Materials

This subtopic lists specific gravities (in range form) and average densities for various metals, timber (air dry), various liquids, minerals and bituminous substances. Specific gravity is defined as the ratio of the density of the given material divided by the density of the reference material. The reference material for the data included here is water at 4 °C. The densities are given in both English and SI units as an average value.

Brinell Hardness for Steels versus Temperature

This subtopic lists Brinell hardness values for the following steels:

.35 carbon
.8 carbon
1.2 carbon
AISI 2340
AISI 1340
AISI 5140
AISI 4140
AISI 6145
0.70C 18W 4Cr 1V

The Brinell hardness number of a material is determined from the diameter of indentation of a spherical indenter. Brinell hardness is given for the following temperatures:

as quenched
200 °F (95 °C)
400 °F (205 °C)
600 °F (315 °C)
800 °F (425 °C)
1000 °F (540 °C)
1200 °F (650 °C)

Mechanical Properties at Room Temperature

Five properties for various classifications of iron, SAE steel, aluminum, copper, and miscellaneous metals at room temperature are listed under this subtopic: Tensile strength, yield strength, ultimate elongation, reduction of area and Brinell hardness number.

This subtopic also covers four properties of ASTM steels: Thickness range, yield point, tensile strength and elongation.

Sound Velocity Values

This subtopic lists values for sound velocity, density, and density * velocity for 12 materials:

Aluminum	Brass
Copper	Iron, soft steel
Lead	Brick
Cork	Wood
Water	Air, dry, CO_2 free, 32 °F
Hydrogen	Water vapor, 212 °F

Superalloys

This subtopic lists the following properties for seven superalloys:

Max temp load (F)	Maximum temperature under load °F
Max temp load (C)	Maximum temperature under load °C
Coeff thermal exp.	Coefficient of thermal expansion
Specific gravity	
Str rupture 1kh, 1200°F	Stress to rupture in 1,000 hours, at 1200 °F, ksi
Str rupture 1kh, 1500°F	
Str rupture 1kh, 1800°F	
Yld stgth .2%, 68°F	Yield strength, 0.2% offset at 68 °F
Yld stgth .2%, 1200°F	
Yld stgth .2%, 1500°F	
Yld stgth .2%, 1800°F	
Tensile stgth 68°F	Tensile strength at 68 °F
Tensile stgth 1200°F	
Tensile stgth 1500°F	
Tensile stgth 1800°F	

Various Metals and Properties

Properties for 21 different metals, such as aluminum, nickel, steel and titanium, are covered in this subtopic. The properties include:

Density	Coefficient of thermal expansion
Thermal conductivity	Specific heat
Approximate melting temperature	Modulus of elasticity
Poisson's ratio	Yield stress
Ultimate stress	Elongation %

Static Friction Coefficients

This subtopic lists the coefficients of static friction at room temperature for 11 smooth surfaces that are clean, covered with paraffin oil, or covered with paraffin oil plus 1% lauric acid. Solid reactivity values are also given.

- Nickel
- Platinum
- Glass
- Cadmium
- Magnesium
- Aluminum
- Chromium
- Silver
- Copper
- Zinc
- Iron

Elastic Properties

This topic includes elastic constants of metals, fatigue limits and bulk modulus of elasticity.

Elastic Constants of Metals

The Mechanical Engineering Rererence Pac lists the following constants for 20 different metals:

- E Young's modulus
- K Bulk modulus
- G Shearing modulus
- μ Poisson's ratio

Fatigue Limits for Reversed Bending

Tensile strength and fatigue limit are given for 18 different metals under this subtopic. The values are in range form.

Bulk Modulus of Elasticity for Various Liquids

The bulk modulus of elasticity for an isothermal (Et) and isentropic (Es) change of state are given. Nine different liquids are listed:

- Ethyl alcohol
- Carbon tetrachloride
- Kerosene (sp. gr. 0.81)
- Machine oil (sp. gr. 0.907)
- Salt water
- Benzene
- Glycerin
- Mercury
- Fresh water

Composition of Metals

This topic lists the composition of several classifications of metals. Trace elements may not be listed. The metals covered under this topic include:

- Stainless steel composition
- AISI steel composition
- Copper base alloys*
- Nickel alloy composition
- Magnesium alloy composition
- Titanium alloy composition
- Brazing alloys*

*The data listed for copper base alloys and brazing alloys include other properties in addition to composition.

Stainless Steel Composition

This subtopic covers a range of austenitic, martensitic, and ferritic steels. The properties given for each classification of these steels include:

- C (%)
- Carbon (%)
- Mn, max (%)
- Manganese, maximum (%)
- Si, max (%)
- Silicon, maximum (%)
- Cr (%)
- Chromium (%)
- Ni (%)
- Nickel (%)
- Other (%)*

*Other (%) refers to micellaneous elements which are included, such as nitrogen (N), selenium (Se), molybdenum (Mo), cobalt (Cb), and tantalum (Ta).

Copper Base Alloys

The Mechanical Engineering Reference Pac lists the following data for 11 copper base alloys:

- Copper Alloy No.
- Nominal Comp (%) Cu
- Nominal Comp (%) Other*
- Tensile strength
- Yield strength
- Elongation (2 in.) %***
- Casting types**
- Conductivity
- Machinability rating
- Weldability

*This data listing gives the percent composition of elements in copper base alloys. For example, the listing for leaded red brass is 5Sn_5Pb_5Zn; meaning that it is composed of 5% tin, 5% lead and 5% zinc.

**There are six casting types, abbreviated in the reference pac as follows:

C	centrifugal

T	continuous
D	die
I	investment
M	permanent mold
P	plaster
S	sand

Standard casting types are given for each copper base alloy. For example, the casting types listed for tin bronze (Cu 905) are C_T_I_S; meaning that centrifugal, continuous, investment, and sand casting methods are used for tin bronze (Cu 905).

