

# *MotorMaster* 4.0

## *User Guide*

**Includes Premium Efficiency Motors**



Developed for the U.S. Department of Energy by the  
Washington State University Cooperative Extension Energy Program



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WSUCEEP 03\_13

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# Acknowledgements

## *MotorMaster+*

The U.S. Department of Energy (USDOE) Office of Energy Efficiency and Renewable Energy funds this BestPractices tool. Appreciation is extended to Peter Salmon-Cox, Paul Scheihing, Chris Cockrill, and Hank Kenchington of USDOE for their support of this work. Thanks also go to Laurie Brown of the USDOE Seattle Regional Office (Western). We also appreciate the input and support provided by Mitch Olszewski and Bob Leach of the Oak Ridge National Laboratory.

Many individuals contributed towards making *MotorMaster+* into a useful industrial motor systems energy management tool. Comments and suggestions have been submitted by Allied Partners, peer reviewers, by industrial end users Experts Group on Motor System Tools, Protocols, and Training, and by a nationwide group of software beta-testers. In July 2000, BJM Corporation, Dreisilker Electric Motors, Inc.; and Pruftechnik, Inc. contributed towards an enhanced version of *MotorMaster+* that enables end users to enter motor predictive maintenance testing data into the Inventory module and to flag motors with values that exceed user specified values. In February of 2003, *MotorMaster+* was updated to support the NEMA Premium™ efficiency motor program.

The Washington State University Cooperative Extension Energy Program developed the *MotorMaster+* 4.0 software tool and User's Guide. Gilbert McCoy designed the software features while Bruce Whitney was responsible for the Visual Basic programming. Nels Christianson provided programming, graphics, and testing support. Laurel le Noble created the print and electronic graphics. Johnny Douglass and Chris Fuess worked with the motor manufacturers to verify the integrity of the motor performance data. Sonia Honeydew developed the On-Line Help system.

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# Disclaimer

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# Overview

## ***MotorMaster+* Features**

*MotorMaster+* Version 4.0 supports motor management functions at medium-sized and large industrial facilities. Designed for utility auditors, industrial energy coordinators, and plant or consulting engineers, *MotorMaster+* supports motor and motor systems improvement planning through identifying the most efficient action for a given repair or motor purchase decision. *MotorMaster+* can be used to identify inefficient or oversized inventory motors and compute the energy and demand savings associated with selection of a replacement energy-efficient model. *MotorMaster+* operates under Microsoft Windows and includes an online help system.

The program is menu-driven, with ample help on-screen. Even if you have never used a computer, you will find using *MotorMaster+* easy. Nothing you do at the keyboard can damage the program. The best way to learn how to install and operate *MotorMaster+* is to follow the instructions on the following pages.

*MotorMaster+* contains an in-plant motor inventory module, maintenance logging and tracking features, a motor manufacturers' motor price and performance database, energy conservation analysis and life cycle costing capabilities, and is equipped with energy accounting and savings tracking functions.

The Inventory module serves as a motor inventory and field measurement storage repository. The module houses motor nameplate information, identification, process, and location codes; load type, operating hours, and working-environment descriptions; and such measured data as voltage, amperage, power factor, and speed at the load point. While *MotorMaster* Version 1.0 could accommodate approximately 10,000 inventory motors, *MotorMaster+* 4.0 has been modified to remove all limits (except for hard-disk space).

You can choose from a variety of descriptor-based motor inventory sorts within the Field Data Module. Also, you can scan for motors operating under abnormal power supply conditions. Measured values are used to determine existing motor loads and efficiencies. Batch analyses can be conducted automatically for populations of motors, determining the costs and energy savings due to changing out all motors in a given facility or process, or only those motors with simple paybacks below a stated value.

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*MotorMaster+* Version 4.0 also includes

- A database of performance and price information on more than **25,000** IEC (metric) and National Electric Manufacturers Association (NEMA) Design B, C, and D three-phase motors. The motors range from 1 to 2,000 horsepower (hp), with speeds of 900, 1,200, 1,800, and 3,600 rpm, and open drip-proof (ODP), totally enclosed fan-cooled (TEFC), totally enclosed nonventilated (TENV), weather-protected (WP), totally enclosed air-over (TEAO), totally enclosed blower-cooled (TEBC) and explosion-proof (EXPL) enclosures. Motors rated to operate at 200, 208, 230, 460, 575, 220/440, 796, 2,300, 4,000, and 6,600 volts are included. Full- and part-load efficiency values are measured in accordance with the IEEE 112 protocol to guarantee consistency. Manufacturers supply the information electronically, and the database is periodically updated. (Motor database updates are available at the USDOE Office of Industrial Technology website ([www.mm3.energy.wsu.edu/mmplus/default.stm](http://www.mm3.energy.wsu.edu/mmplus/default.stm))).
- Technical data that can help optimize a drive system, such as data on motor part-load efficiency and power factor; full-load speed; locked-rotor, breakdown, and full-load torque; and no-load and locked-rotor amperage.
- Purchase information, including list price, warranty period, catalog number, motor weight, and manufacturer's address.
- Analysis features that calculate the energy savings, dollar savings, simple payback, cash flows, and after-tax rate of return on investment from using a particular energy-efficient motor in a new purchase or retrofit application. Variables such as motor efficiency, purchase price, energy costs, hours of operation, load factor, and utility rebates are taken into account.
- Utility rate schedule and motor rebate program data, including minimum qualifying efficiency and rebate dollar values.
- Energy accounting, conservation savings tracking, and greenhouse gas emissions reduction reporting capabilities.
- Menus and extensive help screens that make *MotorMaster+* easy to learn and use.

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*MotorMaster+* Version 4.0 contains many motor energy management features. As an informed *MotorMaster+* user, you can

List

Create a list of available new motors that meet your purchase specifications.

Compare

Determine both energy and dollar savings from selecting and operating a Premium Efficiency motor model.

Life Cycle

Compute annual cash flows and the after-tax rate of return on a motor systems investment.

Inventory

Create your company motor inventory database and generate searches and reports based on motor and load descriptors.

Batch Analysis

Initiate motor repair or replacement analyses for populations of motors within your company.

Savings Tracker

Produce energy conservation summary, facility reduction in consumption, and greenhouse gas emissions reduction reports.

Billing

Production

Reports

Form EIA-1605

*MotorMaster+* is easy to use. Experienced computer users are likely to find that the program's help windows are all they need to operate the program. The *User's Guide* (this manual) provides more detailed help.

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## Some Conventions

Throughout the *User's Guide*, special type styles indicate certain actions:

**Bold** means “press the function key” or “select the toolbar button.” Examples: **Print**, **Save**, **Delete**. Window, screen, and report names are also bold. Quotation marks represent computer messages or prompts: CAPS are used for program file names, such as MOTOR.LST. **BOLD CAPS** are used for information users are to enter via the keyboard, such as **A:SETUP**.

You can use the Tab key to scroll through the *MotorMaster+* data entry and analysis screens or use the mouse to highlight a field of interest. In many cases, a data field uses a combo box containing a predefined list of choices. You may click on the down arrow to view the list, then make the desired selection by clicking on the item with the mouse.

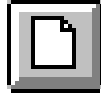
*MotorMaster+* has a primary screen with the main menu on it. See Screen 1. From this **Main Menu** screen, you can select various "destination buttons" that take you to various *MotorMaster+* modules. These modules contain different program features or functions. Each module contains windows within which information can be viewed or entered. Each window has its own menu at the top of the screen, from which all options for that screen may be selected. Most screens have a toolbar under the menu, with multiple buttons corresponding to most of those options.

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The following is a typical toolbar:



The buttons on this toolbar perform the following functions:



**New** Click this button to enter edit mode and create a new record for the current data. For example, on the **Facilities** screen, clicking this button would initiate creating a new facility.



**Edit** Click this button to enter edit mode for making changes to the currently displayed data.



**Save** Once in edit mode (initiated by clicking the **New** or **Edit** buttons), click this button to save the information. Note that in the above toolbar, this button is “grayed out” (“disabled”). In different contexts, certain functions will be unavailable for use. (The above toolbar indicates that the screen is in non-edit mode. The data fields will have a light-gray background and cannot be modified. In edit mode, however, the fields have a white background and can be changed.) The **Save** button is not available unless you are in edit mode. In edit mode, the above toolbar would look like this:



In this context, all buttons are unavailable except **Save**, **Help**, and **Cancel**

**Delete**

Click this button to delete the currently displayed record. This action may have serious repercussions, so it should be used with care. For example, because of the hierarchical nature of the Company Database, deleting a facility implies deleting all its departments. You will always be informed of the possibilities and have a chance to cancel the command.

**Select Hierarchy**

Available only to the **Facilities, Departments, Processes, and Inventory** screens. Click this button to display a selection screen with an ordered listing of the company hierarchy: Facilities, Departments, Processes, and Inventory Motors.

**Copy Motors to Inventory**

Click this button to add one or more motors to the facility inventory from the catalog database or to copy another inventory entry. Multiple copies of any Catalog or inventory motor can be created and incorporated into the facility motor inventory (available only at the **Inventory** screen).

**Print**

Click this button to access a standard **Print Reports** setup screen (see the section on **Printing** near the end of this manual).

**Help**

Click this button for standard Windows-style, context-sensitive help.

**Exit**

Click this button to exit the current screen and return to the previous screen. In edit mode, this button is labeled **Cancel** (see the second toolbar above). Click this button to cancel edit mode and return the edited (or created) data to its previous state. The toolbar is then restored to its original configuration, and you can then exit the screen by pressing this button (now labeled **Exit**) again.

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## Databases

Two databases are used in the operation of *MotorMaster+* Version 4.0: the Master Database and the Company Database. All databases are in Microsoft Access format. Do not attempt to modify the data in any way from Microsoft Access itself. The tables within each database are interconnected in complicated ways, and any attempts to change data outside *MotorMaster+* could result in incompatibility and impaired program performance.

### Master Database

*MotorMaster+* contains a manufacturers' motor price and performance database that is referred to as the Motor Catalog table. This table contains elements of motor data for more than **25,000** NEMA Design B, C, and D, IEC, and two-speed motors from 18 motor manufacturers. This information is supplied in electronic format by the motor manufacturers. All motor efficiency data is taken in accordance with the IEEE 112 testing protocols.

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### *National Electrical Manufacturers Association (NEMA)*

*NEMA is a trade association that establishes standards to help in the selection and application of electric motors and other electrical equipment.*

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### Motor Catalog Data

The motor performance database includes the following information, when available, for each motor.

Horsepower	Voltage rating	Full-load torque
Synchronous speed	Service factor	Breakdown torque
Enclosure type	Nominal full-load efficiency	Locked rotor torque
Manufacturer's name	Nominal 3/4-load efficiency	No-load amps
Model name	Nominal 1/2-load efficiency	Full-load amps
Catalog number	Nominal 1/4-load efficiency	Locked rotor amps
Frame size	Full-load power factor	Number of rotor bars
Features	3/4-load power factor	Number of stator slots
Full-load rpm	1/2-load power factor	List price
Weight (lb.)	1/4-load power factor	Warranty (years)
	Winding resistance	Stalled rotor time
	Peak voltage (0, 5 microseconds)	(hot, cold)

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## **Motor Manufacturers**

The following manufacturers are included in the *MotorMaster+* Version 4.0 Motor Catalog data:

ABB	Lafert	Sterling
A.O. Smith/Magnetek	Leeson	Tatung
Baldor	Lincoln	Teco/Westinghouse
Dayton	Marathon	Toshiba
General Electric	Reliance	U.S. Motors
Hemco	Siemens	WEG

The Master Database also contains the following information:

- EPACT, NEMA Premium™ and NEMA Energy Efficient minimum full-load efficiency motor standards.
- Code lookup tables and default tables that can be altered and maintained by the user, such as load types; default rewind and installation costs; and fuel, electrical energy, and demand escalation rate tables.
- Utility data, including utility rate and rebate schedules. They are also maintainable by the user. The utility rates and rebates can be applied across multiple company databases.

## **Company Database**

The Company Database that you create contains information similar to that in the Motor Catalog table for all the motors in your company, organized in a hierarchical company structure that includes facilities (serviced by utilities), departments (contained in facilities), and processes (contained in departments, and which contain your motors). Field data measurements for the motors can be entered and are used internally to estimate the load imposed on the motor by its driven equipment as well as determine the efficiency of the motor at its operating point.

Multiple companies may be created and accessed, all linked to the single Master Database. *MotorMaster+* comes with a sample Company Database. (Near the end of the manual, there is a tutorial to help you learn how to find your way through this database.)





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### ***Transfer of Company Databases from Previous Versions of MotorMaster***

Install *MotorMaster+* Version 4.0. The default directory or folder for *MotorMaster+* Version 3.0 was C:\MMPLUS3. The default for *MotorMaster+* Version 4.0 is C:\MMPLUS4. A different directory name is selected so users can retain the ability to operate Version 3.0 after Version 4.0 is installed. The Version 3.0 directory may be deleted after the user becomes familiar with Version 4.0 features and functions.

Company databases created with Version 3.0 reside in the MMPLUS3 directory and contain a .mdb extension. Utility rates, energy and fuel cost escalation rate tables, default motor rewind and installation costs, motor rebate tables and customized load list information reside in the MMW.mdb file. To transfer your utility information and in-plant motor inventory into Version 4.0 from Version 3.0, copy your company files and the MMW. mdb file from the MMPLUS3 directory into the MMPLUS4 directory.

When you start *MotorMaster+* Version 4.0, the Version 3.0 MMW.mdb file will automatically be converted to the Version 4.0 format. Next, click on the Browse button at the Company screen. Then click on C:\ at the Folders window. Highlight the file of interest, then click OK to load your company file and in-plant motor inventory into the Version 4.0 Company Database selection box.

### ***Back up! Back up! Back up!***

It cannot be stressed enough that you need to back up your databases regularly and often. If you use the program every day, back up the data every day. This includes the Master Database (MMW.MDB) and your Company Database.

### ***Transfer of Company Databases to Other Users***

To transfer a *MotorMaster+* Company database to another user (such as from a consultant to a client or an industrial end user), simply attach the Company database to an E-Mail and send it to the client. The location of your Company database is indicated within the Disk File Name box at the lower left corner of the Company-View screen. The recipient of the E-Mail stores the Company file attachment into his MMPLUS4 directory, then clicks on the Browse button on his Company screen, highlights the file of interest, and then clicks 'OK' to load the Company database into the work space or Company Database combo box.

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# Getting Started

## Installing *MotorMaster+* Version 4.0

Insert the Decision Tools for Industry CD into the appropriate disk drive. The Decision Tools for Industry Installation System Menu appears. Click on the *MotorMaster+* 4.0 button. The Decision Tools CD also contains the Steam System Scoping Tool, Pumping System Assessment Tool (PSAT), AirMaster+ Compressed Air System Assessment Tool, and the 3Eplus insulation system optimization program.

The Setup program will ask you where on your hard disk you want the program and data installed, with the default subdirectory "C:\MMPLUS4". After *MotorMaster+* has been installed, you can run the program immediately or simply exit to go back to Windows. In Windows Program Manager, you will see a new program group called "*MotorMaster+*" containing the program icon of the same name. Double-click on the icon to run the program.

## Multi-User Access

*MotorMaster+* 4.0 can be installed on a company's local-area or wide-area network and used by anyone with access to that network. (Please note that users must have direct access to the network. Remote dial-in connections and Internet access do not apply.) This feature allows for the use of *MotorMaster+* as a multi-user database in two ways:

1. All save and delete functions are executed as transactions, which guarantee no conflicts with other users performing the same operations. In other words, the program will now prevent the possibility of the database being corrupted if two users are working on the same item, such as a facility, process, or motor. This feature is invisible to the user and requires no new instructions.
2. A company can set up a system of users and passwords with varying degrees of "permissions." For instance, the system administrator could install the program on a network, assign a number of people access to the program, only allowing certain users the ability to enter new data, edit or delete old data, while restricting all others to the ability to view data, do comparisons, etc. (Please note that this is limited to local area networks, not through the Internet.) This feature can be set up as follows:



**New**

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Install the software on a network drive.

- Create or convert the company database to which restricted access is to be applied.
- From the main screen, select the **Options** menu option, then **User Security**.
- On the displayed screen, add users in the same manner as on other screens. The first name added is designated as a System Administrator. Once a System Administrator is identified, only that individual plus those provided security clearance (i.e., given a Network ID and a *MotorMaster* password) by the System Administrator(s) are enabled to access the Company database. Note that users may be assigned different sets of permissions for different company databases.
- Add, Modify, Save, and Delete all function in the same way as in the rest of the program. The network ID is the name the user will use to log in. This could be the same as their company login, or another name if they wish.
- The password will be encrypted in the database, but visible to the administrator.
- The Security Access options should be self-explanatory. For users who will not edit any data, leave all options unchecked. They will still be able to see all data (except user security), perform Comparisons, Lifecycle calculations, and print reports. ***They just will not be able to add, edit or delete records. For instance, without permission to edit inventory records, the Add, Edit, Save, and Delete buttons on the Inventory screen are disabled. The user can still search for motors and view the data, but won't be able to change anything.***
- The System Administrator has complete permission to edit all data, including editing and viewing of User Security data. At least one person MUST have this ability. Otherwise, no one will be able to add, modify or delete any user security information.
- Once one or more users have been added to this company database, all users will be required to enter their name and password before opening the database. Users not in the system will not be able to start the program. (Other databases are still accessible.)
- To return the database to completely free access, the System Administrator must delete all users from the User Security screen.

---

### ***MotorMaster+ Sample Database***

*MotorMaster+ comes equipped with a sample Company Database composed of one company (General Distribution, Inc.), three facilities (Centralia Wood Products, Concentrated Juice, Ltd., and Consolidated Foodstuffs), seven departments, 23 industrial processes, and 112 in-service and spare electrical motors. Utility billing and plant production histories are also available within **Savings Tracker**. Serving utility, nameplate, and field test data are supplied for each motor, so that you can examine and familiarize yourself with the capabilities of the software immediately.*

This sample database is loaded when you start the program, as is shown on the information line at the bottom of the opening screen (Screen 1).

The sample database Company/Facility/Department/Process/Motor hierarchy can be displayed at the **Facilities**, **Departments**, **Processes**, or motor **Inventory** screens by clicking on the **Hierarchy** button.

To help you learn how to use MotorMaster+ to its fullest advantage, we have included a tutorial near the end of this manual. We strongly urge you to step through the tutorial before creating your own Company Database. You will get a better understanding of how the database is structured, how the program pieces work together, and how to use the program to your best benefit.

### Screen 1



Warning: A white band appears at the bottom and right hand side of the MotorMaster+ splash screen when the user has chosen a Display setting of "Large Fonts." To restore the Main Menu screen to its proper appearance, enter "Control Panel," then Display and Settings to select "Small Fonts."

---

## Main Menu

The **Main Menu** offers six choices across the top of the screen: **Field Data**, **List**, **Compare**, **Savings Tracker**, **Options**, and **Help**.

**Field Data** lets you enter or update company, facility, department, process, or utility information, or add or modify motor nameplate information or field data measurements. Descriptive searches and selective reports are generated within the motor **Inventory** portion of the Field Data module.

- **Company Database:** Enter company information, such as address, phone number, contact person, industry type, and SIC code. Also, select another database or create a new one.
- **Utility Service Information:** Enter or edit utility information, including name, address, phone, and contact person. At this screen you will also enter rate schedules and motor rebate program values, if applicable, for each utility.
- **Facilities:** Enter or edit information for one or more company facilities, including address, phone, contact person, production units, serving electrical utility, and specific utility rate information for performing cost-effectiveness calculations for the motors used in the facility.
- **Departments:** Enter or edit department information.
- **Processes:** Enter or edit process information, including process description and operating schedule.
- **Motor Inventory:** Enter or edit motor design and performance information. Each motor record holds a wealth of important information including nameplate data, operating schedule, load status, field measurements, maintenance history, and load, efficiency, and energy use calculations.
- **Batch Analysis:** Batch motor repair versus replace, or operable motor replacement analyses can be made for any set or subset of Inventory motors. Replacement motors can be identical to those in the existing stock, downsized (if appropriate), or upgraded to severe duty motors or motors which conform to IEEE 841 specifications. The user may also specify that existing U-frame motors be replaced with energy-efficient T-frame models. *MotorMaster+* automatically searches its internal motors database or motor manufacturers catalog for appropriate and cost-effective replacements.