***The 2 inches refers to the gage length of the test specimen.

Nickel Alloy Composition

This subtopic lists the percent composition of the following metals for 11 nickel alloys:

Ni	Nickel
Cu	Copper
Fe	Iron
Cr	Chromium
Mo	Molybdenum
Al	Aluminum
Si	Silicon
Mn	Manganese
W	Tungsten
C	Carbon
S	Sulfur
Nb	Niobium
Ti	Titanium

Magnesium Alloy Composition

Magnesium alloys can contain aluminum (Al), zinc (Zn), manganese (Mn) and zirconium (Zr). This subtopic lists the percent nominal composition of these metals, plus the following properties, for 41 magnesium alloys:

Tensile strength
Tensile yield strength
Elongation (2 in) %
Shear strength
Hardness BHN (Brinell hardness)
Elec conduct IACS % (electrical conductivity IACS %)

Each of the 41 magnesium alloys on the menu list includes a code after its name that refers to the treatment type of the alloy. Below are the definitions for these codes:

(-F)	As cast
(-T4)	Artifically Aged
(-T5)	Solution heat-treated
(-T6)	Solution heat-treated

RE in the "NOMINAL COMP. OTHER" listing means a rare earth mixture has been added to the alloy.

Titanium Alloy Composition

This subtopic lists the percent composition of the following elements for 15 titanium alloys:

C	Carbon
N	Nitrogen
O	Oxygen
Al	Aluminum
Fe	Iron
Mn	Manganese
Mo	Molybdenum
V	Vanadium
Other	Other*

*Other can include Sn (tin) and Cr (chromium).

Several titanium alloys in the menu list are accompanied by an additional code, in parentheses, that specifies the phase of the metal and whether it is weldable: α = all alpha phase, β = all beta phase, $\alpha\beta$ = both α and β phase, and W = weldable.

Brazing Alloys

This subtopic lists the percent nominal composition of metals, plus the melting temperature, for 14 brazing alloys. The data for the nominal composition is listed as (in the case of BAg-1): 45Ag_ 15Cu_ 16Zn_ 24Cd; meaning that it is composed of 45% silver, 15% copper, 16% zinc and 24% cadmium.

Properties of Liquids

This topic covers surface tension, density and viscosity for the following 10 liquids.

Alcohol-ethyl	Benzene
Carbon tetrachloride	Gasoline (sp. gr. 0.68)
Glycerin	Kerosene (sp. gr. 0.81)
Mercury	Machine oil
Water-fresh	Water-salt

The phase transition data of fluids under this topic covers 82 liquids.

Surface Tension (δ)

The surface tensions of 10 liquids at one atmosphere and at 68 °F, in vapor, in air and in water, are listed under this subtopic.

Density (ρ)

This subtopic lists the density in slugs per cubic foot of 10 liquids at the following temperatures:

32 °F	68 °F
104 °F	140 °F
176 °F	212 °F

Viscosity (μ) at One ATM

This subtopic gives values of dynamic viscosity (μ) for liquids at atmospheric pressure. Data is listed for the following temperatures:

32 °F	68 °F
104 °F	140 °F
176 °F	212 °F

Fluids - Phase Transition Data

This subtopic lists the following data for 82 fluids:

Formula	Chemical formula
Mol wt	Molecular weight
Tm	Melting temperature
Δh(fus)	Enthalpy of fusion
Tb	Normal boiling point temperature
Δh(vap)	Enthalpy of vaporization

Pc	Critical pressure
Vc	Critical volume
Tc	Critical temperature
Zc	Critical compressibility factor

Gases and Vapors

This category includes reference data for five topics relating to the behavior of gases and vapors:

- Air - Enthalpy and Psi Function
- Critical Data for Various Gases
- Viscosity (μ) at One Atmosphere
- Saturation Temperature
- Saturated Gas Properties
- Water and Steam properties

Air - Enthalpy and Psi Functions

This topic lists values of the enthalpy (h) and psi function for ideal-gas air at 10 K increments from 200 to 2200 K.

Critical Data for Various Gases

This topic lists four properties for 37 gases:

Boiling Temperature	Critical Temperature
Critical Pressure	Critical Volume

Viscosity (μ) at One Atmosphere

The viscosity (μ) for nine different gases at the temperatures listed below is given in this topic.

32 °F	68 °F
140 °F	212 °F
392 °F	752 °F
1112 °F	1472 °F
1832 °F	

Saturation Temperature

This topic lists the saturation temperature in degrees Kelvin of 13 substances under pressure, ranging from .010 to 100 bar. The subtances are:

H_2 (n)	Hydrogen
HCl	Hydrochloric acid
H_2S	Hydrogen sulfide
Hg	Mercury
CH_4	Methane
CH_3OH	Methanol
CH_3Cl	Methyl chloride
Napthalene	Napthalene
N_2	Nitrogen
C_8H_{18}	Octane
O_2	Oxygen
C_5H_{12}	Pentane
K	Potassium

Saturated Gas Properties

Properties for seven gases are included under this topic.

Ammonia	Carbon dioxide
Ethane (R170)	Hydrogen (n)
Methane	Refrigerant 11
Water/steam (properties)	

For each gas named above, with the exception of water/steam, the Mechanical Engineering Reference Pac lists the following properties over a range of temperatures in degrees Kelvin:

P	Pressure
vf	Specific volume (saturated liquid)
vg	Specific volume (saturated vapor)
hf	Specific enthalpy (saturated liquid)
hg	Specific enthalpy (saturated vapor)
sf	Specific entropy (saturated liquid)
sg	Specific entropy (saturated vapor)
cpf	Specific heat at constant pressure (saturated liquid)
cpg	Specific heat at constant pressure (saturated vapor)

The notations (tp) or (cp) after a temperature in the list are abbreviations for triple point and critical point.

Water/ Steam Properties (Saturated)

There are two menu items listed under this subtopic. The first one covers water in the temperature range from 250_K to 647.3_K. The properties given for each temperature are listed below:

P	Pressure
vc	Specific volume (water)
vg	Specific volume (steam)
hc	Specific enthalpy (water)
hg	Specific enthalpy (steam)
sc	Specific entropy (water)
sg	Specific entropy (steam)

Two notations, (s) for solid and (l) for liquid, appear at freezing point temperatures on the list to indicate the point at which water is considered a solid or a liquid.

The second menu item covers water from .01 °C to 102 °C. The properties given for each temperature are listed below:

P	Pressure
V, water	Specific volume, (water)
V, steam	Specific volume, (steam)
U, water	Specific internal energy, (water)
U, steam	Specific internal energy, (steam)
H, water	Specific enthalpy, (water)
H, evap	Specific enthalpy, (evaporation)
H, steam	Specific enthalpy, (steam)

Thermal Properties

This section covers the Thermal Conductivity of metals, liquids, gases and other specified materials; and the Specific Heat of liquids and gases.

Thermal Conductivity

This topic lists thermal conductivity values for the following subtances:

- Metals
- Molten metals
- Gases
- Insulating materials
- Ni-Cr alloys by ANSI number
- Liquids
- Low temperature materials

Metals

The thermal conductivity of metals at a specific temperature is calculated by using the formula: $k_t = k_{to} - a\ (t\text{-}to)$. This subtopic lists the temperature range and values of (kto) and (a) for 45 metals. Below is a list of the variables in this formula and their descriptions:

Variable	Description
k_t	Thermal conductivity at temperature t
k_{to}	Reference thermal conductivity at temperature t_o
a	Correction multiplier
t	Temperature
t_o	Reference temperature

The reference temperature is the *low* temperature in the range given. For example, platinum has a listed temperature range of 70 to 800°F, so $t_o = 70$.

Nickel-Chromium Alloys with Iron by ANSI Number

Using the formula given above for metals, this subtopic lists the temperature range and values for (k_{to}) and (a) for 25 nickel-chromium alloys.

Molten Metals

Eight molten metals are listed in this subtopic, each at three different temperatures. The properties given for each entry are:

k	Thermal conductivity
ρ	Density
cp	Specific heat at constant pressure
μ	Viscosity
Melting Temp	Melting temperature

Liquids

This subtopic lists temperature and thermal conductivity for 19 liquids.

Gases

This subtopic lists temperature and thermal conductivity for 20 gases.

Low Temperature Materials

This subtopic lists thermal conductivities (k) and bulk densities of the following materials for refrigeration and extreme low temperatures:

Corkboard at 100 °F, -100 °F and -300 °F
Fiberglas with asphalt coating (board) at 100 °F, -100 °F and -300 °F
Cellular glass at 100 °F, -100 °F and -300 °F
Rockcork at 100 °F, -100 °F and -300 °F
Santocel at 100 °F, 0 °F and -100 °F
Vegetable fiberboard, asphalt coating, at 100 °F, -100 °F and -300 °F
Polystyrene foams a and b at -100 °F

Insulating Materials

This subtopic gives thermal conductivities of insulating materials for various high temperatures. The bulk density, maximum temperature and thermal conductivity at various temperatures are included for 15 substances, such as asbestos paper, fiberglas block and rock wool.

Specific Heat

This topic covers specific heat at constant pressure (cp) and specific heat ratio for atmospheric pressure (cp/cv), in addition to heat of fusion and mean specific heats, of commmon stubstances used in mechanical engineering.

Cp of Liquids and Gases

This subtopic lists the specific heat at constant pressure of 24 substances (kJ/kg · K) over a range of temperatures from 200 K to 500 K.

Cp/Cv of Liquids and Gases at 1 Atmosphere

This subtopic lists the specific heat ratio for atmospheric pressure (cp/cv), at constant pressure of 25 liquids and gases at 1 Atm over a range of temperatures from 200 K to 500 K.

Heat of Fusion

The heat of fusion in Btu per pound is given for 35 metals, liquids and solids.

Mean Specific Heats, Solids

Mean specific heats of various solids are given in Btu/(lb · °F) for 64 materials.

Fuels and Combustion

This section covers mechanical engineering reference data for 12 topics:

- ASTM Classification of Coals
- Byproduct Fuels
- Heat Values of Petroleum Oils
- Gasoline Specifications ASTM D439
- Aviation Gasoline Specifications Mil-G-5572E
- Diesel Fuel Specifications
- Liquefied Petroleum Gas Specifications
- Flammability Limits in Air
- Comparison of Fuels
- Heats of Combustion
- Products of Combustion
- Flame Temperature

ASTM Classification of Coals

Fixed-carbon limits, volatile-matter limits, calorific-value limits and agglomerating characters of the following coals are listed in this subtopic:

Meta-anthracite
Anthracite
Semianthracite
Low-volatile bituminous
Medium-volatile bituminous
High-volatile A bituminous
High-volatile B bituminous
High-volatile C1 bituminous
High-volatile C2 bituminous (agglomerating)
Subbituminous A
Subbituminous B
Subbituminous C
Lignite A
Lignite B

Description of Limits:

Fixed C Limits % ≥	Fixed-carbon (dry, mineral-matter-free basis)
Fixed C Limits % <	Fixed-carbon (dry, mineral-matter-free basis)
Volatile Limits % >	Volatile-matter (dry, mineral-matter-free basis)
Volatile Limits % ≤	Volatile-matter (dry, mineral-matter-free basis)
Calorific Limits % ≥	Calorific value limits (moist, mineral-matter-free basis)
Calorific Limits % <	Calorific value limits (moist, mineral-matter-free basis)

Byproduct Fuels

This subtopic lists heat value (dry), percent moisture and percent ash (moisture-free) for the following alternate fuels:

- Black liquor
- Coffee grounds
- Cottonseed cake
- Pine bark
- Scrap tires
- Cattle manure
- Corncobs
- Municipal refuse
- Rice straw/hulls
- Wheat straw

Heat Values of Petroleum Oils

This topic lists the following properties for eight petroleum oils:

Density	Density
Qv (per lb)	High heat value at constant volume per pound
Qv (per gal)	High heat value at constant volume per gallon
Qp (per lb)	Low heat value at constant pressure per pound
Qp (per gal)	Low heat value at constant pressure per gallon

Gasoline Specifications (ASTM D439)

This topic lists the following specifications for five volatility classes (A, B, C, D,E) of gasoline, ASTM D439:

- Distillation temperature, °F, 10% maximum evaporation
- Distillation temperature, °F, 40% minimum evaporation
- Distillation temperature, °F, 50% maximum evaporation
- Distillation temperature, °F, 90% maximum evaporation
- Distillation temperature, °F, Endpoint %, maximum
- Distillation temperature, °F, Residue %, maximum
- Test temperature for vapor/liquid = 20, °F, maximum
- Vapor pressure, maximum
- Lead (Pb) level, unleaded maximum

Lead (Pb) level, regular maximum
Corrosion, maximum
Existent gum, maximum
Sulfur, weight %, maximum

Aviation Gasoline Specifications Mil-G-5572E

This topic lists the following specifications for all grades of Mil-G-5572E gasoline:

Distillation temperature, °F, 10% minimum evaporation
Distillation temperature, °F, 40% maximum evaporation
Distillation temperature, °F, 50% minimum evaporation
Distillation temperature, °F, 90% minimum evaporation
End point, temperature, maximum
Sum of 10% and 50% evaporated temperature, minimum
Residue, volume, % maximum
Distillation loss, volume, maximum %
Existent gum, maximum
Potential gum, 16 hours aging
Precipitate, maximum
Sulfur, maximum, weight %
Minimum Reid vapor pressure at 100 °F
Maximum Reid vapor pressure at 100 °F
Freezing point, maximum
Copper corrosion, maximum
Interface rating, maximum
Water reaction, volume change, maximum
Heating value, net heat of combustion, minimum
Aniline-gravity product, minimum

Diesel Fuel Specifications

This topic lists specifications for three ASTM grades of diesel fuel and one U.S. military specified diesel fuel:

ASTM diesel fuel 1-D Limit
ASTM diesel fuel 2-D Limit
ASTM diesel fuel 4-D Limit
MIL-F-16884G

The specifications include:

Flash point
Water and sediment, volume %, maximum

Kinematic viscosity at 100 °F, minimum
Kinematic viscosity at 100 °F, maximum
Carbon residue on 10% residuum, % maximum
Ash, weight %, maximum
Sulfur, weight %, maximum
Ignition quality, centane number, minimun
Minimum distillation temperature, 90 % evaporation
Maximum distillation temperature, 90 % evaporation

Liquefied Petroleum Gas Specifications

This topic lists specifications for propane, butane and propane-butane mixtures. The specifications include:

Vapor pressure at 100 °F, maximum, psi
Volatile residue, butane and heavier, %, maximum
Volatile residue, pentane and heavier, %, maximum
Residue on evaporation
Oil stain observation
Corrosion, copper strip, maximum
Sulfur, maximum
Free water content

Flammability Limits in Air

This topic lists the lower and upper limits of flammability of 24 gasses in air. To propagate combustion, the following gases must be between the limits listed for air mixtures. The flammable limits are given in percent by volume.

Comparison of Fuels

The following specifications offer a comparison of tar sand bitumen and synthetic crude oil from the bitumen with conventional petroleum:

API gravity	API gravity
μ (cSt) at 100 °F	Viscosity at 100 °F
μ (cSt) at 210°F	Viscosity at 210 °F
Carbon, wt%	Carbon, weight %
H2, wt%	Hydrogen %
Nickel, ppm	Nickel, parts per million
Sulfur, wt%	Sulfur, weight %
N2	Nitrogen
Vanadium, ppm	Vanadium, parts per million

Ash, wt%	Ash, weight %
Carbon residue, wt%	Carbon residue, weight %
Pentane insolubles, wt%	Pentane insolubles, wt%

Heats of Combustion

This topic lists the following data for 21 gases, liquids and solids:

Chemical symbol	Chemical symbol
Qv (per lb)	High heat value at constant volume per lb
Qv (per ft^3)	High heat value at constant volume per ft^3
Qp (per lb)	Low heat value at constant pressure per lb
Qp (per ft^3)	Low heat value at constant pressure per ft^3

Products of Combustion

This topic lists the following data for 28 gaseous and liquid fuels:

Chemical formula	Molecular weight
Specific weight at STP	Volume ratio air to fuel
CO_2 from $1ft^3$ fuel	H_2O from $1ft^3$ fuel
N_2 from $1ft^3$ fuel	Weight ratio air to fuel
CO_2 from 1lb fuel	H_2O from 1lb fuel
N_2 from 1lb fuel	

Flame Temperature

Flame temperatures for fuels mixed with a variable amount of theoretical air (80%, 90%, 100%, 120% and 140%) are listed in this topic for the following gaseous fuels:

Hydrogen	Carbon monoxide
Methane	Carbureted water gas
Coal gas	Natural gas
Producer gas	Blast-furnace gas

Refrigerants

This topic covers selected refrigerants and gases in low-temperature applications, transition temperatures and common cryogenic properties.

Selected Materials

This subtopic lists the following data for 27 refrigerants and gases:

Refrigerant no.	Refrigerant number
Molecular weight	Molecular weight
B.P.	Boiling point
Crit. point temp	Critical point temperature
Crit. point pressure	Critical point pressure, psi

Transition Temperatures

This subtopic lists the transition temperatures (To) and critical magnetic fields (Ho) for 14 type I superconductors; and transition temperature (To), upper critical fields (Hc2), and upper transition temperatures (T (K)) for seven type II superconductors.