**List** uses information you enter from the keyboard to create a list of all available motors meeting your specifications, along with their performance and purchase data. Available motors are typically listed in descending order of full-load efficiency.

**Compare** calculates the annual energy consumption and energy costs for particular motors in a specific application. It predicts expected energy and cost savings for replacing an existing motor with a specific Premium Efficiency model, and shows the simple payback from energy-cost savings.

You can compare two motors in three different scenarios:

- **New:** Compare two new motors from the motor catalog.

- 
- **Rewind:** Compare rewinding an existing motor with purchase of a new Premium Efficiency motor.
  - **Replace Existing:** Compare an existing motor with a new Premium Efficiency replacement.

Comparisons produce an analysis of potential savings and the simple payback period. A life cycle cost analysis is also accessible from the Main Menu or the **Compare - Energy Savings** screen. *MotorMaster+* allows the use of "generic" standard efficiency motors or existing inventory motors in the rewind and replace existing motor comparison analyses.

A **Motor Catalog Query** screen is also available and contains parameters for selecting and sorting lists of motors from the catalog of new motors. For instance, the user may wish to create a list of all available 5 hp, 1800 rpm, 460-volt Washdown or Cleanup-duty motors. The list may be sorted in ascending or descending order of the motor's full-load efficiency, full-load speed, power factor, list price, or locked-rotor torque. Reports can be printed and motor performance details viewed.

**Savings Tracker** is designed to allow the facility energy coordinator to document energy savings and illustrate the energy, dollar, and environmental benefits realized from conducting an in-plant motor and motor-driven equipment energy management program. **Savings Tracker** contains three submodules:

- **Billing:** Enter and display utility billing data including billing period, energy use and cost, demand and demand charges, power factor and power factor penalties, and total electricity costs. Multiple meters may be assigned to a single facility.
- **Production:** Enter and display the production by month (millions of gallons or billions of board feet) at the facility level.
- **Reports:** Produce Monthly Billing Summary, Energy Conservation Summary, and Facility Reduction in Consumption reports. The Energy Conservation Summary report aggregates the energy, demand, and dollar savings from all energy actions taken over a specified time period. A Greenhouse Gas Emissions Reduction report (Form EIA-1605EZ) can also be generated. The Reduction in Consumption report vividly portrays efficiency gains by displaying the facility energy use index (EUI or energy consumption per unit of product) on a monthly and an annual rolling average basis.

**Options** lets you customize *MotorMaster+* to reflect industry or utility-specific loads and costs. Alternatives available under this menu item include:

- **Load-List:** *MotorMaster+* comes with a series of load types to be assigned to inventory motors. *MotorMaster+* allows you to create facility-specific load types if you wish.

- 
- **Production Units:** Used to create a master list of products produced along with monthly production units (i.e., millions of pounds of dehydrated potato products). Note: the Production Type is assigned to a particular facility at the **Facilities** screen.
  - **Escalation Rates:** Allows you to create strings of variable annual fuel, electrical energy, and demand escalation rates. These **Escalation Rate** files can be accessed and used within the *MotorMaster+* **Life Cycle** cost analysis module.
  - **Installation Costs:** Allows you to view and edit motor installation cost defaults.
  - **Rewind Costs:** Allows you to view and edit motor rewind cost defaults.
  - **List Price Discount Factors:** Allows you to edit the current set of manufacturer-specific list price discount factors. Those values will automatically be incorporated into **Batch** and individual motor **Compare** analyses.
  - **Import Inventory:** Enables you to import existing motor databases directly into the *MotorMaster+* **Inventory** module.
  - **Recalculate Inventory:** Used after a population of motors has been imported into the **Inventory** module. Determines and indicates the efficiency status of each motor (Premium Efficiency, Energy-Efficient or Standard) based upon an examination of the motor's entered full-load efficiency value.
  - **User Security:** Used to provide multi-user access over a local or wide-area network. A designated system administrator can assign passwords to allow users access to the program and provide read, add, and/or editing permissions.

**New**

**New**

**Help** displays the Help Menu.

To facilitate movement through the linked databases, the **Main Menu** screen is equipped with a cluster of destination buttons. Clicking on any of those buttons takes you directly to the associated view screen. Exiting from any of the screens automatically returns you to the **Main Menu**. Clicking on the **Exit** button exits the program and returns you to Windows.

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## Creating a Company Database

*MotorMaster+* comes with a sample Company Database that is loaded the first time you use the program. We strongly recommend that you experiment with this database by taking the time to step through the tutorial, "**Traversing the *MotorMaster+* Field Data Module**," near the end of this manual. It will help you get a clearer picture of how the Company Database is constructed and how the data it contains can be used. Most of the discussion of the program in the *User's Guide* is based on this sample database.

Now that you're ready to create your own Company Database, here's a quick summary of how the hierarchy of the Company Database works:

- A Company contains one or more facilities.
- Each Facility contains one or more departments.
- Each Department contains one or more processes.
- Each Process may contain any number of motors.

However your company is organized, the above structure must be imposed upon it in order for *MotorMaster+* to work for you. The following steps take you through constructing your own Company Database.

### **Company**

From the **Main Menu** screen, click on the **Company** button. The Company screen appears with the sample Company Database information displayed.

Click on the **New** button on the toolbar to clear the data fields and enter edit mode. Enter your company information. The Company Name, Industry Type, and SIC Code entries are required for **Savings Tracker** Greenhouse Gas Emissions Reduction reports.

Click on the **Save** button on the toolbar. A standard Windows File dialog box will be displayed. A Company Database is actually a Microsoft Access database file. You must assign a filename (no extension) to the new Company Database. Click on the **OK** button to finish saving the new Company Database.

After a few seconds, the new database will have been created and saved. Note that the name of your new Company Database now appears in the Company Database combo box. Click on the down arrow to see that the sample Company Database is still in the list and is accessible for future experimentation.

Click on the **Exit** button to leave the **Company** screen and return to the **Main Menu** screen.



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Note that many buttons are grayed out. That is because some functions are inaccessible due to lack of information. For instance, if there are no facilities yet, it makes no sense to access the **Departments** or **Processes** screen.

### **Utilities**

Click on the **Utilities** button to access the **Utilities-View** screen. Utilities are stored in the Master Database, so all the utilities available to the sample Company Database in the above tutorial are also available to your new Company Database. But you'll probably want to enter your own utility.

Click on the **New** button on the toolbar to blank the data fields and enter edit mode. Enter your utility information. The utility name is the only field required on this screen.

Click on the **Save** button to retain the information you entered. Now you'll need to enter a utility rate schedule, so click on the **Rate Schedules** button in the lower part of the **Utilities-View** screen. The **Utility Rate Schedules-View** screen appears.

The new utility is displayed in the Utility combo box. Click the **New** button on the toolbar to enter edit mode.

Enter the Rate Schedule information. In this case, all fields are important. Enter the beginning day of each of two seasons. (If your utility does not offer seasonally varying rates, enter 01/01 and 12/31 for your start months and days. The software will then assign all 12 billing months to Season 1. Energy and demand charge values need not be entered in the Season 2 boxes.) Now enter the demand charge (\$/kW) and energy charge rates (\$/kWh) for each season. Energy charges may span up to three tailblocks.

Note: The user need not enter the block "size" or a plant's monthly energy use that defines a block. Block size is not relevant because *MotorMaster+* considers the marginal rather than the average cost of energy for each season. Energy efficiency benefits should always be valued at the incremental or marginal cost for the last unit of energy consumed.

Save the data by clicking on the **Save** button. Rate Schedule data can be assigned to a facility and subsequently applied to all motors contained in that facility.

Exit the **Rate Schedules** screen by clicking on the **Exit** button. Note that there is also a **Rebate Programs** button under the **Rate Schedules** button. Refer to the Rebate section later in this book if you wish to enter rebate data. For now, leave the **Utilities-View** screen by clicking on the **Exit** button.

### **Facilities**

From the **Main Menu** screen, click on the **Facilities** button to bring up the **Facilities-View** screen. Click on the **New** button to clear the fields and enter edit mode.

There are four tabs on this screen. Enter the basic Facility information on the first tab.

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Here, the Facility name is the only field required. Now click on the second tab. Assign a utility and rate schedule to this facility by selecting from the corresponding combo boxes. The rate schedule information will be loaded into the display boxes below.

Specify the number of months of operation for this facility in each of the two seasons. Then examine your utility rate schedule and/or monthly billing statement and select the applicable block energy charge for each season.

Click on the **Save** button to save the new Facility data. Repeat these steps to create records for all your facilities. Exit the **Facilities-View** screen by clicking on the **Exit** button. At the **Main Menu** screen, note that the **Departments** button is now colored and accessible.

### ***Departments***

Click on the **Departments** button to bring up the **Departments-View** screen. Even if your company is small enough that there is no need for a department level, impose the program structure by creating at least one department.

From the Facility combo box, select the facility to which you want the new department assigned (if you have only entered one facility, this selection happens automatically). Click on the **New** button to clear the fields and enter edit mode. The only field required is the department name.

Click on the **Save** button to save the new department. Repeat these steps to create records for all your departments. Remember to assign the Facility first. Click on the **Exit** button to return to the **Main Menu** screen. Now the **Processes** button is accessible.

### ***Processes***

Click on the **Processes** button to enter the **Processes-View** screen. Process-related operating schedules are used as defaults for calculating annual energy use and cost for all motors assigned to the process.

From the Facility and Department combo boxes, select the facility and department to which you want the new process assigned. (If you have only entered one facility and one department, this selection happens automatically.) Click on the **New** button to clear the data fields and enter edit mode.

The process name is required. Specify the annual operating hours or the number of days per year for each of the weekday and weekend categories. Also enter the number of hours of operation of the new process in each of the three shifts for weekdays and weekends, if appropriate. The total annual hours of process operation appears in the lower right hand portion of the screen. This number of operating hours is used as a default for all motors assigned to this process.

Click on the **Save** button to save the new process information.

Repeat these steps to create any number of processes. Always remember to select the

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appropriate facility and department first.

Click on the **Exit** button to return to the **Main Menu** screen. The **Inventory** button is now accessible, as well as the **Batch Analysis** button.

### ***Inventory***

Click on the **Inventory** button to bring up the Inventory screen.

From the Facility, Department, and Process combo boxes in the upper part of the screen, select the facility, department, and process to which you want the new inventory motor assigned (if you have only entered one facility, one department, and one process, this selection happens automatically).

Click on the **New** or **Copy Motors to Inventory** button. When the **New** option is selected, a small window appears asking the intent of the motor data input (this query determines that you don't really mean to replace an existing motor with a new one). Accept the option "Routine Motor Addition" by clicking on the **OK** button.

You are now back at the **Inventory** screen in edit mode with the data fields cleared for data entry. If you have or wish to start your own system of motor identification codes, use the "Motor ID" field for that purpose (it will be available for searching later and must be unique). Then enter the description plus motor nameplate information on the first tab.

Note: The user is <u>required</u> to enter at least the motor Description, Motor type, Synchronous speed, Size (hp rating), Enclosure type, and Voltage rating.
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When you click on the **Copy Motors to Inventory** button, a **Copy Motors to Inventory** pop-up screen appears. This feature allows you to copy one or more motors from the *MotorMaster+* catalog or create duplicates of another inventory motors Nameplate screen. (**Copy Motors to Inventory** functions are discussed in detail on page 50).

After the motor **Nameplate** screen is complete, click on the **Operating Profile** tab. Note that the operating schedule for the assigned process is already set as the default for the new motor. These data may be edited.

Now click on the **Load Status** tab. Enter appropriate load, load modulation, starter, grease type, and motor-bearing information. Then click on the **Field Measurements** tab. When sufficient data have been entered, the load on the motor, efficiency at its load point, and annual energy use and cost are displayed. Click on the **Save** button to save the data. Repeat this process, assigning Facility, Department, and Process first, then entering and saving motor data.

To return to the **Main Menu** screen, click on the **Exit** button.

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### ***Finished?***

Your new Company Database is now useable, though it may not be complete. Note that all buttons on the **Main Menu** screen are now accessible. You may add to or update your Company database at any time.

# Motor Selection Guidance: List

Select **List** to create a report of performance and purchase information for motors that meet your specifications.

## Listing Motors

At the **Main Menu**, click on **List**. The **Motor Catalog Query-List** window appears. See Screen 2. Click on the down arrow at the **Motor Type** combo box to obtain a listing of the types of motors contained within the *MotorMaster+* catalog database. Your choices are NEMA Design B, C, or D motors, IEC or metric motors (60 Hz operation), and Two-speed motors. Make your selection. Subsequent queries and choices are dependent upon your Motor Type selection.

### Screen 2

The screenshot shows the 'Motor Catalog Query - LIST' window. It features a search interface with buttons for 'Search', 'Select', 'Clear', 'Detail', 'Reset Cols', and 'Exit'. The search criteria are set as follows: Motor type: NEMA Design B; Enclosure: Totally Enclosed Fan-Cooled; Speed: 1800 RPM; Size: 60 HP; Voltage: 460. The 'Definite Purpose' is set to '- General purpose motors -'. A list of manufacturers is shown, including ABB, AD\_Smith/Magnetek, Baldor, Dayton, G.E., and Hemco. The results are sorted by Efficiency in descending order, showing 61 motors found. The table below represents the data shown in the screenshot.

Manufacturer	Model	List Price	Catalog	Voltage	Eff 100%	Enclosure
Marathon	364TTFSXX2		XP11	460 volts	95.0	TEFC
Marathon	364TTFS6036	4,725	E211	230/460 volts	95.0	TEFC
Marathon	364STFSXX2		XP12	460 volts	95.0	TEFC
AD_Smith/Magnetek	E-PLUS 3SD	6,294	S676	460 volts	95.0	TEFC
Lincoln	Ultimate E2 - Hostile	3,991	LM14809	230/460 volts	95.0	TEFC
Baldor	SUPER-E, NEMA	5,326	EM4314T	230/460 volts	95.0	TEFC
Premium Efficiency	NEMA Table 12-12		MG 1-1998		95.0	TEFC
US Motors	AN65	5,324	Hw60V2E2	230/460 volts	94.5	TEFC
US Motors	AA24	4,840	H60V2B	230/460 volts	94.5	TEFC
Teco/Westinghouse	MAX-E1/HE	4,974	E0604	208-230/460 volts	94.5	TEFC
G.E.	Energy Saver Extra	7,939	E9459	460 volts	94.5	TEFC

At the bottom of the window, there is a button to 'Create new list based on currently-displayed criteria' and a timestamp 'Last update: 01-01-2003'.

ext, click on the down arrow box to display choices for the first motor characteristic, **Speed (rpm)**. You can accept the value displayed, or you can change it. To accept the value displayed on the screen, click or press **Enter**.

OR

To change the value, click to highlight the correct value, then click or press **Enter**. Repeat the process to specify size (hp), voltage, and enclosure type.

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The *MotorMaster+* Version 4.0 motors catalog contains a library of special and definite-purpose motors including:

- Oil well pumpers  
(NEMA Design D motors).
- High-starting torque motors  
(NEMA Design C motors).
- IEC or metric-frame motors.
- Two-speed motors (variable or constant torque).
- C-faced motors.
- Close-coupled pump motors.
- IEEE 841 Petroleum and Chemical duty motors.
- Washdown or cleanup duty motors.
- Severe-duty/extra-tough/corrosion-resistant motors.
- Inverter duty motors (variable torque, constant torque, and vector drive).

**Special Features** motors such as U-Frame (Automotive duty), Vertical Shaft, C-Faced, and D-Flange motors can be listed by clicking on the checkbox next to the indicated feature. Note that multiple “**Special Features**” may be selected. Definite-purpose motors, such as Close-coupled pump motors, Inverter duty motors or IEEE 841 Petroleum and Chemical duty motors, are specified by making a selection in the **Definite Purpose** combo box. Only one Definite Purpose can be specified at a time. Indicate “**General Purpose Motors**” if you do not wish to create an exclusive list of Definite Purpose motors.

*MotorMaster+* Version 3.0 allows users to specify motors with combinations of special features, such as an Explosion-Proof, U-Frame, Two-speed motor.

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Tip: The **Definite Purpose** combo box default is “General Purpose Motors.” **List** then produces a report containing all Standard-efficiency, Energy-Efficient, and Premium Efficiency motors in the manufacturer's database. When any selection is made at the Definite Purpose combo box, **ONLY** motors with the desired feature are listed. For instance, clicking on IEEE 841 Petroleum and Chemical duty motors will produce a list of all such motors with the indicated horsepower speed, enclosure, and voltage ratings.

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You may choose to list qualifying motors from all manufacturers or from one or more selected manufacturers. Clicking on a manufacturer's name in the **Manufacturers** combo box will cause it to be highlighted. Use the up- or down-arrow boxes to view the complete listing of manufacturers. The **List** search is limited to highlighted manufacturers with the number of manufacturers indicated above the Manufacturers display box. Clicking on the **All** button will include all manufacturers in the search.

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When you have finished selecting your search parameters, click on the **Search** button. *MotorMaster+* will examine its database and display a report of the results on the screen. The number of available motors is highlighted on the **Motor Catalog Query** screen. Qualifying motors can be displayed in ascending or descending order of a number of descriptors, including full-load efficiency, power factor, manufacturer's name, or list price. Click on the down-arrow box at the **Sort Column** box to review available sorting options. The values you have selected as search criteria will be retained until you change them.

The **List** report indicates the motor Manufacturer, Model, Catalog number, Voltage rating, Enclosure type, Full-load Efficiency, Speed, and Power Factor; List Price, Frame number, Locked rotor torque, Full-load and Idle amps, and Efficiency at 75 percent and 50 percent load. Columns may be “dragged and dropped” by clicking on a column heading and then moving it to the desired location. The new on-screen report format is permanently retained. Click on the **Reset Columns** button on the toolbar to return the **List** report to its original appearance. Click on the Clear button to restore Definite Purpose and Special Features selections to General Purpose settings. Due to Report Generator limitations, the user cannot modify the appearance of the printed List report.

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## ***Optimizing Motor System Efficiency***

*When selecting a motor, consider these tips:*

- *Some Premium Efficiency motors run slightly faster than their standard-efficiency counterparts at full-rated load. With centrifugal load applications such as fans and pumps, a replacement motor can lose its efficiency benefit if it does not match the full-load speed of the original. This loss happens because the load imposed upon the motor increases significantly at a higher operating speed. MotorMaster+ includes full-load rpm data so that speed changes are taken into account and motors can be properly matched to your equipment needs.*
  - *Some Premium Efficiency motors have high inrush currents. Take this into account when sizing protective circuits. Problems should not occur if your protection system has enough capacity or if your motor has a “soft start” control.*
  - *Resolve power-quality problems such as under or over voltage or phase voltage unbalance prior to taking field measurements or conducting a motor replacement assessment. Consult the motor manufacturer if your power quality is questionable, especially if you are replacing a burned-out motor. If you make major electrical system changes, have an electrical engineer review your plans. Your local electric utility can also advise you about power quality.*
  - *Avoid oversizing motors. Motors should be sized for a load factor of 50 to 100 percent. Lower loads result in reduced efficiency and a lower power factor.*
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### **Summary:**

1. Select **List** from the Main Menu.
2. For each motor characteristic, special feature or definite purpose listed in the **Motor Catalog Query** window, either accept the default value, click on the checkbox, or click on the down-arrow box to display your options.
3. From each option list, scroll until the desired value is displayed. Click to select a highlighted value as your search criteria.
4. Indicate whether you want to list products available from all manufacturers, a specific manufacturer, or any combination of manufacturers. Click on a manufacturer to make your choice. Manufacturers selected are highlighted.