Common Cryogenic Properties

This subtopic lists the following properties for 11 common cryogens:

- Boiling point
- Triple point pressure
- Critical pressure
- Heat of vaporization per lb
- Liquid density
- Gas density
- Triple point temperature
- Critical temperature
- Upper inversion temp
- Heat of vaporization per ft^3
- Vapor density

Environmental Control

This topic presents a comparison of eight different SO_2 control systems:

- Sulfur dioxide emissions limitations (SDEL)
- Low-sulfur fuel (coal or oil)
- Dry fluidized bed combustors
- Wet lime/limestone scrubbing
- MgO scrubbing
- Catalytic oxidation (add-on)
- Na_2SO_3 scrubbing
- Double alkali

The properties listed for each control system include:

- Requirements
- Recoverable material

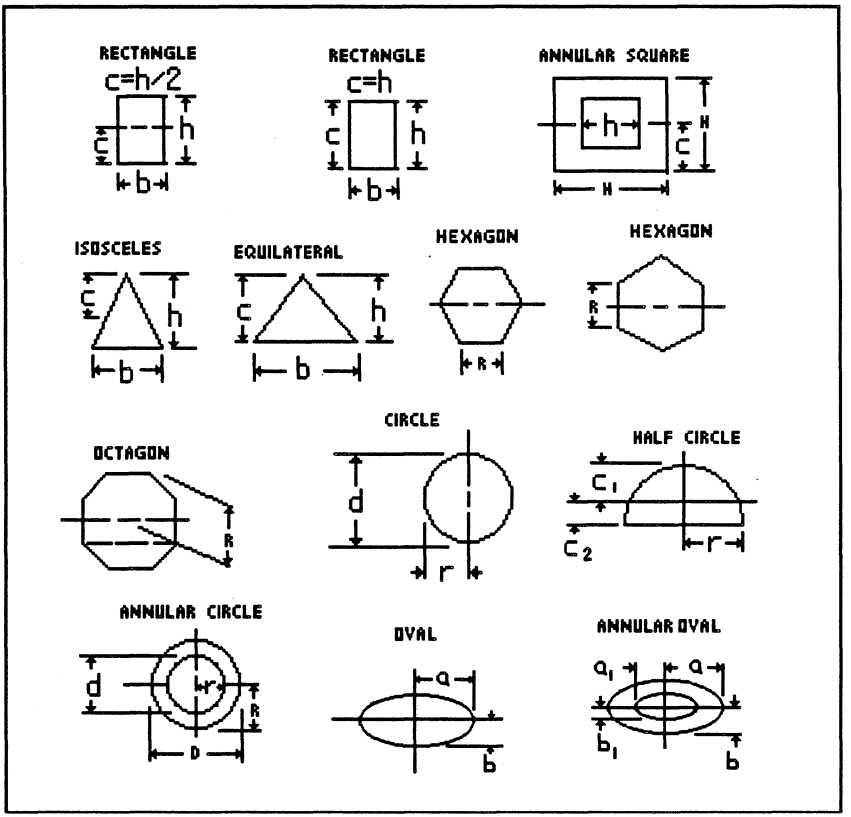
Extra cost of power generation, %
SO_2 efficiency, %
Extra plant investment %

Reference Formulas

This topic lists formulas for moments of inertia and standard numbers.

Moments of Inertia

Formulas for moments of inertia, section modulus, and radius of gyration are given for 12 cross-sections:



Rectangle (C = H/2)
Annular square
Equilateral triangle
Octagon
Annular circle
Oval

Rectangle (C = H)
Isosceles triangle
Hexagon
Circle
Half-circle
Annular oval

Standard Numbers

This subtopic lists the symbol and gives the formula for eight standard numbers:

Reynolds
Euler
Cauchy
Weber

Froude
Pressure coefficient
Mach
Strouhal

Appendix A
Warranty and Service

Pocket Professional Support

You can get answers to your questions about using your Pocket Professional from Sparcom. If you don't find the information in this manual or the HP 48SX *Owner's Manual*, contact us in writing, at 897 N.W. Grant, Corvallis, OR 97330, U.S.A., or call us at 503-757-0501 between 8:00 AM and 5:00 PM Pacific Standard Time.

Limited One-Year Warranty

What Is Covered

The Pocket Professional is warranted by Sparcom Corporation against defects in material and workmanship for one year from the date of original purchase. If you sell your card or give it as a gift, the warranty is automatically transferred to the new owner and remains in effect for the original one-year period. During the warranty period, we will repair or replace (at no charge) a product that proves to be defective, provided you return the product and proof of purchase, shipping prepaid, to Sparcom.

What Is Not Covered

This warranty does not apply if the product has been damaged by accident or misuse or as the result of service or modification by Sparcom or its authorized representatives.

No other warranty is given. ANY OTHER IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS IS LIMITED TO THE ONE-YEAR DURATION OF THIS WRITTEN WARRANTY. IN NO EVENT SHALL SPARCOM CORPORATION BE LIABLE FOR CONSEQUENTIAL DAMAGES.

Products are sold on the basis of specifications applicable at the time of manufacture. Sparcom shall have no obligation to modify or update products, once sold.

If the Card Requires Service

Sparcom will repair a card, or replace it with the same model or one of equal or better functionality, whether it is under warranty or not. There is a service charge for service after the warranty period. Cards are usually serviced and reshipped within five working days.

Send the card to Sparcom Corporation, 897 N.W. Grant, Corvallis, OR 97330, U.S.A.

Service Charge

Contact Sparcom for the standard out-of-warranty repair charges. This charge is subject to the customer's local sales or value-added tax wherever applicable. Cards damaged by accident or misuse are not covered by the fixed charges. These charges are individually determined based on time and material.

Shipping Instructions

If your card requires service, ship it to Sparcom.

- Include your return address and a description of the problem.
- Include proof of purchase date if the warranty has not expired.
- Include a purchase order, along with a check, or credit card number and expiration date (VISA or MasterCard) to cover the standard repair charge.
- Ship your card postage prepaid in adequate protective packaging to prevent damage. Shipping damage is not covered by the warranty, so we recommend that you insure the shipment and use extreme care in shipping the product.

Environmental Limits

The reliability of the Pocket Professional depends upon the following temperature and humidity limits:

- Operating temperature: 0 to 45 °C (32 to 113 °F).
- Storage temperature: –20 to 60 °C (–4 to 140 °F).
- Operating and storage humidity: 90% relative humidity at 40 °C (104 °F) maximum.

Appendix B

References

"American Institute of Physics Handbook," Third edition, McGraw-Hill, 1972.

ASHRAE, "Air-conditioning Refrigeration Data Books."

ASHRAE Handbook Fundamentals 1981.

ASTM Standards, Part 1.

ASTM, "Standards on Gaseous Fuels, Coal and Coke."

ASTM-IP, "Petroleum Measurement Tables"

Avallone, E. A., and T. Baumeister III, "Mark's Standard Handbook for Mechanical Engineers," Ninth Edition, McGraw-Hill, New York, 1978.

Baumeister III, T., and L. S. Marks, "Mark's Standard Handbook for Mechanical Engineers," Seventh Edition, McGraw-Hill, New York, 1967.

Beck, "Technology of Magnesium and its Alloys," Annual Standards, ASTM.

Bland and Davidson, "Petroleum Processing Handbook," McGraw-Hill.

Bowden and Taylor, "The Friction and Lubricants of Solids," Oxford.

Burns and Roe, "TVA's Clean Air Strategy," Public Utilities Fortnightly, 34: June 6, 1974.

Chappell and Cockshutt, Natural Resources Council, Report NRC LR 759 (NRC No. 14300), 1974.

"CRC Handbook of Chemistry and Physics," 52nd edition, CRC Press Inc., 1971-72.

"CRC Handbook of Chemistry and Physics," 67th edition, CRC Press Inc., 1986-87.

Chigier, "Energy, Combustion and Environment," McGraw-Hill.

"Data Book 1975," Third edition, Metal Progress, ASM.

Davis et al., "Testing and Inspection of Engineering Materials, " McGraw Hill.

Durham, McClintock, and Reed. "Cryogenic Materials Data Handbook," PB 171-809, U.S. Department of Commerce.

Felder, R. M. and R. W. Rousseau, "Elementary Principles of Chemical Processes," John Wiley & Sons, Inc., New York, 1978.

Fink, D. G. and D. Christiansen, "Electronics Engineers' Handbook," Third Edition, McGraw-Hill, NY, 1989

Fossil Energy Reports, U.S. Department of Energy.

Glassman, "Combustion," Academic Press, New York, 1977.

Goodwin, NBS Tech. Note 653, 1974.

Goodwin, Roder, and Straty, NBS Tech. Note 684, 1976.

"Handbook of Natural Gas Engineering," McGraw-Hill.

"Handbook of Titantium Metal," Titanium Metals Corp. of America, New York.

"High Temperature, High Strength Alloys," AISI.

"International Critical Tables," McGraw-Hill.

"Liquid-Metals Handbook," Second edition, US Government Printing Office, Washington D.C., 1952,

Mantell, "Engineering Materials Handbook," McGraw-Hill, 1958.

"Metals Handbook," ASM.

Peat, "U.S. Bureau of Mines Mineral Commmodity Summaries," 1983.

"Reference Data for Radio Engineers," Sixth edition, Howard W. Sams & Co., Inc., New York, 1975.

Rohsenow et al., "Handbook of Heat Transfer Fundamentals," McGraw-Hill.

Satterfield, "Generalized Thermodynamics of High Temperature Combustion," Sc.D. thesis.

Simmons and Krivobok, "Compilation of Chemical Compositions and Rupture Strength of Super-strength Alloys," ASTM Pub 170-A.

"Smithsonian Physical Tables," Ninth revised edition, Vol. 120, Smithsonian Institution, Washington D.C., 1954.

SAE Handbook.

"Steam Tables," ASME, 1967.

"Standards Handbook, Part 2 - Wrought Alloy Data," Copper Development Association.

"Standards Handbook, Part 7 - Cast Alloy Data," Copper Development Association.

"Steel Products Manual," AISI.

"Tables of Thermal Properties of Gases," NBS Circular 564, 1955.

Thermophysical Properties of Refrigerants, ASHRAE, New York, 1976.

Timoshenko, "Strength of Materials," pt. II, Van Nostrand.

Van Vlack, L. H., "Elements of Materials Science and Engineering," Addison-Wesley, 1980.

Vukalovich and Altunin, "Thermophysical Properties of Carbon Dioxide," Atomizdat, Moscow, 1965.

Weast, R. C., "CRC Handbook of Chemistry and Physics," 67th edition, CRC Press Inc., 1986-87.

Wilkes, "Heat Insulation," Wiley.

Appendix C
Menu Structure

Constants library

- Universal
- Magnetic
- Mechanical, Thermal

Solids and liquids

Mechanical properties
- Specific gravity of materials
- Brinell hardness for steels
- Mechanical properties at room temperature
- Sound velocity values
- Superalloys
- Various metals and properties
- Static friction coefficients

Elastic properties
- Elastic constants of metals
- Fatigue limits
- Bulk modulus of Elasticity

Composition of metals
- Stainless steel composition
- AISI steel composition
- Copper base alloys
- Nickel alloy composition
- Magnesium alloy composition
- Titanium alloy composition
- Brazing alloys

Properties of liquids
- Surface tension (δ)
- Density (ρ)
- Viscosity (μ) at one ATM
- Fluids - phase transition

Gases and vapors

- Air - Enthalpy, Psi function
- Critical data gases
- Viscosity (μ) at one ATM
- Saturation temperature
- Saturated gas properties

- Ammonia
- Carbon dioxide
- Ethane (R170)
- Hydrogen (n)
- Methane
- Refrigerants 11
- Water, steam properties

Thermal properties

Thermal conductivity
- Metals
- Ni-Cr alloys by ANSI#'s
- Molten metals
- Liquids
- Gases
- Low temperature matls
- Insulating materials

Specific heat
- Cp of liquids & gases
- Cp/Cv of liquids & gases at 1 ATM
- Heat of fusion
- Mean specific heats, solids
- Heat of fusion
- Mean specific heats, solids

Fuels and combustion

- ASTM classification of coals
- Byproduct fuels
- Heat values of petroleum oils
- Gasoline specifications ASTM D439
- Aviation gas specifications Mil-G-5572E
- Diesel fuel specifications
- Liquefied petroleum gas specifications
- Flammability limits in air
- Comparative fuel specifications
- Heats of combustion
- Products of combustion
- Flame temperature

Refrigerants

- Selected materials
- Transition temperatures
- Type I superconductors
- Type II superconductors
- Common cryogenic properties

Environmental control

- Compare of SO_2 control systems

Reference formulas

- Moments of inertia
- Standard numbers

Appendix D

Questions and Answers

Commonly Asked Questions

Q. I'm not sure whether the Pocket Professional card is malfunctioning or I'm doing something improperly. How can I verify that the card and the calculator are functioning properly.