When you have finished selecting all of your criteria, click on **Search** to provide an on-screen list of the motors that meet your specifications.

## **Viewing the On-Screen List**

Motors that meet your specifications are selected automatically from the *MotorMaster+* database and listed on screen in ascending or descending order of the selected **Sort Column** parameter. Typically, motors are listed in descending order of full-load efficiency. See Screen 2. The NEMA Premium™ and Energy-Efficient motor minimum full-load efficiency standards displayed when motors are listed in descending order of full-load efficiency. When you select an electrical utility from the **Motor Catalog Query - Utility Rebate Schedule** combo box, also displayed for each motor class is the minimum full-load efficiency that a motor must equal or exceed to qualify for a rebate. See the **Options** section of this *User's Guide* for instructions on adding, editing, or displaying utility rebate program parameters.

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### ***NEMA, EPACT, and Utility Minimum Full-Load Efficiency Standards***

*NEMA establishes minimum nominal full-load efficiency standards for motors that may be designated as "Premium Efficiency" or "Energy Efficient." The NEMA standards apply to 1 to 500 hp motors rated at 600 volts and below and which operate at 1200, 1800, or 3600 rpm. The NEMA Premium Efficiency standards also apply to 250 to 500 hp form-wound motors rated at 5,000 Volts or less. The Energy Efficient standards also apply to motors with a synchronous speed of 900 RPM. The minimum full-load efficiency values for Premium Efficiency motors are consistent with Table 12-12 of NEMA MG 1-1998, Rev 2. Energy-Efficient motor standards are taken from Table 12-11 of the same document. Motors listed above the standard bars meet the NEMA standard.*



The Energy Policy Act of 1992 (EPACT) requires that most general purpose motors manufactured for sale in the United States after October 24, 1997 meet new minimum efficiency standards. EPACT applies to 1 to 200 hp single-speed, foot-mounted T-frame NEMA Design A and B motors. Covered motors are designed to operate with 230 or 460 volt power supplies, have open or totally-enclosed enclosures (including explosion-proof) and operate at speeds of 1200, 1800, or 3600 rpm. An EPACT standard bar appears when a List report is generated for covered motors.

If you select a utility motor rebate program the List report will include a standard bar, indicating the minimum full-load efficiency that a motor must equal or exceed to qualify for the utility's motor rebate incentive.

Click on the arrow boxes to scroll through the list of available motors. For each motor, the on-screen list includes the manufacturer and model, full-load efficiency rating, rpm, and list price. *MotorMaster+* can give you much more information about any of the motors listed. For detailed information on a specific motor, double-click to highlight an individual motor data line, then click again, press **Enter** or click on the **Detail** button. A formatted display of performance information for the motor of interest appears. Use the **Previous** or **Next** buttons to scroll up or down and view other screens.

The **Motor Catalog Detail** screen (Screen 3) shows this extended information.

### Screen 3

The screenshot shows the 'Motor Catalog Detail' window with the following data:

Manufacturer		Efficiency (%)		Power Factor (%)	
G.E.		Full Load	94.5	Full Load	78.0
Model: X\$D Ultra - IEEE 841		75% Load	94.7	75% Load	73.6
Catalog: M9455		50% Load	94.3	50% Load	63.3
Motor type: NEMA Design B		25% Load	91.6	25% Load	41.5
Size (HP): 50	Full load speed (RPM): 1780	Torque (ft-lbs)		Amperage (amps)	
Speed (RPM): 1800		Full Load	147.4	Full Load	63.5
Enclosure type: TEFC	Frame No.: 326T	Breakdown	294.8	Idle	25.7
Voltage rating: 460 volts		Locked Rotor	206.4	Locked Rotor	362.5
Definite purpose: IEEE '841' petroleum/chemical duty		Stalled rotor time (sec.)		Peak voltage	
U-Frame <input type="checkbox"/>	C-Face <input type="checkbox"/>	Hot	92.9	@ 0 ms.	2000.0
Vertical shaft <input type="checkbox"/>	D-Flange <input type="checkbox"/>	Cold	115.2	@ 5 ms.	
Service factor: 1.15	Insulation Class: F	Rotor bars	38	Stator slots	48
Weight (lbs.): 511.0	List Price (\$): 4615				
Winding resistance (mDhms@25C): 99.5	Warranty (yrs): 5.0				

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## Printing

Click on the **Print** button on the toolbar to display the *MotorMaster+* **Print Reports** screen. There are two options for printing or saving the information you have selected from the motor database. See the section on **Printing** for more details.

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# Determining Energy and Cost Savings: Compare

Select **Compare** to calculate energy consumption and annual energy costs for specific motors in your particular application. **Compare** enables you to make the most cost-effective purchase decision.

## Comparing Costs

From the **Main Menu**, select the **Compare** option. A **Motor Comparison** window appears on the screen. (Screen 4). You now have three choices:

1. **Compare New Motors (New)** compares the costs of acquiring and operating a new Energy Efficient motor with those of a Premium Efficiency model. For motors between 250 hp and 500 hp, Compare is used to determine the savings associated with selecting a new Premium Efficiency or Energy Efficient motor over a Standard efficiency motor. In all cases, *MotorMaster+* determines the energy and cost savings possible due to purchase of the higher-efficiency motor model. Then, assuming that the Premium Efficiency motor is also more expensive to purchase, it calculates the simple payback: the time it takes for the savings to pay back the difference or increase in the new motor purchase price.
2. **Rewind vs. New (Rewind)** compares the cost-effectiveness of rewinding a failed motor with the cost of purchasing a new Premium Efficiency model. This comparison takes into account a reduced efficiency for the rewind motor attributable to age and rewind losses. Default rewind efficiency losses of 1.0 percent for motors less than or equal to 40 hp and 0.5 percent for larger motors appear in the "Rewind Effic Loss (%)" box. These values are user-editable.
3. **Replace Working Motors (Replace Existing)** analyzes the cost-effectiveness of replacing an operable Standard-efficiency motor with a new Premium Efficiency model. This calculation is useful for deciding whether to replace older, low-efficiency, rewind, and oversized and under-loaded motors. The analysis considers the entire purchase price and installation costs as the motor price premium in determining the simple payback.

The **Motor Comparison** screen is designed so that motor descriptors, operating parameters, and performance values for the existing or lower-efficiency motor are entered in the left column. Corresponding values for the Premium Efficiency alternative are entered in the right or "Premium Efficiency Motor Comparison" column. To compare two motors with the same horsepower, speed, enclosure, voltage, and features, enter your choices for the Standard model. The same default values will appear for the Premium Efficiency or Energy Efficient model. If you want to compare two motors of different horsepower ratings or enclosure types, use the down-arrow boxes to view and select different values for the energy-efficient model.

## Screen 4

Motor Description and Features	Energy-Efficient <Avg Energy-Efficient>	Premium Efficiency <Avg Premium Efficiency>
Size/Speed	200 hp 1200 RPM	200 hp 1200 RPM
Enclosure/Voltage	TEFC 460 Volts	TEFC 460 Volts
Hours use/yr	8760	8760
Load (%)	75.0	75.0
Efficiency (%)	95.1	95.8
Full load RPM		
Dealer discount (%)	25.0	25.0
Purchase Price (\$)	11393	13276
Motor Rebate (\$)		
Peak Months	12	12

Once the motor characteristics and load point are entered, *MotorMaster+* responds with default motor efficiency and price values. The efficiency values shown are consistent with the indicated motor load. The generic motor performance values (at full, 75, 50 and 25-percent load) are determined through examining motors contained within the *MotorMaster+* internal motor manufacturer's catalog. These defaults are representative for the efficiency class (Standard, Energy Efficient, or Premium Efficiency) and for the type (horsepower, speed, and enclosure) of motor you selected.

Whenever possible, enter more precise or motor-specific data by following these directions.

- **Model:** Click on **Catalog** to choose a specific motor model from the *MotorMaster+* motor performance database. The **Motor Catalog Query** screen appears. Enter your motor search criteria (horsepower, speed, voltage, and enclosure), and then click on the **Search** button. A list of qualifying motors appears. If you wish to make your selection from a list of C-Face, vertical shaft, severe-duty, IEEE 841, or Inverter-duty motors, indicate the desired motor attributes and again click on the **Search** button. Click or use the down-arrow key to highlight the motor of interest, then click on the **Select** button or double-click on the highlighted motor to enter data into the **Compare** analysis. Motor search criteria, motor efficiency at the stated load point, the discounted list price, and the full-load speed are entered automatically into the **Motor Comparison** screen. (Note that motor size, speed, enclosure, voltage, operating hours, and load values are copied automatically from the left or "Existing" motor to the right or "Premium Efficiency" motor displays.) Conversely, the motor descriptors entered at the **Motor Comparison** screen are displayed automatically as default search criteria at the **Motor Catalog Query** screen. Changing search criteria at the **Motor Catalog**

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**Query** screen will result in corresponding changes in the **Motor Comparison** screen.

---

Tip: To compare the energy and cost savings due to purchase and operation of a new Premium Efficiency motor over a generic or industry-average existing Standard motor, simply enter your Standard motor descriptors, annual hours of use, and load in the left column. The appropriate average Standard motor default efficiency value appears. Note that the right-hand column is now filled in with default values that are representative of a typical Premium Efficiency motor. Use these values or click on **Catalog** to obtain model-specific information.

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*Note: Users can create lists of two-speed motors and view performance data within **List**. Two-speed motors currently cannot be analyzed within the **Compare** module.*

---

You can also enter motor descriptions manually. Enter the motor characteristics, annual operating hours, load, efficiency at the motor's load point, and discounted purchase price. The default Standard and Premium Efficiency motor models with typical performance and price values are retained and used in the analysis unless you select motors by clicking on the in-plant motor **Inventory** button, choose a new motor from the *MotorMaster+* manufacturer's **Catalog**, or manually change the values.

For the **Rewind** and **Replace Existing** motor scenarios, you can access and download information for the existing Standard-efficiency motor directly from the **Field Data Module** motor **Inventory** database. Refer to the **Field Data Module** section of this *User's Guide* for instructions on creating, editing, or displaying the motor **Inventory** screens plus a description of **Motor Inventory Query** functions. The in-plant motor database is accessible through clicking on the **Inventory** button. The **Motor Inventory Query** screen appears. Enter search criteria, then click on the **Search** button. A list of operating motors that satisfy all search criteria appears. Click or use the down-arrow key to highlight the motor of interest, then click on the **Select** button or double-click on the highlighted motor to enter values into the **Compare** analysis. Click on the **Catalog** button to select a potential Premium Efficiency replacement motor.

In addition to motor performance parameters, the following elements are automatically incorporated into the **Motor Comparison** analysis:

- The facility to which the existing motor is assigned.
- The serving electrical utility.
- The rate schedule in effect.
- The utility rebate (for eligible motors).
- The facility's seasonally averaged energy and demand charges.

You may modify the facility-specific energy prices and demand charges at the **Motor Comparison** screen. Click on the down-arrow box at the **Utility**, **Rate Schedule**, or **Facility** combo boxes to display choices. Click or use the down-arrow key to highlight your choice, then press **Enter** or click again. The appropriate energy and demand charges are entered into the analysis. If you directly modify the entries in the energy price or demand charge boxes, “User-Defined” appears in the **Utility** combo box, and the **Rate Schedule** and **Facility** fields are cleared.

A rebate value is displayed automatically when an eligible, Premium Efficiency motor is selected, the serving electrical utility offers a motor rebate program, and minimum full-load efficiency qualification and rebate dollar values are contained within the *MotorMaster+* utility rebate program database. A notation in the lower left-hand corner of the **Motor Comparison** screen indicates when a utility rebate program is in effect. A warning appears at the bottom of the screen when the new or replacement motor does not qualify for an available rebate. A completed **Motor Comparison** window is shown as Screen 5.

Screen 5

	Existing	Premium Efficiency
Ref Compressor #1	Lafert	Baldor
NEMA Design B	NEMA Design B	NEMA Design B
Size/Speed	60 hp 1800 RPM	60 hp 1800 RPM
Enclosure/Voltage	ODP 440 Volts	ODP 440 Volts
Hours use/yr	6240	6240
Load (%)	68.7	69.9
Efficiency (%)	91.5	95.2
Full load RPM	1760	1775
Old Motor Effic Loss		
Dealer discount (%)		35.0
Purchase Price (\$)		2139
Installation Cost (\$)		125
Motor Rebate (\$)		450
Peak Months	12	12

- **Manufacturer:** If you selected a model from the *MotorMaster+* catalog, the motor model name and manufacturers' name is entered automatically.
- **Annual hours of use:** Enter the estimated hours the motor will run per year. The highest value accepted is 8,760. This field is automatically filled when an **Inventory** motor is selected and annual operating hours have been entered at the **Operating Profile** tab. The user always has the option to edit the indicated values.

- 
- **Percentage load:** Enter the percentage load or load factor. If you choose a motor from the Field Data Module motor **Inventory**, this value is entered automatically. Load factor indicates the amount of work performed by the motor compared to its design capacity. For example, a 10-hp rated motor powering a 7.5-hp load has a load factor of 75 percent. If you do not know the load factor, enter **75**.

Note that *MotorMaster+* automatically inserts the correct load for the Premium Efficiency replacement motor, even when it has a different horsepower rating than the existing motor. The load factor is used in calculating energy consumption. It also affects the selection of motor efficiency values. For example, selecting a 50 percent load factor causes *MotorMaster+* to use the selected model's 1/2-load efficiency values for its calculations. If you choose a load factor other than 25, 50, 75, or 100 percent, *MotorMaster+* performs a linear interpolation to calculate efficiency values. If part-load values are not available for the motor you choose, *MotorMaster+* uses interpolated "industry average" default values.

Note: For motor loads below 25% of full-load, *MotorMaster+* calculates the efficiency as equal to the load served divided by the sum of the load served plus the motor's fixed losses at the 25% load point.

## Bin Analysis Capabilities

**New**

The *MotorMaster+* 4.0 facility **Inventory** module's **Field Measurements** tab has been modified to accommodate variable load information. The user may specify the percentage of operating time for up to six load "bins". Actual motor loads are automatically determined through the examination of measured data (operating voltage, amperage, power factor, operating speed, or power readings) supplied at each operating point. Both motor load and efficiency are determined for each load point. Annual energy use and utility costs and weighted average load and efficiency values are also internally calculated and displayed.

The *MotorMaster+* 4.0 **Compare/Motor Replacement** and **Rewind** analyses have been modified to extract efficiency values for plant **Inventory** and **Catalog** motors at each load point and to aggregate energy savings through conducting a "Bin" analysis. The software considers an existing motor's load, full-load speed, operating hours, efficiency at load point, and annual operating costs; it then determines the efficiency improvement and operating cost savings given that the incumbent motor is replaced with a specified Energy Efficient or Premium Efficiency motor. Speed/slip correction factors are taken into consideration for motors coupled to centrifugal loads. Accurate energy and dollar savings results are thus determined for variable loaded motors.

- **Rewind/Old motor efficiency loss:** Enter the efficiency reduction expected if you continue to use an older, rewound motor. *MotorMaster+* assigns a default rewinding loss of one efficiency points for smaller ( $\leq 40$  hp) motors with one-half point subtracted for larger motors.

- 
- **Full-load RPM:** The full-load rpm from the motor nameplate is entered into the **Motor Comparison** screen automatically and the **Centrifugal load** checkbox is filled in when the existing or inventory motor drives a centrifugal fan or pump. *MotorMaster+* then uses the full-load rpm value for the replacement motor to compute the speed-adjusted load imposed by the rotating equipment. Full-load rpm-corrected values are used to determine annual electrical demand, energy consumption, and savings. If no full-load rpm values are available, the speed/load adjustment is ignored. (This option appears in the **Compare New Motors** and **Replace Existing Motor** analyses.) For the **Compare New Motors** analysis, click on the **Centrifugal Load** check box to compute the speed-corrected load for the new energy-efficient motor. See Screen 5.
  - **Efficiency (%):** If you select a motor from the *MotorMaster+* motor **Inventory** database or **Catalog**, its efficiency value (if available in the database) is entered automatically. Otherwise, use the default or enter your own value. In the **Compare New Motors** scenario, the default “Average Energy Efficient” motor efficiency value is derived as the average performance of all general purpose motors on the market. This population of motors must have full-load efficiency values equal to or exceeding the NEMA MG 1, Table 12-11 full-load efficiency standard, yet less than the Premium Efficiency motor standard. Premium Efficiency motor defaults are derived through determining the average full- and part-load performance of all motors in a stated horsepower, speed and enclosure class that equal or exceed the minimum full-load efficiency requirements as specified in Table 12-12 of NEMA MG 1-1998.

For the **Compare Rewind** and **Compare Replace Existing Motor** analyses, the existing or in-place standard-efficiency motor efficiency defaults are taken as the average performance of all motors currently on the market that perform below the old NEMA 12-6B Energy Efficient motor standards (Table 12-6B of NEMA MG 1-1987). These defaults are thus representative of older Standard-efficiency motor models. The "Average Premium Efficiency" motor defaults are now defined as the average performance of all general purpose motors on the market with full-load efficiency values equal to or exceeding the NEMA 12-12 nominal full-load efficiency standard.

- **Dealer Discount (%):** Retailers frequently offer discounts of 25 to 40 percent or more off the manufacturer’s list price. Contact your vendor for this information. The user may edit and save a unique list price discount factor for each manufacturer (see Customizing *MotorMaster+* : List Price Discount Factors).
- **Purchase price (\$):** Contact your vendor for the most accurate price. Manufacturer’s list price is entered automatically if you used the *MotorMaster+* database catalog; otherwise, a typical price for the motor class is entered. Note: *MotorMaster+* motor purchase prices include the specified dealer discount.



- 
- **Rewind cost (\$):** Costs associated with rewinding a failed motor. (Applicable only under **Rewind vs. New.**) *MotorMaster+* provides a default motor rewind cost. Users are encouraged to obtain and enter price quotations from local repair shops. Motor rewind price defaults may be viewed and modified at the **Options-Rewind Costs** screen.
  - **Installation cost (\$):** Enter labor and materials costs associated with replacing a working motor. (Applicable only under **Replace Existing Motor.**) An editable default motor installation cost is supplied. Motor Installation cost defaults may be viewed and modified at the **Options-Installation Costs** screen.
  - **Motor Rebate (\$):** If the electric utility serving the facility where an existing motor is assigned offers a motor rebate program, or if you selected a utility rebate program earlier in *MotorMaster+* and have selected a qualifying Premium Efficiency motor, that rebate will appear here automatically. Otherwise, contact your local electric utility for its motor rebate program information.

---

### ***NEMA Motor Efficiency Standards***

*NEMA Publication MG1-1998, (Table 12-11) lists nominal full-load efficiency values for each horsepower, speed, and enclosure type that motors from 1 to 500 horsepower must meet to be labeled “Energy-Efficient.” A motor must equal or exceed the nominal efficiency thresholds contained within Table 12-11 to be classified as “Energy Efficient”. In June of 2001, NEMA introduced their NEMA Premium™ motor program. Under this program, NEMA established a set of minimum full-load efficiency values that a motor must equal or exceed to be deemed a Premium Efficiency motor. These efficiency values are contained in Table 12-12 of NEMA MG 1-1998.*

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- **Energy Price (\$/kWh).** Utility rate schedule and energy and demand charges are incorporated automatically into the analysis when an existing **Inventory** motor is selected. Otherwise, make your choices at the appropriate **Utility** and **Rate Schedule** combo boxes, check your utility bill, or contact your electric utility for the rate you pay per kWh of electricity.
- **Demand Charge (\$/kW/mo.).** A utility charge based on the highest rate of electric energy consumption during a rolling 15- or 30-minute period each month. Contact your local electric utility for this amount. (In the United States, power demand charges vary considerably.)
- **Peak months.** The number of months per year that the motor operates during the facility's peak demand period. For instance, a motor may only operate for six months each year in a food processing plant with seasonal operation. Absent demand-ratcheting clauses in the utility rate schedule, demand reduction benefits due to installation of a Premium Efficiency motor can only be claimed for the number of months that the facility is expected to operate.