A. There are several possibilities for this condition to occur.

- check to make sure that the card is properly seated in the calculator port.
- turn the calculator ON and press [LIBRARY]. The calculator checks the reference card when it turns on; if "Invalid Card Data or Port Not Available" message is displayed, then the card may require service. If the library menu does not include the reference name shown in Chapter 1, then the card may require service.
- a third possibility occurs when you remove a merged RAM card incorrectly and install the Pocket Professional card. In this case, the calculator display shows "Recovering Memory".

Q. What do three dots (...) mean at the end of a display line?

A. The three dots indicate that the object is displayed too long to show on one line. To view the complete object, select the object using the [▼] or the [▲] key by moving the pointing arrow to the object to be displayed, press [→] and [VISIT]. Pressing [ENTER] or [ATTN] will return to the browser.

Q. While searching a list of information, I used the alpha key to do the search, but the search did not work. Why?

A. Most likely, the search did not work because of case sensitivity of the alpha search.

Index

A

Accessing Available Libraries 1-3
Accessing the Pocket Professional 1-3
Air-Enthaply and Psi function 2-22
AISI steel composition 2-18
ASCII Table 1-9
ASTM classification of coals 2-27
Aviation gasoline 2-29

B

Binary equivalents 1-9
Blank entries 1-9
Brazing alloy 2-18
Brinell Hardness 2-14
Browser 1-5
Bulk modulus 2-17
Byproduct fuels 2-28

C

Comparison of fuels 2-30
Composition of metals 2-18
Constants Library 2-13
  Mechanical and thermal constants 2-14
  Universal Constants 2-13
Copper base alloys 2-18
Cp/Cv of liquids and gases 2-26
Critical Data for Gases 2-22

D

Decimal equivalents 1-9
Density of Liquids 2-21
Diesel Fuel specifications 2-29
DTAG command 1-7

E

Editing the Browser 1-6
Elastic constants of metals 2-17
Elastic properties 2-17
Environmental control 2-32
Environmental Limits C-36

F

Fatigue limits 2-17
Flame temperature 2-31
Flammability limits in air 2-30
Fluids and Phase Transition 2-21

Fuels and Combustion 2-27
  ASTM classification of coals 2-27
  Aviation gasoline specifications 2-27
  Byproduct Fuels 2-27
  Comparison of fuels 2-27
  Flame temperature 2-27
  Flammability limits in air 2-27
  Gasoline specifications 2-27
  Heats of combustion 2-27
  Values of Petroleum oils 2-27
  Liquefied petroleum specifications 2-27
  Products of combustion 2-27
  Fuels and specifications 2-27
  Diesel fuel specifications 2-27

G

Gases and Vapors 2-22
  Air-Enthalpy 2-22
  Critical Data 2-22
  Saturated gas properties 2-22
  Saturation Temperature 2-22
  Viscosity 2-22
  Water and steam properties 2-22
Gasoline specifications 2-28

H

Heat Capacity of liquids and gases 2-26
Heat of fusion 2-26
Heat Values of petroleum oils 2-28
Heats of combustion 2-31
HEX equivalents 1-9
HP 48SX character set 1-10

I

Installing an Application Card 1-1

K

Key
  [α] 1-11
  [ATTN] 1-5
  [CST] (Custom Menu) 1-3
  [LIBRARY] 1-3
  [ON] 1-3
  [VISIT] 1-5

L

Liquified gas specifications 2-30

M

Magnesium alloy 2-18
Magnetic constants 2-14
Managing units 1-7
Mean specific heats 2-27
Mechanical properties 2-14
Mechanical properties-room temperature 2-15
Metal properties 2-14
Moments of interia 2-33

N

Nickel alloy composition 2-18

O

Octal equivalents 1-9

P

Print function 1-8
Products of combustion 2-31
Properties of Liquids 2-21

R

Reference formulas 2-33
Refrigerants 2-31
  Common cryogenic properties 2-32
  Selected materials 2-32
  Transition temperatures 2-32
Removing the card 1-2
Repair or Servicing your Pocket Professional C-36

S

Saturated gas properties 2-23
Saturation temperature of gases 2-23
Search Mode 1-8
Selecting a port 1-2
Softkey
  -DEL 1-12
  -SKIP 1-12
  ABOUT 1-3
  FONT 1-5, 1-11
  INS 1-12
  MAIN 1-11
  MERE 1-3
  ON 1-1
  PRINT 1-11
  QUIT 1-5, 1-11
  UNITS 1-7, 1-11
  UP 1-11
Solids and Liquids 2-14
  Composition of metals 2-18
  Elastic properties 2-17
  Mechanical properties 2-14
  Properties of Liquids 2-21
Soud velocities 2-15
Specific Gravity of materials 2-14
Stack
  Pushing entries to 1-7
Stainless steel composition 2-18
Standard numbers 2-34
Static friction coefficients 2-14
Superalloys 2-14
Surface Tension 2-21

T

Thermal Conductivity 2-24
  Gases 2-25
  Insulating materials 2-26
  Liquids 2-25
  Low temperature materials 2-26
  Metals 2-25
  Molten metals 2-25
  Nickel Chromium alloys 2-25
Thermal Properties 2-24
  Specific heat 2-26
  Thermal Conductivity 2-24
Titanium alloy composition 2-18

U

Using the Main Menu 1-4
Using the Reference Pac 1-6

V

Viscosity of gases 2-22
Viscosity of Liquids 2-21

W

Warranty and Service C-35 - C-36
Water and Steam properties 2-24

Mechanical Engineering Reference Pac Changes

The following changes were made to the Mechanical Engineering Reference Pac for version 2.5:

- ✔ Browser: Cursor movement and scrolling speed have been increased.
- ✔ Constant Library: Constants have been updated to conform to latest accepted values.

HP 48GX USERS ONLY: You should install the application card in Port 1 for two reasons:

1. Application cards installed in Port 1 will execute ~ 20% faster than those installed in Port 2.

2. Application cards installed in Port 2 may experience long pauses (~ 5-10 seconds or more) intermittently during operation. This is not a software defect. It is caused by the new memory architecture of the extended HP 48GX Port 2, which is different from the HP 48SX Port 2. Such pauses will not occur if the application card is operated from Port 1 of the HP 48GX or if it is operated from either port of the HP 48SX.

Mechanical Engineering Reference Pac Manual Changes

These changes apply to the Mechanical Engineering Reference Pac Manual, Edition 2, August 1991.

Changes for the HP 48GX

General: To display all libraries on the HP 48GX, press [→] [LIBRARY] instead of [←] [LIBRARY].

General: On the HP 48GX, the [ATTN] key has been replaced by CANCEL.

General: To perform a screen dump on the HP 48GX, press [ON]–[I/O] instead of [ON]–[MTH].

General: To display an item too wide for the display on the HP 48GX, press [→] [CMD] instead of [→] [VISIT].

Changes for Version 2.5

Page 1-7: Managing Units: Values in the Constants Library will now display units dependent on whether or not the units key is toggled on or off. Also, [ENTER] now views an item instead of placing it onto the stack. To place an item onto the stack, press [→STK].

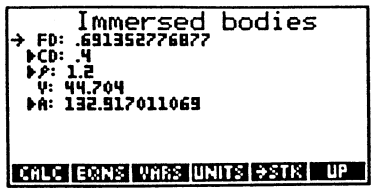
Page 1-8: Using the Search Mode: The search mode is now case-insensitive.

Page 1-9: Summary of Functions: [ENTER] now views an item instead of placing it onto the stack. To place an item onto the stack, press [→STK].

Page 3-3: Using Steam Tables: 1st and 2nd pictures should indicate sixth menu key as [UP] instead of [QUIT].

Page 9-4: Constants Library: 2nd picture should indicate 1.7445299E-40_Btu*h as the value of h instead of 1.74599E-40_Btu*h.

Page 9-5: Standard Prefixes: Picture should indicate prefixes as 1E18, 1E15, ...



Page 1-20: Loading Values from the Stack: First Method: **▷STK** should be **▶STK**.

Page 2-5: Cantilever Beam – Point Load: Example: Solve equations 1, 3, and 4.

Page 2-6: Cantilever Beam – Uniform Load: Example: Solve equations 3 and 4.

Page 2-7: Cantilever Beam – Moment: Example: Solve equations 3 and 4.

Page 2-9: Simple Beam – Uniform Load: Equation 1 should contain $+x^3$ instead of $-x^3$

Page 2-9: Simple Beam – Uniform Load: Equation 2 should contain $+4x^3$ instead of $-4x^3$.

Page 2-11: Simple Beam – Moment: Example: Solve equations 3 and 4.

Page 2-24: Manometers: Example: Solve equations 2 and 4 instead of 3 and 4.

Page 2-26: Immersed Bodies: Example: Solve equations 1 and 3.

Page 2-32: Thermodynamics/Ideal Gas Law: Variable description for Vs1 should be "specific volume state 1."

Page 2-33: Thermodynamics/Ideal Gas Law: Example: RG=6.8479_Btu/(lb*°R).

Page 2-49: Semi-Infinite Solid: Example: Solve equations 1, 2, 3, and 4.

Page 2-50: Blackbody Radiation: Example: Solve equations 1 and 3 for first part of example and equation 2 for second part of example.

Page 2-56: Inclined Planes: Equation 5 should be deleted.

Page 2-57: Inclined Planes: Example: Solve equations 1 and 2.

Page 2-59: Axial Load: Example 2: Solve equations 4 and 5.

Page 2-62: Torsion: Variable γ should have angle units instead of no units.

Page 2-62: Torsion: Example 1: t=418.8790_MPa, γ=0.4_°.

Page 2-64: Principal Stresses: Equation 2 should contain $COS(2\cdot\Theta) - \tau xy\cdot SIN(2\cdot\Theta)$ instead of $COS(2\cdot\Theta) + \tau xy\cdot SIN(2\cdot\Theta)$.

Page 2-65: Principal Stresses: Example: Solve equations 1 and 2; $\sigma y1$=–60705.081_Pa.

Page 2-67: Mohr's Circle: Example: Solve equations 1, 2, and 4.

Page 2-68: Simple and Compound Pendulums: Example 2: Solve equation 2.

Page 2-72: Natural Frequency – Beams: Example: Solve equation 1; fn1=1.5381_Hz.

Page 2-74: Helical Springs: Equation 7 should be $\frac{4\cdot C-1}{4\cdot C-4}+\frac{.615}{C}$ instead of $\frac{2\cdot C+1}{2\cdot C}$.

Page 2-75: Helical Springs: Example: Solve equations, 2, 6, 7, 8, and 9; Ds=1_in; Ks=1.1448, C=10, τ=4518714961.02_Pa, k=947.76_N/m, y=105.51_cm.

Page 3-3: Using the ECON Function: ECON should be MCON.

Page 3-3: Using the ECON Function: Picture menu keys should read MEAP MCON ABOUT instead of MEAP ECON DEREC DERUB ABOUT.