When you are satisfied with all of the values, click on **Savings** to perform the analysis. When its calculations are complete, *MotorMaster+* displays the comparison results in the **Energy Savings** window. See Screen 6.

Like the **Motor Comparison** screen, the **Energy Savings** screen is split into two columns. The left column displays the energy use and annual operating costs for the existing motor. The right column yields comparable values for the Energy Efficient or Premium Efficiency motor alternative. Annual energy and demand savings, total savings, and the simple payback due to investing in the Premium Efficiency motor are summarized at the bottom of the screen.

If you want to perform another comparison, click on **Exit** from the **Energy Savings** window, return to the screen with the data you want to change, then retrace the same steps. To print or save your analysis before performing a new one, click on the **Print** button.

### Screen 6

Parameter	Existing Motor	Alternative Motor
Motor premium (\$)		1,814
Energy use (kWh/yr)	209,780	204,953
Energy cost (\$/yr)	12,447	12,160
Demand chg (\$/yr)	1,481	1,446
Energy savings (kWh/yr)		4,827
Demand savings (kW)		0.8
<b>Total savings</b>		<b>\$ 320</b>
<b>Simple payback</b>		<b>5.66 yrs</b>

### *Sensitivity of Load to Motor Speed*

*For centrifugal loads such as fans or pumps, even a minor change in a motor's full-load speed translates into a significant change in load and annual energy consumption. Fan or "affinity" laws indicate that the horsepower loading imposed on a motor by a centrifugal load varies as the third power, or cube, of its rotational speed. In contrast, the quantity of air or fluid delivered varies linearly with speed.*

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*Some Premium Efficiency motors tend to operate with reduced “slip” or at a slightly higher speed than their Standard-efficiency counterparts. This seemingly small difference—an average of only 5 to 10 rpm for 1,800-rpm synchronous-speed motors—is significant. A seemingly minor 20-rpm increase in a motor’s full-load rotational speed from 1,740 to 1,760 rpm can result in a 3.5 percent increase in the load placed upon the motor by the rotating equipment. A 40-rpm speed increase can boost energy consumption by 7 percent, completely offsetting the energy and dollar savings typically expected from the purchase of a Premium Efficiency motor.*

*The **Compare** feature of MotorMaster+ accounts for speed/slip/load relationships when analyzing savings for motors in applications with centrifugal loads.*

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### **Summary**

1. Select **Compare** from the Main Menu.
2. At the **Motor Comparison** screen, select **New**, **Rewind**, or **Replace Existing** motor.
3. Use the mouse or **Tab** key to move to any data field you want to modify. Either enter new data in the box or click on the down-arrow box to view the list of data options. To compare similar motors, enter data into the left column; the corresponding values for an energy-efficient motor will appear in the second column. To compare dissimilar models, enter data directly in both columns.
4. To perform a **Rewind** or **Replace Existing** motor analysis, click on **Inventory** in the existing motor column. Then use the **Motor Inventory Query** screen features to select the motor of interest. The energy price and demand charge for the facility to which the motor is assigned are incorporated automatically into your cost-effectiveness analysis.
5. To use the catalog to select a new Energy Efficient or Premium Efficiency replacement motor model for comparison, click on the **Catalog** button to the right of the **Manufacturer** box in the Energy Efficient column. Then use the **Motor Catalog Query** window features to select a motor model.
6. Otherwise, use your mouse to move through the items, accepting the defaults or entering new information.
7. Click on **Savings** when the information on the screen is as you want it. The **Energy Savings** window appears.

---

## Viewing the Energy Savings Window

The following definitions will help to interpret the results of the analysis shown in the **Energy Savings** window.

**Motor Premium (\$):** The difference between the purchase prices of the Energy Efficient model and the Premium Efficiency model, assuming the Premium Efficiency model has a higher price. If a rebate is available, the incremental cost is the difference between purchase prices less the rebate. The price premium for a motor that replaces a working motor is the total purchase price of the new motor, plus installation cost, less any available utility rebate.

**Energy Use (kWh/yr):** Energy use measured in kilowatt-hours per year. The formula is:

$$(\text{hp} \times \text{load}/100 \times 0.746 \times \text{hours used})/\text{efficiency at the appropriate load point}$$

**Energy Cost (\$/yr):** The dollar value of energy used per year. The formula is:

$$\text{kWh (consumed)} \times \text{cost per unit of energy (\$/kWh)}$$

**Demand Charge (\$/yr):** The dollar value of demand costs per year. The formula is:

$$[(\text{hp} \times \text{load}/100 \times 0.746)/\text{efficiency}] \times \text{monthly demand charge} \times \text{peak demand months}$$

**Annual Energy Savings (kWh or \$):** In kilowatt-hours, the difference in annual energy consumption between the existing Standard motor model and the Premium Efficiency alternative, assuming lower consumption with the Premium Efficiency motor model.

In dollars, the annual kWh savings times the unit cost of energy.

**Demand Savings (kW or \$/yr):** The difference in peak demand or annual demand charges for Standard and Premium Efficiency motors.

**Total Savings (\$/yr):** The sum of annual energy dollar savings and annual demand dollar savings.

**Simple Payback (yr):** In years, the time it takes to recover the motor price premium from energy and demand cost savings. Calculated by dividing the motor price premium by total annual cost savings. (See box, How to Use Analysis Results.)

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## ***How to Use Analysis Results***

*The **MotorMaster+ Energy Savings** analysis can be used in several ways. The easiest way to compare the cost of purchasing and powering alternate motors is to compare their simple paybacks. Usually, the shorter the payback period, the more cost-effective the investment. Some industries use a maximum simple payback value of two or three years as a standard by which to make purchasing decisions. If you are considering several Premium Efficiency motor models, look for the one offering the most rapid payback on investment or shortest simple payback period. Note that once the payback period has passed, your energy cost savings continue.*

***MotorMaster+** also contains life cycle cost analysis capability. This feature provides the after-tax rate of return on a Premium Efficiency motor or motor system conservation investment, the net present value, after-tax benefit to cost ratio, and levelized or uniform annual costs of conservation, plus displays before and after-tax cash flows.*

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## **Conducting a Life Cycle Cost Analysis: Life Cycle**

*Life Cycle Cost Analysis (LCCA) is an economic decision-making tool for choosing between alternative motors or motor-systems that are intended to serve the same purpose. An LCCA adjusts for the time-value of money and sums, over a designated study period, all costs related to the owning and operating of a motor-driven system.*

The LCCA incorporated into *MotorMaster+* may be used to analyze a wide variety of energy conservation (or generation) projects. The first step in initiating your LCCA is to click on **Life Cycle** at the **Energy Savings** screen or at the **Main Menu**. When **Life Cycle** is accessed from the **Energy Savings** screen, the motor purchase and installation cost, utility rebate value, annual energy and demand savings, and utility rate information are loaded automatically into the **Life Cycle Economics** screen. See Screen 7. The **Life Cycle Economics** screen is divided into five segments labeled (1) Depreciation Method, (2) Costs, (3) Financing, (4) Electricity Use and Cost, and (5) Project Life.

## Screen 7

Life Cycle Economics				
File Calculate Escalation Help				
<input type="radio"/> Project <input checked="" type="radio"/> Corporate		Depreciation Method	Straight line	
			Calc ? Exit	
<b>Costs</b>		<b>Default Escalation Rates</b>	<b>Financing</b>	
Capital costs (\$)	11,557	5.0 %	Date of loan (yr)	1998
Installation costs (\$)	155		Loan life (yrs)	0
Interest during construction (\$)	0		Loan interest rate (%)	10.0
Annual O&M cost (\$)	0	5.0 %	Discount rate (%)	18.0
Annual fuel cost (\$)	0	5.0 %	Property tax rate (%)	0.0
Fuel cost escalation rate table	*Use Default Value		Corporate tax rate (%)	35.0
			State income tax rate (%)	0.0
<b>Electricity Use and Cost</b>		<b>Default Escalation Rates</b>	<b>Project Life</b>	
Project annual energy savings (kWh)	28,090		Base year	1998
Average energy cost (\$/kWh)	0.039330	3.0 %	First year of operation	1998
Electric cost escalation rate table	*Use Default Value		Life expectancy (yrs)	15
Project demand reduction (kW)	3.2		Depreciation life (yrs)	5
Average demand cost (\$/kW)	3.67	5.0 %	Salvage value (\$)	0
Demand escalation rate table	*Use Default Value		Junk value (\$)	0
Peak demand months	12			

Note that *MotorMaster+* computes after-tax benefits based on the corporate or the individual project level. Depreciation credits that are not needed to reduce or eliminate tax liability for project-related savings or revenues are multiplied by the composite federal and state tax rate and counted as a benefit as they may be used to reduce the overall corporate tax liability. Many of the input parameters, such as loan date, interest rate, discount rate, and corporate and state tax rates, are retained as defaults for subsequent analyses. All other variables are reset to zero. Definitions of capital investment cost variables follow:

## Depreciation Method

**Straight line:** A constant annual depreciation charge is made for each year of the depreciation period (starting with the year of project startup). The annual charge is equal to the total installed cost less salvage value, divided by the depreciation life in years.

**Sum of years digits:** The annual depreciation charge is computed as the remaining useful depreciation life at the beginning of the year, divided by the sum of the year's digits for the total depreciation life, with this ratio multiplied by the total amount to be depreciated (total installed cost less salvage value). This method results in more rapid depreciation than the straight-line method during the early years of the asset life with necessarily smaller charges as the asset nears the end of its depreciation period, or estimated life.

---

**Double-declining balance:** Double-declining balance is an accelerated depreciation method in which the book value of an asset can be depreciated at double the straight-line rate. The book value is the measured cost less depreciation to date. The general equation is:

$$\text{Double Declining Balance in any year} = \frac{2}{N}x(\text{book value})$$

Double-declining-balance depreciation charges cease when the book value equals the estimated salvage value. *MotorMaster+* automatically switches from double declining balance to straight-line depreciation when the straight-line depreciation method results in larger charges and a more rapid reduction in the book value of an asset.

## Costs

**Capital costs:** The total motor or motor-systems-improvement equipment cost less any available utility rebate. All costs are expressed in base-year dollars and are unadjusted for price escalation during the planning or construction period.

**Installation costs:** The costs associated with installation of a Premium Efficiency replacement motor or other systems improvement. Note that Installation Cost defaults are provided only in the Replace Existing Motor scenario.

**Interest during construction:** Used for large revenue-generating projects with multi-year duration for planning and construction. Dollars needed to meet debt service requirements incurred between loan date and year of commercial operation. Expressed in base-year dollars.

**Annual operating and maintenance (O&M) cost:** Annual operating, maintenance and repair expenses. Only costs that vary for the standard and energy-efficient alternatives need to be considered in a LCCA of motor and motor-systems.

**Annual fuel cost:** The cost in base-year dollars for fossil fuel, such as oil or natural gas. (Note: This value is generally set equal to “0”; however, for some conservation actions fossil-fuel-related costs are incurred. One example is the replacement of an electric motor with a natural-gas-fired engine.)

**Fuel cost escalation rate table:** The average annual rate at which fuel costs are expected to change over the study period (percent). You may enter a fixed or constant annual value or create a file of variable escalation rates over the duration of the study period. See the **Options** section of this *User's Guide* for instructions regarding the construction and labeling of **Escalation Rates** tables. Clicking on the **Fuel Cost Escalation Rate Table** combo box provides a listing of previously-created tables that may be accessed. When a table is chosen, the fixed annual fuel escalation rate box is grayed out. Select **User Defined** if you elect to enter and use a fixed fuel escalation rate over the period of your analysis.

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## Financing

**Date of loan:** The loan origination date (i.e., 2003). The loan date must occur after the base-year and prior to or coincident with project startup or first year of operation.

**Loan life:** The number of years in which the loan will be repaid (years). Typically the loan is repaid before the expected end of life for the motor-systems improvement. A loan life of “0” indicates that the project is funded through cash reserves.

**Loan interest rate:** The annual interest rate of the loan in nominal or market terms (percent).

**Discount rate:** The time value of money (percent). For public organizations, this may be equivalent to the bond rate or loan interest rate. For private industry, the discount rate is the hurdle rate or minimum attractive rate of return on investment.

**Property tax rate:** A uniform annual tax levied on property equal to the tax rate times the total project installed cost (percent). The property tax commences upon project startup and continues until the end of project life.

**Corporate tax rate:** The federal income tax rate applied to the last dollar of income to the investor (percent).

**State tax rate:** The state income tax rate applied to the last dollar of income to the investor (percent). As state taxes are allowable itemized deductions when determining federal tax liability, the combined incremental tax rate, in percent, is 100 times the sum of the

$$\frac{\text{state tax rate}}{100} + \frac{\text{federal tax rate}}{100} \times \left(1 - \frac{\text{state tax rate}}{100}\right).$$

## Electricity Use and Cost

**Project annual energy savings (kWh):** The total annual quantity of energy conserved or produced by the project or conservation alternative under consideration (kWh).

**Average energy cost (\$/kWh):** The seasonally averaged marginal cost of electrical energy conserved (\$/kWh). (For generation projects, the price paid for electrical energy produced.)

**Electrical cost escalation rate table:** The constant or fixed annual rate at which energy costs are expected to increase (or inflate) over the study period (percent). You may create and save a file of variable annual escalation rates that are applied over the duration of the study period. See **Options**. Clicking on the **Electric cost escalation rate table** combo box provides a list of previously created choices.



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**Project demand reduction (kW):** The instantaneous demand reduction (in kW) achieved by the energy efficiency or demand limiting project. Alternatively, the quantity of generating capacity expected during a purchasing utility's peak period.

**Average demand cost (\$/kW):** The seasonally averaged marginal electrical demand charge (\$/kW). Also, the price paid for peak generating capacity.

**Demand escalation rate table:** The constant or fixed annual rate at which demand charges are expected to increase over the study period (percent). You may create and save a file of variable annual demand escalation rates that are used over the duration of the study period. See **Options**. As with the fuel and electrical cost escalation rates, click on the **Demand escalation rate table** combo box to display a choice list.

**Peak demand months:** The number of months per year that the motor or motor-driven system operates during the peak demand period of the facility.

## Project Life

**Base-year:** The year in which the study begins. All benefits and costs are discounted back to the base-year date and are expressed in "base-year" dollars. All cost data must be entered in base-year dollars.

**First year of operation:** The year in which a conservation project is put in service or a generating project commences operation.

**Life expectancy (yr):** The expected or useful life of the motor or motor-systems improvement (years).

**Depreciation life (yr):** The number of years over which the motor or motor-systems improvement will be depreciated. The depreciation period cannot extend beyond the useful operating life of the project.

**Salvage value (\$):** The salvage value is deducted from the initial asset cost before calculating depreciation. Expressed in base-year dollars.

**Resale value (\$):** A **Resale value** may be assigned in the **Rewind** or **Replace Existing** motor scenarios. When an existing motor is sold, rather than retained as a spare, the sales price is considered as a benefit that occurs in the first year of project operation.

Financial parameters include the loan date, loan life, loan interest rate (percent), discount rate (percent), corporate tax rate, state tax rate, and property tax rate (percent). Enter a loan life of "0" for projects that are funded out of existing maintenance or capital equipment budgets. A "before-tax" analysis is completed when the corporate and state tax rates are set equal to "0."

The base-year average energy and demand costs, energy and demand reductions, and the peak demand months are downloaded automatically from the **Energy Savings** screen to the Electricity Use and Cost segment of the **Life Cycle Economics** screen. The user may modify these values. The LCCA adjusts base-year costs for price changes over the study period. You may choose fixed electricity, demand, and fuel escalation rates over the life of the analysis; or you may enter, save, and recall sets of variable price indices or annual escalation rates. Also, you may choose either straight-line, double-declining balance (with automatic conversion to straight-line depreciation), or a sum-of-years-digits depreciation method.

## Viewing Life Cycle Analysis Results

Click on **Calculate** after entering all values on the **Life Cycle Economics** screen. The program calculates after-tax rate of return on investment, present worth, before- and after-tax benefit-to-cost ratios, and levelized nominal dollar electrical energy conservation cost values, plus before- and after-tax annual cash flows. The cost of the energy efficiency project is levelized to the first year of project operation and over the useful operating life of the project, using a capital recovery factor based on the discount rate and project life. Click on the **Print** button to print the **Life Cycle Analysis Results** screen. (See Screen 8.)

### Screen 8

Life Cycle Analysis Results							
Loan Amount (\$)	11,712	After tax return on investment (%)	9.6				
Capital recovery factor	1.00	Benefit-to-cost ratio (before tax)	0.74	Print			
Annual loan payment (\$)	11,712	Benefit-to-cost ratio (after tax)	0.74	Exit			
After tax net present value (\$)	-3,086	Levelized cost of conserved energy (mills/kWh)	81.9				
Year	Project Revenues (Nominal\$)	Loan Pmt + Op Costs (Nominal\$)	Depreciation (Nominal\$)	After Tax Benefits (Nominal\$)	After Tax Benefits (YB\$)	Cumulative After Tax Benefits (YB\$)	Conserved Energy Cost (Nominal\$)
1998	1246	11712	2342	-10082	-10082	-10082	417
1999	1286	0	2342	1656	1403	-8679	0
2000	1327	0	2342	1683	1208	-7471	0
2001	1370	0	2342	1711	1041	-6430	0
2002	1415	0	2342	1739	897	-5533	0
2003	1461	0	0	949	415	-5118	0
2004	1508	0	0	980	363	-4754	0
2005	1557	0	0	1012	318	-4437	0
2006	1608	0	0	1045	278	-4159	0
2007	1660	0	0	1079	243	-3915	0
2008	1714	0	0	1114	213	-3703	0
2009	1770	0	0	1151	186	-3516	0
2010	1828	0	0	1188	163	-3353	0
2011	1888	0	0	1227	143	-3210	0
2012	1950	0	0	1268	125	-3086	0

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# Motor Energy Management: Creating your Company Structure

Use the **Field Data Module** to create new company motor inventory databases, to establish Facility/Department/Process relationships, to display process operating schedules, to maintain utility rate schedule and motor rebate program values, and to assign a serving utility and rate schedule to your facility.

From the Main Menu, click on the **Field Data** Module, and a list of choices appears. Use your mouse to highlight and make your selection. Alternatively, you may click directly on any **Main Menu** destination button to access the screen of interest.

## Company Database

**To use an existing company database**, select a company from the list of companies in the combo box near the top of this screen. Facilities, Departments, Processes, and the Motor Inventory that have been assigned to this company may now be viewed at their respective screens.

**To create a new company database**, click on the **Add** button. Enter the company name, ID number, Industry type, SIC code, and contact person address at the **Company Information** tab. Then click on the **Save** button. A pop-up screen appears, allowing you to enter a disk file name. After a name is entered, the suffix MDB is added, the file is initialized, and the company name is added to your company database list. Note that upon exiting to the main menu, the **Department**, **Process**, **Inventory**, and **Batch Analysis** select boxes are not accessible (grayed out). You must assign one or more facilities to the new company before a department can be assigned to its corresponding facility. Similarly, departments must be identified before processes can be linked to them, and processes must be created prior to motor assignment. See “Creating a Company Database” under “Getting Started” for a step-by-step procedure.

The **Browse** button is used to search your computer’s directory to load other Company Databases that may have been created previously. Highlight the Company file of interest, then click on **OK**. Your company is now added to the database list. Click on the **Down-arrow** button, then highlight and select your company to display company-specific facility, utility, department, process, and motor information. The Overview/Databases section of this User Guide indicates how to convert company databases created with *MotorMaster+* Version 1.0 or 2.01 into the Version 3.0 format.

- Motor Efficiency Status Report:** Clicking on the **Motor Efficiency Status** tab provides a display (Screen 9) based upon a search of all in-service motors assigned to all facilities within your company. The display screen indicates the percentage of Premium Efficiency and Energy Efficient motors by population and size, total connected horsepower, and total load served. Premium Efficiency motors are those 1 to 500 hp NEMA Design B motors equaling or exceeding the minimum full-load efficiency criteria contained within Table 12-12 of NEMA MG 1-1998, Rev. 2. Click on the **Motor Efficiency Status Recalc** button to update the display after an **Add Motor** or **Edit Existing Motor** button is selected for the company or facility of interest. A motor status report is available by clicking on the **Print** button.
- Facility Energy Ranking Report:** Clicking on the **Facility Energy Ranking** tab provides a list of facilities assigned to your company ranked in ascending or descending order of annual energy consumption, annual energy cost, Energy Use Index (EUI, annual energy use normalized by annual production) or Energy Cost Index (ECI, energy cost per unit of production). Enter the ending date, and then click on the **Recalc** button to update the display. The EUI and ECI columns are only filled in when facilities produce a common product. Use the product value in dollars for facilities with multiple product lines. Production types and units are created within **Options** and assigned at the **Facilities** screen.

Screen 9

The screenshot shows a software window titled "Facilities - View" with a menu bar (File, Options, Help) and a toolbar. The "Facility" dropdown is set to "Concentrated Juice, Inc." and there is a "Utility Meters" button. Two tabs are visible: "Motor Efficiency Status Report" (active) and "Energy Use by Load Type".

**Motor Efficiency Status Report**

Horsepower	1-3	5	7.5	10	15	20	25	30	40	50	60	75
Premium	0	0	0	0	0	0	0	0	0	0	0	0
Energy Efficient	0	0	0	2	0	0	0	0	0	0	0	0
Standard	0	0	1	2	1	4	2	1	7	0	2	5

Horsepower	100	125	150	200	250	300	350	400	450	500	Total
Premium	0	0	0	0	0	0	0	0	0	0	0
Energy Efficient	0	0	0	0	0	0	0	0	0	0	2
Standard	1	0	0	1	0	0	0	0	0	0	27

Data Not Current     

Energy efficient    Premium efficiency  
 % by number      6.9      0.0  
 % by horsepower    1.5      0.0  
 % by load served    1.8      0.0

---

## Facilities

Select an existing facility from the list of facilities in the combo box near the top of this screen or use appropriate buttons on the toolbar to create a **New** facility, **Edit** the currently displayed facility, **Save** a current edit or new entry, or **Delete** the currently displayed facility.

The facility data are divided by tabs into four sections. A **Utility Meters** button is also present. See Screen 10. The tabs are labeled:

- **Facility Information:** Enter name, address, contact, and phone number. Specify the production units appropriate for your facility. (Note: New Production types and units are created within **Options** or by clicking on the button to the right of the **Production Units** combo box.)
- **Utility Service:** Select the utility servicing the current facility, and the rate schedule in effect for your facility. Appropriate rate schedule information will be displayed. (Note: Rate Schedule choices are created in the **Utilities** window.) Enter the number of months this facility is run during each of the two seasons. Select one energy charge block for each season by clicking on it. The highlighted boxes will be saved, as well as the calculated averages for Demand and Energy charges. These averages will be used in calculating energy costs and savings in motor comparisons and batch inventory analyses.
- **Motor Efficiency Status Report:** Click on the **Motor Efficiency Status** tab to indicate the percentage of Premium Efficiency and Energy Efficient motors by population and size, total connected horsepower, and total load served **at the facility level**.
- **Energy Use by Load Type:** Click on the **Energy Use by Load Type** tab to obtain a list for a specified facility of total connected horsepower and/or total motor-driven load served by load type (centrifugal fans, pumps, or compressors).

The screenshot shows a software window titled "Facilities - View". At the top, there is a menu bar with "File", "Options", and "Help". Below the menu bar is a toolbar with several icons, including a printer, a question mark, and an "Exit" button. The main area of the window is divided into two tabs: "Motor Efficiency Status Report" and "Energy Use by Load Type". The "Energy Use by Load Type" tab is active and contains a sub-tab for "Facility Information". The "Facility Information" sub-tab shows a form with the following fields:

- Name: Concentrated Juice, Inc.
- Code ID: F3
- Address 1: [Empty]
- Address 2: [Empty]
- City: Seattle
- State: Washington
- Zip: [Empty]
- Contact: [Empty]
- Phone: ( ) - [Empty]
- Production unit: Juice

### Utility Meters

Click on the **Utility Meters** button at the Facilities-View Screen to assign one or more electric utility meters to each of your facilities. Select your facility, then click on the toolbar **Add** or **Edit** buttons. Enter a Meter Number and Location.

Actual monthly utility billing information for each meter is entered within the **Billing** section of the **Savings Tracker** module. Energy consumption and cost data are used in the **Savings Tracker Monthly Billing Summary** and **Reduction in Consumption** reports. Review the **Savings Tracker** section of this *User's Guide* for details on **Savings Tracker** features and functions.

## Departments

There is a combo box for **Facilities** and a combo box for **Departments**. When you select a facility, the list in the **Departments** combo box changes to a list of the departments for the selected facility. Selecting a Department results in the data for that department appearing in the data fields on the right of the screen. As in **Facilities**, the **New**, **Edit**, **Save**, **Delete**, **Print**, **Help**, and **Exit/Cancel** buttons behave in the usual way.

---

Within the hierarchical nature of the company database, departments are assigned to facilities, which in turn are assigned to a company. A serving utility is designated for each facility. More than one facility may be served by the same utility. Industrial processes are linked to departments within a facility and individual motors and motor-driven equipment are assigned to processes. More than one motor may be assigned to the same process. Each process has an operating schedule that is used as a default for all motors assigned to that process. However, you may enter and store different operating periods for motors assigned to the same process.

## Processes

At the third level of the company hierarchy, there are three combo boxes. Select a facility from the list of company facilities, a department from the list of departments for that facility, and then a process from the list of processes for that department. The **New**, **Edit**, **Save**, **Delete**, **Print**, **Help**, and **Exit/Cancel** buttons behave in the usual way.

Process information includes a process name and data describing the operating schedule for that process, including number of days the process operates on weekdays and weekends, and the number of operating hours over three possible shifts. Yearly total hours and days are calculated and displayed. Alternatively, the user may directly enter a value for yearly total hours. These numbers serve as defaults for any motors assigned to this process, although they may be individually adjusted. These totals are used in calculating energy consumption and costs for existing motors in motor comparison and batch inventory analyses.

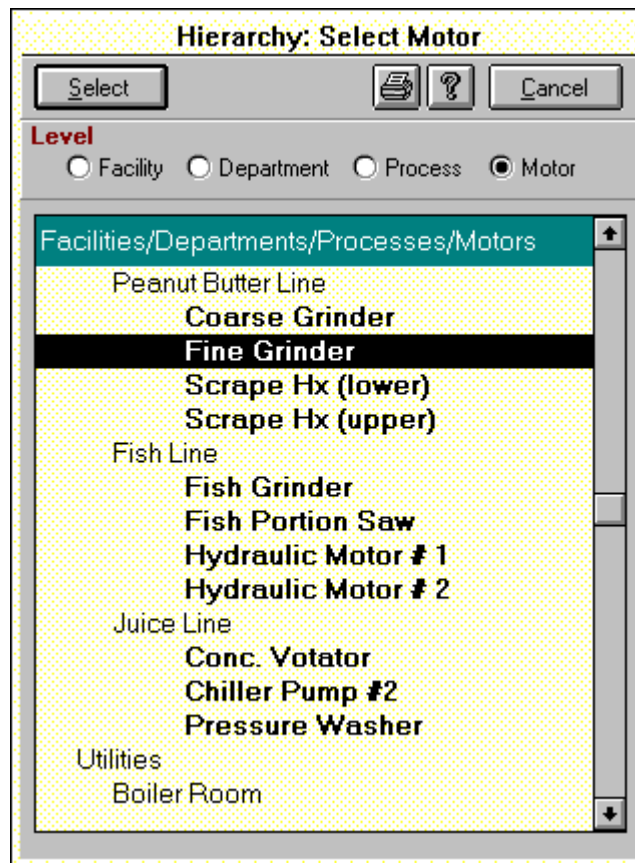
**Facility**, **Department**, and **Process** choices are displayed in Screen 11. The serving electrical utility, the rate schedule under which the facility falls, and the average energy and demand charges are indicated on the **Facilities-View** screen. See Screen 10. Energy costs are determined by identifying the applicable blocks in the seasonal declining block structure of the serving utility.

## Screen 11

		Weekdays	Weekend	Year Total
Days/Year		250	50	300
Hours Per Day	Day Shift	8	4	
	Eve. Shift	8	4	
	Night Shift	4		5400

The **Hierarchy** screen is a special feature search method available to the **Facilities**, **Departments**, **Processes**, and motor **Inventory** screens for selecting an item for that screen. As indicated in Screen 12, the **Hierarchy** screen depicts the Facility/Department/Process/Motor assignments. Change the view level by clicking on the desired option near the top of the screen. Selectable items are shown in boldface. For instance, if you display this screen from the **Facilities** screen, all facilities in the list will be in bold letters. Select the desired facility, in this case, by double-clicking on the item, or highlighting the item and pressing **Enter**. The screen disappears and the appropriate data are loaded and displayed.





## Utility Rate Schedule Information

To load information such as the contact person (account executive), available commercial or industrial rate schedules, and motor rebate program details of your serving utility, click on the **Utilities** button at the **Main Menu**. The **Utilities-View** screen appears. This screen contains a menu with **File**, **Rate Schedules**, and **Rebate Programs** choices, plus a toolbar.

Select **File**, then click on **New** or click on the **Add** button to create a new utility. You will need the following:

- Utility name.
- Address (for rebate program).
- Contact person (for rebate program).
- Phone (for rebate program).

Select **Rate Schedules** to open the **Utility Rate Schedules-View** display (Screen 13) and enter a utility rate schedule name and associated energy and demand charges. *MotorMaster+* can accommodate both seasonal charges and declining (or escalating) energy block rates. Two seasons (typically winter and summer) can be handled with three blocks each season for energy charges (\$/kWh) and a single block for capacity or

demand charges (in \$/kW-mo.). Select **Rebate Schedule** at the **Utilities-View** screen to insert motor rebate program design criteria, minimum qualifying efficiency ratings for each motor class, and rebate values. *MotorMaster+* utility rebate handling capabilities are discussed in detail in the **Utility Rebate Program Support** section of this *User's Guide*.

### Screen 13

		Season 1	Season 2	Average
Start Month/Day		11/01	05/01	
# Months		6	6	
Demand (\$/kW-mo)		0.50	0.50	0.50
Energy Charge (\$/kWh)	Block 1	0.071600	0.065100	0.068300
	Block 2	0.046200	0.042000	0.044100
	Block 3	0.038800	0.038800	0.038800

Click on the **Edit-Open** button at the **Utility Rate Schedules-View** or **Utility Rebate Program-View** screens to enter changes to an existing rate schedule or rebate program, based on current information from your utility. Click on the **Save** button to retain information for future analyses. Use the **Remove** button to delete obsolete rate schedules or rebate programs from *MotorMaster+* to avoid inadvertently including them in a report or analysis.

**Assigning a Utility Rate Schedule to a Facility:** Electrical utility rate schedule information is accessible at the **Utility Service** tab on the **Facilities-View** screen (Screen 10). The **Utility Name** and **Rate Schedule** combo boxes contain choices that have been created previously through the **Utilities-View** screen. Select the electrical utility that serves your facility from the **Utility Name** combo box. Then identify the rate schedule in effect at the **Rate Schedule** combo box.

---

*MotorMaster+* allows a single utility Rate Schedule containing multiple energy block charges to be used for several facilities within a single utility service territory. To assign the tailblock that represents the marginal energy cost for each season, click on the seasonal blocks that are in effect for the facility in question at the **Facilities-View** screen. Annual operating hours are prorated by the months that a seasonal charge is in effect (6/6, 7/5, or 8/4) and used to calculate annual average energy and capacity values. These averaged utility charges are used in **Batch** or **Compare** simple payback and life cycle cost analyses. Note that the utility demand and energy charges cannot be edited at the **Facilities-View** screen. Rate schedule changes must be made at the **Utilities-View** screen. However, you may edit the calculated annual average energy and demand charges at the **Facilities-View** screen.

---

### ***Time-of-Day Rates***

*Some utilities offer time-of-day rate schedules that contain on-and off-peak rates for energy and/or electrical demand. This structure can be approximated with **MotorMaster+** by creating three separate rate schedules: Schedule A—Continuous operation, Schedule A—On-peak, and Schedule A—Off-peak only. The continuous-operation schedule would contain a prorated energy charge and the applicable on-peak-demand charge. Motors that operate only during the peak period would be charged at the on-peak rates for energy and demand. Off-peak only motors would be assigned a lower energy rate and are not subject to a demand charge.*

*To use these rate schedules, break your in-plant motor inventory into three populations: those that operate continuously, during only off-peak hours, or on-peak. Assign each motor population to a facility to which its corresponding rate schedule is assigned. Motors with similar operating profiles are thus matched with the utility charges that are in effect when the motor is in operation. When you do a **Query** of the motor Inventory or a **Batch** analysis, do it for “All” facilities in your company. In this manner, all in-service motors are considered with the energy savings and economic benefits determined with respect to the appropriate time-of-day charges.*

*Changes in motor operating costs can be determined due to implementing such demand management strategies as operating a motor only during the "off-peak" period. Load shifting benefits are obtained by going into **Edit** mode and re-assigning the motor in question from the facility served under the On-Peak schedule to the one served by the Off-Peak only schedule. Savings are equal to the difference in the motor's total annual operating costs (as shown on the **Motor Inventory View** screen's **Field Measurements** tab).*

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# The In-Plant Motor Inventory: Inventory

*Select the Motor Inventory Module to create or update motor inventory information for your facility, to generate searches and selective reports based on sets of motor descriptors, and to initiate motor repair or replacement analyses for populations of motors within your company.*

## Building Your Motor Inventory

Typically, all motors in a given facility, or all motors greater than a minimum size (such as 5 or 75 horsepower) are inventoried. The plant Energy Coordinator is encouraged to gather nameplate and field data measurements for all NEMA Design B, C, and D motors. While the *MotorMaster+* internal database and batch motor replacement analysis considers only motors up to 4,000 hp, the user may create Inventory records and maintenance log entries for larger or fractional horsepower motors. This feature enables the user to display energy consumption for **all** motor-driven equipment in any given process, department, or plant, and account for **all** motor or motor-system related conservation benefits. Energy efficiency activities associated with equipment coupled to larger motors can be documented when the motor is included in the plant inventory.

To assign a motor to a process (and its associated Department, Facility, Utility Service, and Company), use the **Facility**, **Department**, and **Process** combo boxes at the top of the **Motor Inventory-View** screen to make your selections. Then click on the **New** or **Add** button on the toolbar and begin entering information.

The motor **Inventory** database contains three data entry screens plus one measured and calculated data screen for each motor. The motor **Inventory** is set up in Windows like a card file. Clicking on the **Nameplate**, **Operating Profile**, **Load Status**, or **Field Measurements** tabs will cause that screen to appear.

The **Nameplate** screen (Screen 14) contains motor identification, description, and nameplate information. Information contained on this screen include the motor operating status (in-service or spare), serial number, plant assigned identification number, voltage rating, size, enclosure type, synchronous speed, service factor, frame number, insulation class, rewind history, kVA code, temperature rise, and full-load amps, efficiency, power factor, and speed. Click on the arrow box, when present, to display choices. Click on the display box to enter user-supplied information.

---

Tip: At a minimum, the **Nameplate** screen must contain Motor type, Synchronous speed, Size (hp), Enclosure type, Voltage rating and Wired-for-voltage values. *MotorMaster+* assumes that the inventory motor is a standard efficiency product when the full-load efficiency value is missing. Check the **Rewound** box if your motor has previously been rewound.

---

Screen 14

Voltage ratings for dual- and tri-voltage motors are obtained from the voltage-rating list, which is consistent with NEMA MG 1 labeling protocols. For dual- and tri-voltage motors, the in-plant or wired for distribution system voltage is also required.

For dual-voltage motors such as a 230/460-volt motor, a slash (/) appears in the nameplate box for full-load amps (i.e., 4.6/2.3). Be sure to enter the amperage value that is consistent with your plant distribution system or “wired for” voltage. An error message appears when you attempt to save data and the amperage values provided are not consistent with motor design voltage and delivered horsepower values. Click on the **Rewound** box if the motor has been rewound. Identify the status of the motor (i.e., in-service or spare). *MotorMaster+* can identify and list rewound, spare, and high-, medium- or low- priority motors.

---

## Copy Motors to Inventory

Click on the **Copy Motors to Inventory** toolbar button to copy one or more motors from the *MotorMaster+* internal motor catalog into the **Inventory** database. Alternatively, you can create duplicate entries of another **Inventory** motors **Nameplate** screen.

When the **Copy Motors to Inventory** feature is accessed, a **Copy Motors to Inventory** pop-up screen appears. Indicate whether you want to select a motor from the **Catalog** or from the **Inventory**. Then click on the **Select Motor** button. If you choose the **Catalog** option, the **Motor Catalog Query** screen appears. Enter the required motor characteristics, then click on **Search** to create a listing of eligible motors. Double-click on a specific motor data line or click once to highlight the motor of interest, then click on the **Select** button to make your choice. The motor to be copied is now indicated on the pop-up screen. (Screen 15)

Screen 15

Specify the number of copies to be made, provide a motor description prefix, and indicate the Company, Facility, and Process to which the copied motor(s) are to be assigned. Then click on the **Begin Copy** button. The newly created motors are designated as Description prefix #1, #2, etc. and are given identification numbers.

When you choose the **Select Motor from Inventory** path, the **Motor Inventory Query** screen appears. Use the **Query** search capabilities to isolate the motor of interest, then double-click on the motor, or click on the motor and the **Select** button to make your choice. The Inventory motor now appears as the “Motor to Copy” on the **Copy Motors to Inventory** pop-up screen. Indicate the number of copies to be made, and enter a Description prefix. Click on **Begin Copy** to create your new Inventory motor or **Cancel** to terminate the process. After your Catalog or Inventory motors have been created, you may click on the **Edit** button at the **Nameplate** screen to enter the appropriate motor serial number, operating status, and wired-for voltage.

Tip: Motor distributors can use the **Copy Catalog Motors to Inventory** feature to stock a warehouse facility (or facilities) and then monitor the provision of services or sales of Premium Efficiency motors to their customers.

---

The **Operating Profile** screen (Screen 16) contains as a default the operating schedule for the process to which the motor has been assigned. Values may be changed by clicking on the **Edit-Open** button. *MotorMaster+* allows the user to edit the total annual operating hours box directly. Click on the **Save** button to retain new information. Changes made at this screen are retained until changed again. The operating profile screen also displays queries regarding motor priority, motor location, and motor age. The year installed (age) may be used as a search criteria.

### Screen 16

**Motor Inventory - View**

File Search Energy Action Other Data Help

Facility: Concentrated Juice, Inc. Process: Peanut Butter Line  
 Department: Production Motor: Fine Grinder (4)  
 ID Search: INV-104 #104 (search) 40 HP, 3600 RPM, TEFC  
 Description: Fine Grinder In Service Spare  
 Nameplate Operating Profile Load Status Field Measurements  
 Year Installed: 1990 Location:   
 Priority:   
 High   
 Medium   
 Low  
 Operating Schedule  

	Weekdays	Weekend	Year Total
Days/Year	250	50	300
Hours Per Day			
Day Shift	8	4	5400
Eve. Shift	8	4	
Night Shift	4		

 Reset

The **Load Status** screen (Screen 17) contains information about the load type, load modulation devices employed, motor starter, grease type, and drive and opposite drive-end bearing type, brand, serial number, and size.

Screen 17

**Motor Inventory - View**

File Search Energy Action Other Data Help

**Facility** Centralia Wood Products    **Process** Boilers   

**Department** Lumber Curing    **Motor** Sec Boiler Fan (4)   

**ID Search**  #56 (search)    25 HP, 3600 RPM, ODP

Description Sec Boiler Fan     In Service  Spare

Load Type Centrifugal Fans    Rotating Equipment Speed 900 (RPM)

Load Modulation Throttling valve, air    Grease type Polyurea

Coupling Type Flat Belts

Starting Method Across the line

**Load Characteristics**

Steady, ON during shift  
 Starts/stops; steady while ON  
 Starts/stops; fluctuates while ON

**Bearings**

	Drive End	ODE
Type	Roller	Ball
Brand	NTN	KBC
Serial No.	4T-30210	XY-659
Bore (in.)	1.9685	1.9685
O.D. (in.)	3.5430	3.5500
Width (in.)	0.8563	0.7800

Screen 18

**Motor Inventory - View**

File Search Energy Action Other Data Help

**Facility** Centralia Wood Products    **Process** Boilers   

**Department** Lumber Curing    **Motor** Sec Boiler Fan (4)   

**ID Search** INV-056 #56 (search)    25 HP, 3600 RPM, ODP

Description Sec Boiler Fan     In Service  Spare

**Field Measurements**

	Voltage	Line Current	Other Data
Measurement	ab 479.0	a 18.0	Power Factor (%) 89.0
Date	bc 482.0	b 18.0	Measured Speed
Bin Analysis <input type="checkbox"/>	ca 476.0	c 18.0	Power Draw (kW)

Voltage Unbalance (%)	Average Volts	Average Amps	Motor Load (%)	Motor Efficiency (%)
0.6	479.0	18.0	62.0	86.9

Load Estimation Method:

**Pacific Power and Light**

Energy price (\$/kWh)

Demand charge (\$/kW)

Annual Energy Use	Demand Charge	Total Cost	Efficiency Rating
(kWh) <input type="text" value="55291"/>	(kW) <input type="text" value="13.3"/>	(kW) <input type="text" value="3070"/>	<input type="radio"/> Premium efficiency <input type="radio"/> Energy-efficient <input checked="" type="radio"/> Standard
(\$) <input type="text" value="2990"/>	(\$) <input type="text" value="80"/>	(\$) <input type="text" value="3070"/>	





---

The **Field Measurements** screen (Screen 18) serves as a repository for line-to-line voltage, root-mean-square current, power factor, motor speed, and power draw information, as well as the date (month-day-year) on which measurements were taken. Direct input power values can be supplied if you have access to demand metering equipment. These field data measurements are used to determine the load on the motor and the motor efficiency at its load point. The **Calculated Data** portion of this screen contains values that are derived from information provided on the **Nameplate**, **Operating Profile**, and field data measurements. The **Calculated Data** display includes the voltage unbalance, motor load, motor efficiency at its load point, and the demand, annual energy use, and operating cost for the motor-driven system.

The *MotorMaster+* 4.0 **Field Measurements** tab can accommodate variable load information. When the user selects "starts/stops: fluctuates while on" at the **Load Status** tab, the **Bin Analysis** checkbox is automatically marked on the **Field Measurements** tab and a bin data entry format is displayed. Alternatively, the user can access the bin data entry display by clicking on the **Bin Analysis** checkbox at the **Inventory** screen **Field Measurements** tab. Note that you must be in the **Add** or **Edit** mode to convert to the bin data entry format.

When the **Bin Analysis** is selected, field measurements previously entered under constant load conditions are retained and labeled as occurring 100% of the operating time. The bin data entry display calls for average line-to-line supply voltage and average amperage values. The user is able to enter measured data and the percentage of operating time for up to six operating points or load bins. The total operating time must sum to 100%. *MotorMaster+* determines the motor load and efficiency at each bin load point through using one of four internal motor load and efficiency estimation techniques. The "best available" technique is used based upon the data elements entered. The weighted average motor load and the time and load weighted average motor efficiency are given at the bottom of the **Field Measurements** display. Demand charges are computed by assuming that the motors' highest loading is coincident with the facility's peak demand period.

---

## Estimating Motor Load

*MotorMaster+* 4.0 contains **four** internal motor load and efficiency estimation techniques. The "best available" technique is used based upon available field data measurements. When nameplate data plus supply voltage and measured speed values are available, and a kVA code selection is made at the **Inventory** screen's **Nameplate** tab, the ORMEL basic method is used. This method is preferentially used whenever the necessary input values are available.

Next, the motor load is derived from kilowatt draw data provided at the **Measurements/Calculated Data** screen if power (kW) or voltage, amperage and power factor readings are available.

The voltage compensated slip technique is used when nameplate data plus supply voltage and measured speed are given (and no kVA code selection is made).

Finally, the voltage compensated amperage ratio technique is used when only supply voltage and current measurements are available. The *MotorMaster+* internal load and efficiency estimation techniques contain factors to correct for in-plant voltage deviations from nameplate or design conditions.

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### **Kilowatt Ratio Motor Load Estimation Technique**

$$\text{Motor load} = \frac{kW \text{ input or } Volts_{avg} \times Amps_{avg} \times (Power \text{ Factor}(\%)/100) \times \sqrt{3}}{(hp \text{ rated} \times (0.746) / Full \text{ load Efficiency}(\%)/100) \times 1000}$$

### **Voltage Compensated Amperage Ratio Technique**

$$\text{Motor load} = \frac{Amps \text{ measured}}{Amps \text{ full load nameplate}} \times \left( \frac{Volts \text{ measured}}{Volts \text{ nameplate}} \right)$$

### **Voltage Compensated Slip Technique**

$$\text{Motor load} = \frac{RPM \text{ synch} - RPM \text{ measured}}{(RPM \text{ synch} - RPM \text{ full (nameplate)}) \times \left( \frac{Rated \text{ Voltage}}{Measured \text{ Voltage}} \right)^2}$$

### **ORMEL**

The Oak Ridge National Laboratory developed ORMEL96, a low intrusion tool for estimating in-service motor load and efficiency. The ORMEL Basic method uses nameplate data to construct an equivalent circuit for the motor. The equivalent circuit is a version of IEEE's Standard 112 enhanced to account for stray load losses and friction and windage losses.

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When conducting batch analyses (see the section on **Batch Analysis**), you may specify a default load value such as 70 percent. The default value can be assigned to all motors

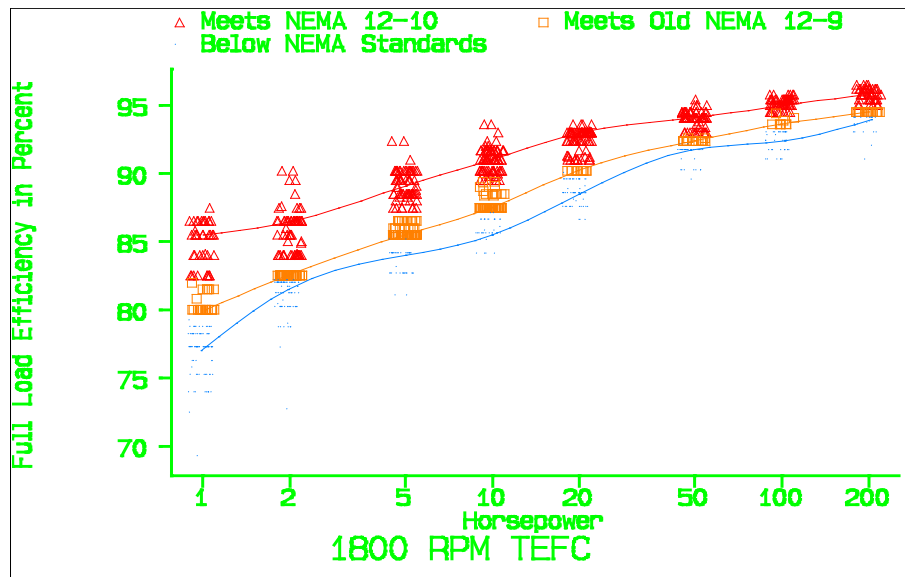
or used only when motors are lacking measured data. When default load estimates are specified, input kilowatt values are derived from load, nameplate, horsepower, and calculated efficiency (at load point) values.

## Determining Motor Efficiency

When the motor load is known, the efficiency at that load point must be determined. *MotorMaster+* contains four part-load efficiency tables that are produced by examining the full, 75, 50, and 25 percent efficiency characteristics of all motors within the *MotorMaster+* database that fall into specified speed, horsepower, and enclosure classes. See Figure 1. The part-load curves are defined for:

- **Premium Efficiency motors.** With a full-load efficiency value equal to or exceeding the NEMA Premium Efficiency™ motor standard (As defined in Table 12-12 of NEMA MG 1-1998, Rev 2).
- **Energy Efficient motors.** With a full-load efficiency value equal to or exceeding the NEMA Energy Efficient motor standard (In accordance with Table 12-11 of NEMA MG 1-1998, Rev 2).
- **Standard Efficiency motors.** Having a full-load efficiency below the minimum standards given in Table 12-6B of NEMA MG 1-1987.
- **High Efficiency motors.** Motors that had previously been characterized as Energy Efficient but which do not meet the present energy-efficient motor standard. (With full-load efficiency values that exceed the NEMA Table 12-6B standard but below the current Table 12-11 Energy Efficient motor standard).

Figure 1



Motor efficiency values that are consistent with operating loads are obtained from one of four empirical look-up tables. Motors are assigned to an appropriate efficiency table based upon their stamped nameplate full-load efficiency value. Motors with no nameplate data are assumed to be Standard Efficiency motors. *MotorMaster+* uses nameplate data plus field measurements in conjunction with one of its four internal

load estimation techniques to determine the load on a motor. The efficiency lookup tables are then accessed and linear interpolation is used to identify an appropriate operating efficiency at the calculated load. The actual motor nameplate full-load efficiency value (when available) is used for interpolations in the range of 75 to 100 percent load. Below 25 percent load, the motor efficiency is considered to equal:

$$EFF = \frac{Load}{Load + Losses \text{ at the } 25\% \text{ Load Point}}$$

## Changing Nameplate or Measured Data

Select your motor of interest, then click on the **Edit** button on the toolbar of the **Motor Inventory-View** screen to modify or add new information. The **Edit Inventory Motor** pop-up screen then appears (See Screen 19). Select an **Edit Energy Action Option** or indicate that you are routinely updating data.

Depending on your **Edit Action Option** choice, *MotorMaster+* will present a series of queries prior to allowing changes in the **Nameplate**, **Operating Profile**, **Load Status** or **Field Measurements** screens. The user must specify whether a new motor is to be selected from the list of available spares, or from the catalog database. Users must also indicate whether a changed-out motor should be junked or assigned to the spare inventory. The user also indicates when a motor has been rewound; and specifies whether changes in measured data reflect a process change or system improvement, installation of a Premium Efficiency replacement motor, completion of a motor or systems-related maintenance action, or simply represents an updated set of field measurements.

### Screen 19

**Edit Inventory Motor**

Energy Action Option

- Motor Replacement**
- System Improvement**
- Motor Rewind**
- Operating Schedule Change**
- Maintenance Log/Motor**
- Maintenance Log/System**
- Complete Pending Action**

You have opted to edit the current inventory motor. If the change in data is the result of an energy savings action, select the appropriate option from the list at left. Otherwise, select 'Routine Data Update'.

**Routine Data Update**

**OK**  **Cancel**

---

## Creating Energy Action Records

Modifications to the **Field Measurements** screen are used to record the energy and dollar savings benefits of in-plant energy conservation improvements. Modifications to motor-driven equipment that conserve energy—such as trimming a pump impeller—are reflected as reduced motor loads. Motor amperage draws, which are entered on the **Field Measurements/** screen, decrease.

*MotorMaster+* monitors the energy and dollar savings consequences of all motor and motor-driven equipment energy-conservation activities through the creation of **System Improvement** or **Motor Replacement Energy Action** records. Before-and-after measured and calculated data, plus a text file, are retained when there are changes in the serving utility, utility rates, operating schedules, measured data, or nameplate data.

---

*Tip: As **Energy Action** records use “before-and-after” field measurements, it is best to enter **Energy Actions** in chronological order. *MotorMaster+* 4.0 also creates and maintains a **Measurements** history file for each inventory motor. To view this file, click on the **Measurements** button at the top of the Motor **Inventory** screen. Click on the **Measurement Date** combo box to add new measurements, or view or edit past values. Note that editing the Measurement History for a motor may change the savings associated with previously created **Energy Action** records. This change occurs when “before” and “after” measured values are modified. *MotorMaster+* updates all date-stamped **Energy Action** records to be consistent with the **Measurement History**.*

---

## Energy Efficiency Improvement Records

*MotorMaster+* also creates an **Energy Efficiency Improvement Energy Action** record when a motor-operating schedule change occurs, and the user selects **Energy Efficiency Improvement** when the modified motor inventory record is saved. Energy Efficiency Improvement records may also be produced when process operating hours change. These records document savings related to reduced motor operation due to a plant efficiency gain or productivity increase. An example might be operation of packaging or bottle-filling-line conveyor motors for one, instead of two, shifts because of increases in the filling or packaging rate. Choose **Plant Schedule Change Only** if an **Energy Action** record is not warranted.

**Energy Action** records can be viewed and the energy, demand, and dollar savings at the process, facility, or company level aggregated over a specified date range within the **Savings Tracker** module. Greenhouse gas emission reductions are also calculated when they originate from the installation of conservation measures or the implementation of efficiency improvements. Review the **Savings Tracker** section of this *User’s Guide* for information on *MotorMaster+* Version 4.0 energy management program analysis and report-writing capabilities.

---

## Replacing Inventory Motors

When the **Motor Replacement Edit** option is selected at the **Edit Inventory Motor** screen, the **Replace Inventory Motor** screen appears. Indicate whether the replacement motor is to be selected from the **Catalog** or from the facility spare motor population. Make your choice and then click on the **Select Replacement** button. When the **From Catalog** checkbox is marked, the program takes you to the **Motor Catalog Query** screen. The Motor Characteristics boxes are filled in with values that are consistent with your existing or inventory motor. These may be edited. When the values are as you like, click the **Search** button. Then make your motor selection by double clicking on the motor data line or by highlighting the motor of interest and then clicking on the **Select** button.

The **Replace Inventory Motor** screen now shows the Current Motor and Proposed Replacement motor. (See Screen 20) Indicate whether the motor to be replaced should be assigned to spare or junk status. Then click on the **OK** button.

When a replacement motor is selected from the *MotorMaster+* **Catalog**, appropriate values are entered automatically at the **Nameplate** screen within **Motor Inventory-View** and the **Field Measurements** screen is cleared. **Load Status** and **Operating Profile** information is retained. After the replacement motor has been installed, a new set of measured data should be obtained and entered. When the replacement motor **Nameplate** screen is filled in and measured data are omitted, *MotorMaster+* creates an **Energy Action Pending** record (Screen 21). This record is completed when you enter a new set of field measurements.

### Screen 20

**Replace Inventory Motor**

The current motor will be replaced by the motor selected from the catalog. After pressing OK to accept the replacement, be sure to complete the data entry for the replacement motor and save.

Current Motor	Replacement Motor
Boiler Fuel Hog	Lincoln Ultimate E2 - Hostile Du
30 HP, 1800 RPM, TEFC	30 HP, 1800 RPM, TEFC
460 volts	230/460 volts

Assign old motor to spares  
 Delete old motor

From Catalog  
 From Spares

Select Replacement

OK Cancel

Screen 21

**Energy Action - View**

**File Help**

**Facility** 
**Motor**  (4)

**Department** 
**Motor ID**  **ID#**

**Process** 
**Entry Date**

**Action Type** 
**Date** 
**Status** Action Pending

**Title**

**Motor cost (\$)** 
**Installation cost (\$)**

	Old Motor	New Motor	Savings
Energy (kWh)	89009	<input type="text"/>	<input type="text"/>
Use (\$)	3501	<input type="text"/>	<input type="text"/>
Demand (kW)	16.5	<input type="text"/>	<input type="text"/>
Charge (\$)	726	<input type="text"/>	<input type="text"/>
Total Savings (\$)			
<input type="text"/>			

**NOTES**

Old Motor -  
Coarse Grinder  
40 HP, 1800 RPM, TEFC

New Motor -  
G.E. ENERGY SAVER  
40 HP, 1800 RPM, TEFC

Replacement motors that lack measured data are indicated by a red **Action Pending** message on the **Nameplate** screen within **Motor Inventory-View**. When you edit information for a motor with an **Action Pending** notation, the **Measurements to Complete Action** choice is highlighted on the **Edit Inventory Motor** screen. A list of motors with Actions Pending can be created through use of the **Energy Actions Pending** checkbox at the **Query/Additional Inventory Query Parameters** screen.

---

## Logging Maintenance Actions

Click on the **Edit** button at the **Motor Inventory** toolbar, then select either the **Maintenance Log/Motor** or **Maintenance Log/System** buttons at the **Edit Inventory Motor** pop-up screen. Click on the **Maintenance Log/Motor** button, then **OK** to bring up the motor **Maintenance Log-New** screen (See Screen 22). Enter the title for your maintenance activity, and then use the **Notes** field to fully describe the motor condition, tests made, and actions taken.

Screen 22

Motor Testing		
<input type="checkbox"/>	Insulation Resistance	--
<input type="checkbox"/>	Polarization Index	--
<input type="checkbox"/>	Surge	--
<input type="checkbox"/>	Vibration	--

---

*Tip: Motor-related maintenance actions are linked to a motor's unique identification number. These action records "follow" the motor. If a motor is assigned to "spare" status, motor-related Maintenance Log entries are still accessible through clicking on the **Motor History** button at the top of the **Inventory** screen. In contrast, system or motor-driven-equipment-related maintenance records remain with the system. For example, assume that a Premium Efficiency motor is purchased and used to replace an existing Standard Efficiency air compressor drive motor. The Standard motor is held in "spare" status. All existing compressor-related **Maintenance** records are automatically reassigned to the **Motor History** file for the new Premium Efficiency replacement motor. All motor-related maintenance actions may be viewed by clicking on the **Motor History** button for the spare motor.*

---



The **Maintenance Log** screen is designed to accommodate and trend the results of four typical motor predictive or preventive maintenance tests: Insulation Resistance, Polarization Index, Surge, and Vibration. Click on the **Motor Testing** checkbox to display a pop-up screen for the test of interest. These pop-up screens are depicted on Screen 23. Enter your data, and then click **OK** to record test results.

**Screen 23**

**Vibration Test (velocity, in./sec.)**

Freq Band Hz. Begin	Freq Band Hz. End	ODE Horizontal	ODE Vertical	DE Horizontal	DE Vertical	DE Axial
0.8	18.8	0.0001	0.0054	0.0013	0.0013	0.0047
22.8	30.8	0.0004	0.0002	0.0002	0.0005	0.0000
0.0	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
0.0	0.0	0.0000	0.0000	0.0000	0.0000	0.0000

**Polarization Index Test**

DC test voltage

	1 min.	10 min.	Polarization Index
A-B	0.000	0.000	0.000
A-C	0.000	0.000	0.000
B-C	0.000	0.000	0.000

**Insulation Resistance Test (MegOhms)**

DC test voltage       Temperature (C.)

A       B       C       Minimum acceptable value

**Surge Test**

DC test voltage

**Deviation from master (%)**

A       B       C

## Motor History

Click on the **Motor History** button on the **Motor Inventory--View** screen to access the **Inventory Motor History Query** screen for the motor that is selected. (Screen 24) This screen contains a chronological listing of all motor maintenance actions, rewinds or repairs, operating schedule changes, and system-related conservation improvements. Use the **Action Type** pulldown menu to list "All" or only a particular type of action. The "From" and "To" boxes can be used to selectively display only those actions that occurred within a specified date range. Click on one or more **Predictive Maintenance Tests** boxes to obtain a list of test actions and dates. Highlight any row and then click on **Detail** button to review complete **Energy Action** records or predictive maintenance testing results. Use the **Print** button to obtain records of motor and system-related **Energy Action** records and maintenance activities.

Screen 24

Inventory Motor History Query

File Query Help

Clear Search Detail Print ? Cancel

Motor ID: ID# 56 Description: Sec Boiler Fan *2 records*

Action Type: From: / / To: / / Action Pending:  Tests:  Insul. Resist.  Surge  Polar. Index  Vibration

Type	Costs	Savings	Pend	Insltn	Polar.	Surge	Vibrtn
peller: Sys Improve		\$ 559					
est MntLogMoto							Yes

---

## Predictive Maintenance/Condition Analysis Screening

To support predictive maintenance program activities, *MotorMaster+* 4.0 allows the user to conduct queries and list all motors with recorded test values that exceed user-specified limits. Only the most recently dated maintenance record for each motor is examined. Funding for this enhancement was provided by BJM Corp, Dreisilker Electric Motors Inc, and Pruftechnik, Inc. This modification is designed to be "generic" or testing equipment neutral. As long as consistency is maintained, any test parameters and units may be saved in the data entry, display, and query range fields. While this enhancement was funded by a consortium of private firms, the modification is available for all users of *MotorMaster+*.

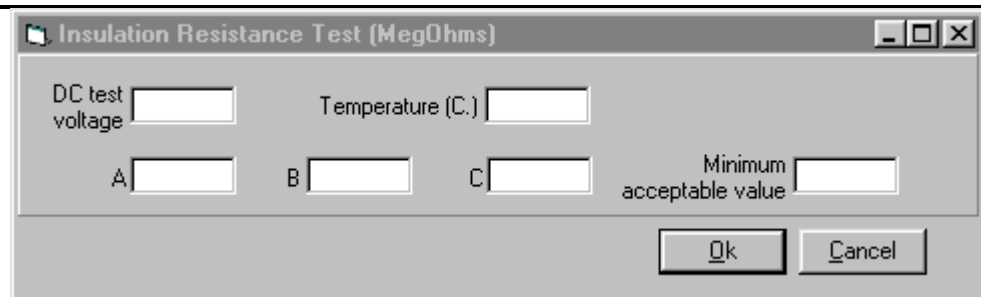
*MotorMaster+* 4.0 allows users to perform a condition analysis of in-service motors within their plant inventory. The **Maintenance Log/Motor** screens have been redesigned to accommodate phase balance data (resistive, inductive, and impedance unbalance), insulation resistance values, and vibration analysis results in terms of velocity and shock pulse.

### Entry of Test Data

Identify the motor of interest at the **Motor Inventory-View** screen. Click on the **Energy Action** menu and select the **Maintenance Log/Motor** menu item to enter the **Maintenance Log/New** screen (See Screen 22).

You must enter a title for this screen. You may also enter notes and any associated costs for the analysis. To enter your Meg-Ohm readings, click on the **Insulation Resistance** checkbox to view the Insulation Resistance popup screen (Screen 25).

#### Screen 25



The screenshot shows a dialog box titled "Insulation Resistance Test (MegOhms)". It features a standard Windows-style title bar with a minus, maximize, and close button. The main area contains several input fields: "DC test voltage", "Temperature (C.)", "A", "B", "C", and "Minimum acceptable value". The "A", "B", and "C" fields are arranged horizontally. At the bottom right, there are two buttons: "Ok" and "Cancel".

Enter the Meg-Ohm test voltage and winding temperature, if available. You can enter the Meg-Ohm value for the motor in any or all three of the fields labeled A, B, or C. The minimum acceptable value is an optional data entry field. When finished, close this form by selecting **OK**.

Click on the **Surge** checkbox to access the **Surge Test** popup screen (Screen 26). Surge is the Phase Balance portion of the data entry. The DC test voltage is not required. Enter in your maximum percent unbalance for resistance, inductance and

impedance in the appropriate fields. Note that all the fields do not need to be filled in. You may enter data for a single test or all of the tests. Close the form by selecting **OK**.

## Screen 26

Surge Test

DC test voltage

**Deviation from master (%)**

A / Resistive unbalance (R)

B / Inductive unbalance (L)

C / Impedance unbalance (Z)

Ok Cancel

Open the Vibration Analysis portion of the **Motor Maintenance Log-New** screen by selecting the **Vibration** checkbox in the **Motor Testing** menu. The Vibration Test data entry and query functions are flexible with respect to measured test parameters and units. The data entry screen has been modified to show that the second column may be used either for the end bracket of a frequency range or another parameter such as ODE axial vibration (See Screen 27). The vibration test allows one to four frequency bands to be used in a single record. The variables have been dual-labeled for consistency with past labeling and newer conventions. The user may utilize the data fields for any parameters or units with values from 0.0001 to 9999.9999. Enter the appropriate data and select **OK**. In the **Motor Maintenance-Log** screen, select the **Save** icon and continue.

*Note: The **MotorMaster+** 4.0 enhanced predictive maintenance features are less restrictive in terms of tracking and displaying test parameters than earlier versions. Labeling convention retains a connection to earlier versions while also showing newer conventions. Any parameters and units can be stored in the data entry fields and the query range fields as long as consistency is maintained.*

Screen 27

Freq Band Hz, Begin	Hz, End / ODE Axial	ODE Horizontal	ODE Vertical	DE Axial	DE Horizontal	DE Vertical
0.0	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
0.0	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
0.0	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
0.0	0.0	0.0000	0.0000	0.0000	0.0000	0.0000

Callout boxes and arrows point to the following elements:

- 'In/sec' points to the 'Hz, End / ODE Axial' column.
- 'Shock Pulse Carpet,' points to the 'ODE Horizontal' column.
- 'Shock Pulse Max,' points to the 'DE Axial' column.

Predictive Maintenance Query

Click on the **Query** button at the **Motor Inventory-View** screen. Then click on "**Clear**" to scan maintenance records for all in-service motors in your company, or use the **Characteristics** and **Facility/Department/Process** choice boxes to identify a subset of motors to analyze. Then click on the **Other Criteria** button to view the **Additional Query Parameters** screen (See Screen 28).

---

## Screen 28

---

Motor Inventory Query - BATCH ANALYSIS

File Query Help

Clear Search Other Criteria Reset Cols Run Batch [Printer] [Help] Exit

**Characteristics**

Motor type: NEMA Design B Facility: ALL FACILITIES

Speed (RPM): 1800 Size (HP): 100 Dept.: [ ]

Voltage: - All - Process: [ ]

Enclosure: Totally Enclosed Fan-Cooled Description: [ ] ID: [ ]

**Other Criteria**

Status: In Service

Sort Column: Efficiency  Ascending  Descending Remove Row **1 motor found**

#	Motor ID	Description	Manufacturer	Model	HP	Facility
154	INV-096-1	Rotary Screw	G.E.	Energy Saver Extra	100	Concentrated Juice, Ir

Now click on the **Predictive Maintenance analysis** checkbox to begin the process of obtaining a list of all motors with measured test values falling above or below critical user-specified limits. To enter your test limits, click on the shaded box to the right of the **Predictive Maintenance analysis** checkbox (See Screen 29).

## Screen 29

**Additional Inventory Query Parameters**

**Other Characteristics**

Load type: - All -  
Priority: - All -  
Efficiency level: - All -  
Status: In Service  
History: - n/a -

Rewound only   
Missing measurements   
Energy actions pending

**Load Modulation**

All  
 ASD  
 Throttling valves/dampers

**Special Features**

Definite purpose: -- All motors --

U-frame  C-face   
Vertical shaft  D-flange

**Range Checks (one only)**

Voltage unbalance (%) >=   
Oversized/underloaded (%) <=   
Overloaded (%) >=   
Power factor (%) <=   
Over/under voltage (%) +/-   
Predictive maintenance analysis  ...

**Other Ranges**

HP range >=   
<=   
Energy use (kW/h/yr) >=   
Power draw (kW) >=   
Age (years) >=

Clear OK Cancel

The **Predictive Maintenance Analysis Parameters** query and reporting screen is organized into three predictive maintenance categories; Phase Balance, which accommodates surge test or other motor circuit analyses, Insulation Resistance, and Vibration (See Screen 30). Separate queries and reports must be performed for each of these categories. Note that the values entered are only retained until you exit *MotorMaster+*. The **Predictive Maintenance Analysis Parameters** fields are reset to "zeroes" when you reboot the software.

Select either **Phase Balance** (previously limited only to surge test), **Insulation Resistance**, or **Vibration**. Enter range limits as desired for the query. **Phase Balance** data and query fields accept unbalance values normally expressed as a percentage. These fields are labeled for either surge test or common motor circuit analyzer parameters. They may be used and queried for any parameters with values from 0.1 to 999.9.

**Insulation Resistance** on the **Predictive Maintenance Analysis Parameters** screen allows one query range value. But, there are three data cells in the **Insulation Resistance** data entry screen. Usually only data cell A is used, but three cells have been provided for the uncommon circumstance of users isolating phases during insulation testing. The query will list a motor if any cells, A, B, or C have a non-zero value lower than the query range value. The fields and query may be used for any parameters or units with values from 0.1 to 9999.9.

The **Vibration** test data and query function are also flexible with respect to parameters and units. The query operates from a single range limit per column and checks to see if any line in the column contains an over-range value. The variables have been dual-labeled for consistency with past labeling and newer conventions. The user may utilize the data fields for any parameters or units with values from 0.0001 to 9999.9999.

To generate a report, click **OK**, then click on the printer icon when query results are listed on your screen. Then select the **Predictive Maintenance Analysis "radio button"** on the **Print Reports** screen.

### Screen 30

The screenshot shows a dialog box titled "Predictive Maintenance Analysis Parameters". It contains three radio button options: "Phase Balance", "Insulation Resistance", and "Vibration".

- Phase Balance** (selected):
  - A / Resistive unbalance (R) > [ ]
  - B / Inductive unbalance (L) > [ ]
  - C / Impedance unbalance (Z) > [ ]
- Insulation Resistance**:
  - Megger < [ ]
- Vibration**:
  - ODE Bearing**:
    - A / Vibration (in/sec) > [ ]
    - H / Shock pulse carpet (db) > [ ]
    - V / Shock pulse max (db) > [ ]
  - DE Bearing**:
    - A / Vibration (in/sec) > [ ]
    - H / Shock pulse carpet (db) > [ ]
    - V / Shock pulse max (db) > [ ]

On the right side of the dialog box, there are three buttons: "Clear", "Ok", and "Cancel".



---

# Descriptor Searches and Selective Reports: Query

Use the **Query** screen's location, motor characteristics, and operating parameter filters to scan your in-plant motor inventory and to obtain listings of motors meeting all specified search conditions. **Query** can flag motors that are operating with sub-optimal power supply conditions or select subsets of the motor inventory for "Batch" rewind or energy-efficient motor replacement analyses.

## Motor Inventory Search Capabilities

Typically, all motors in a given facility, or all motors greater than a minimum size, (such as 5 hp) are inventoried. Once created, the *MotorMaster+* in-plant motor inventories can be subjected to successive sets of location, motor design characteristic, and operating-parameter-related filters (Table 1).

The **Motor Inventory-View** screen is equipped with motor design characteristics, location filters, and print options. A listing of all motors, all 25- to 75-hp motors, or all motors in a given process, department, or utility service territory can be readily displayed. Click on the **Query** button to provide a set of available search criteria. See Screen 31. Clicking on the **Other Criteria** button provides a supplemental set of search criteria. See Screen 32.

---

*Tip: The **Definite Purpose** combo box default is "All Motors" with the prescribed features within the company, facility, or department inventory. Select "**General Purpose Motors**" to obtain a list of all non definite-purpose motors. Make any other selection to obtain an exclusive list of **Definite Purpose** motors.*

---

The *MotorMaster+* **Query** screen is also designed to conduct range checks that scan for and flag motors that are overloaded or operate under sub-optimal power supply conditions, such as over- or under-voltage or voltage unbalance. Only one range check value can be applied at a given time. Motors that have been rewound also can be identified. Conservation opportunities can be targeted through listing motors in descending order of annual energy consumption or by identifying that subpopulation of motors whose energy usage exceeds a preselected minimum value.

---

## ***Database Power at Work***

### ***Location Searches***

*List all motors in descending order of size or annual energy consumption.*

- *All motors.*
- *By facility.*
- *By department.*
- *By process.*
- *By utility.*

### ***Operating Parameter Search Capabilities***

*List:*

- *Motors with power supply problem (voltage unbalance  $\geq$  3%, 2%, 1%).*
  - *Indicate all motors with power factor  $\leq$  stated value.*
  - *List motors  $\geq$  selected age.*
  - *Identify rewind motors.*
  - *List motors by process equipment type.*
  - *Identify motors  $\geq$  or  $\leq$  stated hp value.*
  - *List all spares.*
  - *List all oversized motors (load  $\leq$  40%, 50%, etc.).*
  - *Show motors with annual energy use  $\geq$  or  $\leq$  stated value.*
  - *Display motors with “Energy Actions Pending.”*
- 

**Table 1**

<b>Location sorts by:</b>	<b>Characteristics sorts by:</b>	<b>Operating Parameters:</b>
company	motor type	voltage unbalance
facility	motor size range	oversized and underloaded
department	speed	low power factor
process	voltage	energy use threshold
utility	enclosure	demand
	motor age	spares list
	process equipment type	rewind
	priority	by motor priority or importance
	efficiency status	
	special features	

Motor speed, enclosure, and horsepower class search criteria are summarized below:

Speed	Enclosure	hp Class			
All	All	1	10	60	300
3600	ODP	1.5	15	75	500
1800	TEFC	2	20	100	600
1200	TENV	2.5	25	125	700
900	EXPL	3	30	150	800
	WP	5	40	200	1000
	TEAO	7.5	50	250	1250

**Screen 31**

The screenshot shows the 'Motor Inventory Query - BATCH ANALYSIS' window. The interface includes a menu bar (File, Query, Help), a toolbar with buttons for Clear, Search, Other Criteria, Reset Cols, Run Batch, and Exit. The search criteria section is divided into 'Characteristics' and 'Other Criteria'. Under 'Characteristics', Motor type is set to '- All -', Speed (RPM) to '- All -', Voltage to '- All -', Enclosure to '- All -', Facility to 'Centralia Wood Proc', Dept. to 'Lumber Curing', and Process to 'Boilers'. Under 'Other Criteria', Status is set to 'In Service'. The 'Sort Column' is set to 'Efficiency', with 'Descending' selected. A 'Remove Row' button is visible. The results table shows 4 motors found, with columns for #, Motor ID, Description, Manufacturer, Model, Facility, and Dep.

#	Motor ID	Description	Manufacturer	Model	Facility	Dep
57	INV-057	Boiler ID Fan	G.E.		Centralia Wood Products	Lum
58	INV-058	Boiler Fuel Hog	Hemco		Centralia Wood Products	Lum
56	INV-056	Sec Boiler Fan	US Motors		Centralia Wood Products	Lum
55	INV-055	Prim Boiler Fan	Baldor		Centralia Wood Products	Lum

Click on **OK** or **Cancel** after search criteria have been selected from the **Additional Inventory Query Parameters** screen. “Other” criteria that have been chosen are then displayed in the **Other Criteria** box in the upper right-hand corner of the **Motor Inventory Query** screen. Click on **Search** at the **Motor Inventory Query** screen after all criteria have been selected. Only motors that satisfy all selected criteria are shown on the **Motor Inventory Query** list.

You can display the motor list in ascending or descending order of a number of descriptors including horsepower, full-load efficiency, or annual energy usage. This feature is accessed through clicking on the **Sort Column** descriptor arrow box.

The motor list contains columns for the motor identification number, description, manufacturer, model, facility, department, process, size, speed, enclosure, voltage rating, full-load efficiency and power factor, motor age, frame size, and annual energy use. Click on the **Right Arrow** button to view the entire list. Clicking on the top border allows you to "drag and drop" columns and reformat the on-screen display. Click on the **Reset Cols** button to restore your display to its original appearance. Clicking on any motor within the list causes it to be highlighted. Click on the **Select** button to display the **Motor Inventory-View** screen for the highlighted motor. Click the **Clear** button to restore default values to the **Motor Inventory Query** screen.

---

## Finding a Motor

There are several ways to search for **Inventory** motors:

- **Query screen:** Click the **Query** button on the toolbar of the **Inventory** screen. You can filter your search with multiple parameters. Click on the **Other Criteria** button to display a screen with additional parameters. Make your selections and then click on **OK**. Double-click on any listed motor to view its **Motor Inventory--View Nameplate** tab. Notice also the **Description** field on the **Motor Inventory Query** screen. You can enter any part of the description and press **Enter** to search for all motors with those characters anywhere in the description field.
- **Hierarchy:** Don't forget about the **Hierarchy** button for displaying the Facility/Department/Process/Motor hierarchy list, a quick way to find motors within the company structure. Double-click on any motor name to observe its **Motor Inventory--View Nameplate** tab.
- **Motor ID and ID# Searches:** The **Motor ID** field is available at the **Nameplate** tab of the **Motor Inventory--View** screen for a company's own motor coding scheme. If used, you can bring up a motor quickly by typing in the code in this field and pressing **Enter**. In addition, each motor is assigned a number internally that is always displayed with the motor and on the **Motor Inventory Query** screen. You can recall this motor quickly by typing the number in the **Motor ID #** box and pressing **Enter**.
- **Facility, Department, and Process Combo Boxes:** Select the appropriate facility, department, process, and motor from the combo boxes at the top of the **Inventory** screen.

---

# MotorMaster+ Motor Improvement Planning Capabilities: Batch Analysis

*MotorMaster+ can analyze repair versus replace, or replace operating motor decisions in a batch mode. All of the motors in an industrial plant—as many as 1,000—can be analyzed at once, with energy, demand, dollar savings, and rebate entitlements summarized for all replacement motors with simple paybacks on investment falling below a user-specified cut point (such as two or three years).*

## Batch Mode Operations

The *MotorMaster+* **Compare** module may be used to analyze one motor at a time in a user-interactive mode. The analyst chooses an existing motor from **Inventory** or specifies the characteristics of the base case motor, selects a more efficient model from the **Catalog**, determines the value of both energy and demand savings, and prints an energy savings report. The process is then repeated for the next motor and the next.

Motors contained within the *MotorMaster+* motor **Inventory** module can also be accessed and analyzed in a batch mode basis after filtering with location, characteristics, and operating parameter values. Information necessary for analysis, such as motor design characteristics, operating hours, load point, and efficiency at the load point is incorporated automatically into the analysis.

You establish the simple payback criteria, motor list price discount factor, and number of months when the motor is expected to operate during utility “peak” demand periods. Then indicate whether “best available” replacement motors should be selected or if replacements should come from a particular manufacturer, such as U.S. Motors, Reliance, or General Electric. The “best available” replacement motor provides the quickest simple payback on investment. (When a group of motors exhibit “immediate” paybacks, the motor with the greatest annual dollar savings is designated as the “best available” unit.)

A “bin” analysis is conducted for motors with variable loads. Energy savings are determined by superimposing each in-plant motors’ load profile on the Premium Efficiency replacement motor. The efficiency at each load point is computed, and then used to determine energy use, demand, and reductions in annual operating costs. Annual energy savings are determined by summing the savings obtained at each load point.

Industrial plant engineers can use *MotorMaster+* to examine the cost-effectiveness of an immediate or group change-out to Premium Efficiency motors. Alternatively, the plant manager can identify those motors that should be replaced by Premium Efficiency models versus undergoing repair when the motors fail. Only potential replacement motors that meet your simple payback criteria are listed.

**New**

**Batch Analysis** thus accepts motor inventory measurement and performance inputs automatically from the **Field Data Module**, conducts an analysis, and then aggregates results from changing out all motors or only those motors with simple paybacks below a specified hurdle rate.

### Batch Analysis

To perform a batch analysis, go to the **Motor Inventory Query** screen by clicking on the **Batch Analysis** button on the Main Menu screen. Select a list of motors to analyze by specifying appropriate search filters and clicking on the **Search** button.

*MotorMaster+* now allows the user to enter a **Motor ID #** so that a single motor can be selected for a batch analysis or to pare down a selected list of motors by deleting rows. Highlight the row of interest, and then click on the **Delete Row** button to remove individual motors from the batch to be analyzed.

Choose the group of motors that you wish to include in your Batch Analysis, and then click on the **Run Batch** button on the toolbar, and the **Batch Analysis Setup** screen appears. See screen 33.

### Screen 33

**Batch Analysis Setup**

File Help

Rewind  Replace Existing

Batch Run ? Exit

**Load Estimation Technique**

kW calculation

- > Slip technique (measured RPM)
- > Measured amperage values

Use default load for missing values

Default load only

**Manufacturers (ALL)**

Manufacturer	Discount(%)
ABB	35.0
AO_Smith/Magnetek	35.0
Baldor	35.0
Dayton	35.0
G.E.	35.0
Hemco	35.0
Lafert	35.0
Leeson	35.0

Setup All

**Defaults**

Default load (%)

Payback (yrs) <=

Peak months

Auto downsizing

U-frame to T-frame

200V for 208V service

**Upgrade Option**

No upgrade

IEEE 841

Severe duty

Select technique for estimating inventory motor loads

Now, indicate whether you want to initiate a **Rewind** or **Replace Existing** motor(s) analysis. The **Rewind** analysis considers the incremental cost between rewinding a failed motor versus procuring a new Premium Efficiency model. As the replacement is assumed to occur at the time of motor failure and removal for repair, no additional installation costs are incurred. In contrast, the **Replace Existing** motor analysis considers the FULL costs of obtaining and installing a new Premium Efficiency motor.

---

Available utility rebates are incorporated into both analysis scenarios. Select your batch analysis default values, and indicate which manufacturers should be included in the motor replacement evaluation. Click on the **All** checkbox to include all manufacturers, or specify specific manufacturers by highlighting them in the listbox with a mouse click.

*MotorMaster+* allows the user to specify unique motor list price discount factors for each motor manufacturer. These values are then automatically incorporated into subsequent **Compare** and **Batch** analyses. Review the *Customizing MotorMaster+* section of this *User's Guide* for instructions regarding the preparation of manufacturer specific list price discount tables.

Click on the **Run Batch** button when data entry is complete. The standard *MotorMaster+* **Print Reports** screen is displayed (see the section on *Printing* for more general details).

Click on the **Print** button to begin the actual analysis. The report produced will provide a list of all motors that can be immediately replaced (with a simple payback below the industry's investment criteria), or a list of motors that are candidates for replacement versus rewinding should they fail. For competitive bidding purposes, the report shows the three top replacement motor candidates. Energy, demand, and annual dollar savings are presented for a population of motors, a department, a process, a facility or an entire company. Company totals take each facility's utility rate schedule into account and assume the retrofit of the existing motor with the best available replacement.

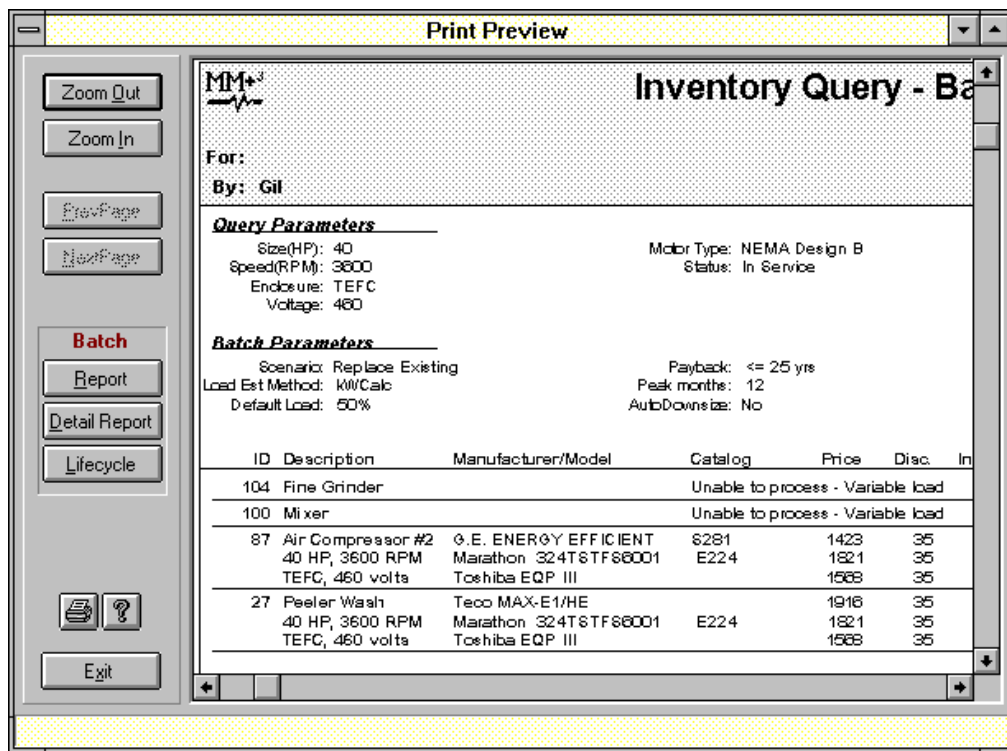
Note that motors with the following characteristics are deleted from batch rewind or motor replacement evaluations:

- Voltage not in valid list.
- Enclosure type not in list.
- Synchronous speed not in list.
- Two-speed motors.
- Insufficient data to estimate load plus no default.

When the analysis is completed, the report will be displayed in the **Print Preview** screen. In this situation, however (unlike all others), *two* files are created. When the **Print Preview** screen appears, there are two extra buttons, labeled **Detail Report** and **Life Cycle Setup**, at the left of the screen. The primary results of the batch analysis are displayed in the viewing box, (Screen 34) including total equipment, repair and installation costs; annual energy and demand savings; annual dollar savings; the serving utility rebate; and the simple payback on investment.



## Screen 34



A detail file has also been created that can be viewed by clicking on the **Detail Report** button. This file gives a complete listing of comparison information and calculations (including energy, demand, and cost savings) for every pair of motors (motor inventory vs. new motor catalog) compared. The **Detail Report** button is actually a toggle, as its changing label indicates, between this **Detail File** and the **Batch Analysis Results** report originally displayed.

## Automatic Downsizing of Motors

**Batch Analysis** will not only examine replacing an existing oversized and underloaded motor with a Premium Efficiency equivalent (in terms of hp, enclosure, full-load speed, and special features) but at your discretion, will also consider appropriately sized replacement motors.

The purpose of incorporating the **Auto Downsizing** routine into *MotorMaster+* is to help industrial facility personnel to make the best and most cost-effective motor replacement choice. Motors that operate at less than 40 percent of full-load are candidates for a downsized, Premium Efficiency replacement motor. Because of uncertainties with respect to load estimation, the loading on the replacement motor is not allowed to exceed 85 percent.

To incorporate automatic motor downsizing into your analysis, click on the **Auto Downsizing** check box at the **Batch Analysis Setup** screen.

---

Downsizing makes sense as the list price for a new 40-hp motor is only 35 percent of that for a new 100-hp energy-efficient motor. Appropriate downsizing can exert a significant influence on the cost-effectiveness of a Premium Efficiency motor change-out decision.

The projected cost for the downsized replacement motors should be modified to contain a price premium to account for frame adapters or coupling modifications. The energy savings due to selecting the best or optimally sized replacement motor includes the consideration of speed/slip relationships and efficiencies at actual operating points. Downsized motor replacement recommendations are highlighted or flagged on the **Batch Analysis** printout.

## Batch Motor Upgrade Analyses

Some industries are interested in replacing existing U-Frame with T-Frame motors, or in procuring only 200-volt-rated motors for 208-volt service. Others want to replace existing standard T-Frame motors with higher quality motors such as Severe-Duty/Extra-Tough/Corrosion-Resistant motors, Inverter-Duty motors, or motors that are designed in accordance with the IEEE 841 Petroleum and Chemical duty specifications. The objective is to improve energy efficiency while obtaining the benefits of durability, reliability, and an extended mean time between failures. A longer motor life is expected when motors are acquired that are designed to rigorous standards and constructed with superior materials.

*MotorMaster+* allows motor upgrades to be taken into consideration in **Batch Analysis**. Click the U-frame to T-frame checkbox and/or make a selection at the **Upgrade Option** combo box to initiate your **Batch Motor Upgrade Analysis**. Only one **Upgrade Option** may be selected at a time. Standard motors will now be replaced only with the “best available” replacement motor containing the designated special feature(s).

## Life Cycle Analysis of Batch Run

A life cycle analysis of the proposed “project” can be initiated from the **View Report** screen by clicking on the **LifeCycle** setup button. The **Life Cycle Setup** screen is displayed (see the **Life Cycle Analysis** section). Inputs to the life cycle cost analysis include the total purchase and installation costs for the replacement motors, annual energy savings and demand reductions, and weighted average utility rates. (Energy and demand charges for each facility are automatically weighted by the percentage of the total savings obtained by that facility.) Other inputs, which are retained and carried over from previous calculations, include the loan date, life, and interest rate, corporate and state tax rates, replacement motor life expectancy, electrical cost escalation rate, discount rate, depreciation life, and salvage value.

After data has been entered, click on the **Calc** button to display cash flows and view such life cycle cost-effectiveness criteria as net present value and after-tax return-on-investment.

---

You can still view the **Batch Analysis Detail** file and **Batch Analysis Results** file in the usual way. Once the life cycle analysis is completed, the **Life Cycle Analysis** button also becomes a toggle between redisplaying the life cycle results and returning to the **Life Cycle Setup** screen. In this way, you can quickly and easily perform a comprehensive equipment replacement and/or downsizing analysis.

Click on the **Exit** buttons to return to the **Print Reports** screen and then the **Batch Analysis Setup** screen.

# Energy Accounting: Savings Tracker

Select **Savings Tracker** from the **Main Menu** to create records of billing data for your facility, to enter production history data, and to generate a series of energy management reports. Available reports include the **Monthly Billing Summary**, the company-wide or facility **Energy Conservation Summary**, the **Facility Reduction in Consumption Report**, and the **Greenhouse Gas Emissions Reduction Report**.

## Utility Billing Information

From the Main Menu, click on the **Billing** segment of the **Savings Tracker** destination button. The **Billing-View** screen appears (Screen 35).

Screen 35

The screenshot shows a software window titled "Billing - View". It features a menu bar with "File", "Search", and "Help". Below the menu bar is a toolbar with icons for file operations, a "NewRepeat" checkbox, "Query" buttons, a help icon, and an "Exit" button. The main area is divided into several sections:

- Facility:** A dropdown menu showing "Centralia Wood Products".
- Meter:** A dropdown menu showing "82109".
- Bill date:** A dropdown menu showing "09/29/1996".
- Utility Information:** A section titled "Pacific Power and Light" containing:
  - Avg energy price (\$/kWh): 0.05408
  - Avg demand charge (\$/kW): 0.50
- Billing Data:** A table with columns for "Electric Usage", "Electric Demand", and "Power Factor/Penalty".

Billing Data		Electric Usage	Electric Demand	Power Factor/Penalty
From	08/29/1996	570000 kWh	1438.0 kW	81.0 %
To	09/29/1996	\$ 30825.60	\$ 719.00	\$ 1206.00
<b>TOTAL</b>				\$ 32750.60

Select the Facility and Meter of interest (meters have to be created and assigned to their respective facilities at the **Facilities** screen). Note that the Serving Utility name and the average facility, energy, and demand charges are indicated in the upper-right-hand portion of the screen.

Notice that the **Meter** box is a combo box. Click on the down arrow to obtain a listing of all meters assigned to your facility. Highlight the meter of interest and then click to bring up the **Billing Data** display. The **Bill date** combo box provides access to previous utility bills. Click on the down arrow to view a list of prior billing dates. Highlight the date of interest and then click on it to review past billing data. Use the toolbar **Edit** button to modify existing values.

---

Click on the familiar toolbar **Add** button to input new billing data. The last-entered billing period “To” date automatically becomes the “From” date for the current entry. Enter your “To” date, electrical energy use and cost, demand use and cost, and facility power factor and power factor penalty. Then enter the total billing amount. Because of fixed monthly service, hookup, and miscellaneous utility charges, the total monthly billing amount does not have to be equal to the sum of the individual energy, demand, and power factor penalty charges. An error warning appears, however, when the sum of individual charges exceeds the total billing amount.

It is expected that users will enter billing data in a chronological order. Users may edit billing period “From” and “To” dates—the software will automatically adjust the “To” date from the previous billing period to equal the new “From” date in the subsequent or current period. *MotorMaster+* will accept data from utilities that bill on a bi-monthly basis.

Click on the **Query** button to view a complete history of **Billing Data** for a particular electrical meter (Screen 36). Click on any billing period to highlight it, then click again to return to the user-editable **Billing-View** screen for the specified billing period. Click on the **Print** button to send the Billing or Billing History report to your printer.

Click on **Exit** to return to the **Main Menu**.

### Screen 36

The screenshot shows a window titled "Billing Data" with a menu bar (File, Help) and a toolbar (Select, Print, Help, Exit). Below the menu bar, there are dropdown menus for "Facility" (Centralia Wood Products) and "Meter" (82109). The main area contains a table titled "Billing History (24 entries)".

#	From	To	kWh	kWh \$	kW	kW \$	Power Factor %	PF Penalty \$	Total \$
13	09/23/95	10/27/95	570000	\$30826	1404	\$702	89.0	\$459	\$31987
14	10/27/95	11/20/95	548400	\$29657	1440	\$720	91.0	\$307	\$30684
15	11/20/95	12/24/95	591600	\$31994	1428	\$714	89.0	\$467	\$33175
16	12/24/95	01/28/96	541200	\$29268	1428	\$714	90.0	\$385	\$30367
17	01/28/96	02/25/96	601200	\$32513	1392	\$696	89.0	\$455	\$33664
18	02/25/96	03/25/96	558000	\$30177	1488	\$744	90.0	\$401	\$31322
19	03/25/96	04/20/96	646800	\$34979	1488	\$744	88.0	\$574	\$36297
20	04/20/96	05/24/96	597600	\$32318	1464	\$732	90.0	\$395	\$33445
21	05/24/96	06/23/96	577200	\$31215	1440	\$720	89.0	\$471	\$32406
22	06/23/96	07/24/96	544800	\$29463	1416	\$708	81.0	\$1187	\$31358
23	07/24/96	08/29/96	627600	\$33941	1490	\$745	82.0	\$1146	\$35832
24	08/29/96	09/29/96	570000	\$30826	1438	\$719	81.0	\$1206	\$32751

## Plant Production

To access the **Production-View** screen (Screen 37), click on the **Production** segment of the **Savings Tracker** button at the **Main Menu**.

### Screen 37

The screenshot shows a window titled "Production - View" with a menu bar (File, Help) and a toolbar (Print, Help, Exit). Below the menu bar, there is a dropdown menu for "Facility" (Centralia Wood Products). The main area contains a table titled "Production History (24 entries)".

#	Mth/Yr	Wood Products (million board feet)
13	10/1995	3.1
14	11/1995	3.0
15	12/1995	3.2
16	01/1996	2.9
17	02/1996	3.5
18	03/1996	3.4
19	04/1996	3.7
20	05/1996	3.6
21	06/1996	3.5
22	07/1996	3.4
23	08/1996	3.8
24	09/1996	3.5

---

Select a **Facility**, then click on the **Add** or **Edit** toolbar buttons to enter or modify monthly production quantities. The Production Types (product definitions) and monthly production rate units table is created within **Options/Production Types** and then assigned to an individual facility at the **Facilities-View** screen. The assigned product and the accompanying production units appear as labels on the **Production History** portion of the screen.

When you click on the **Add** button, the **Month/Year** box indicates the next month of the Production History or record. Enter the quantity produced in the specified units. Similar to the **Billing** screen, the **Production** screen is designed to be created chronologically. Enter a “**0**” for the quantity produced when a facility is off-line due to seasonal production or is shut down for a prolonged maintenance outage.

Click on the **Print** button to obtain a **Facility Production History Report** or **Exit** to return to the **Main Menu**.

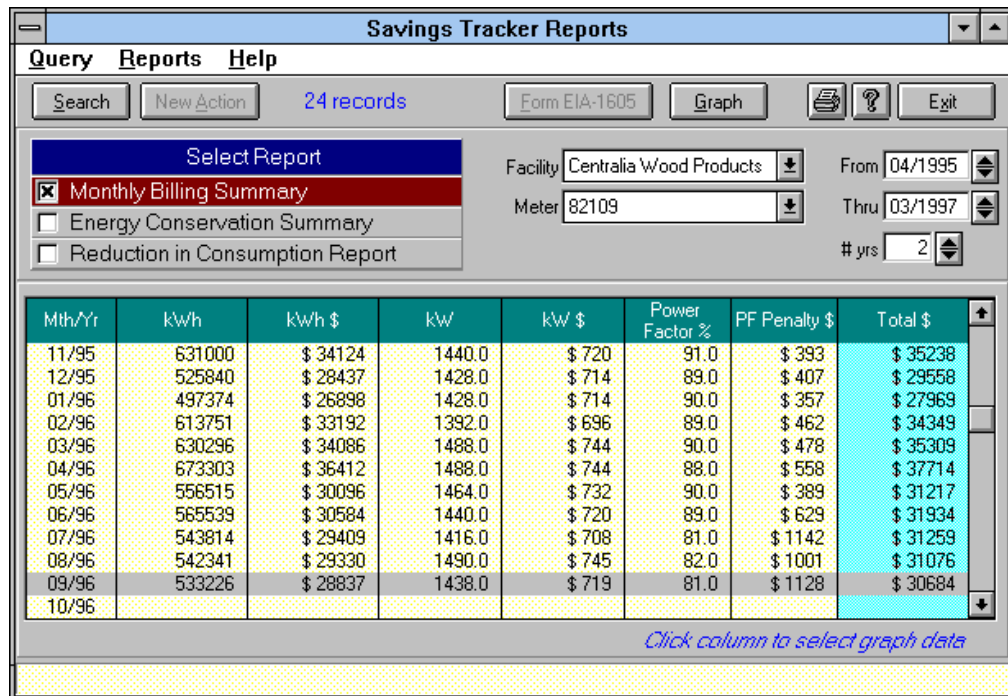
## Savings Tracker Reports

Click on the **Reports** segment of the **Savings Tracker** button to access **Tracker’s** powerful report writing and graphics capabilities. At the **Savings Tracker Reports** screen, select your facility and then specify the report date range (From/To). Then use the checkboxes under the **Select Report** heading to access the report of interest.

## Monthly Billing Summary Report

Mark the **Monthly Billing Summary** checkbox and then click on the **Search** button. For each month during the selected date range, *MotorMaster+* indicates the energy consumption and cost, demand and demand cost, and power factor and power factor penalty. The analyst may use the **Meter** combo box to consider all meters or any individual meter assigned to a selected facility (Screen 38).

## Screen 38



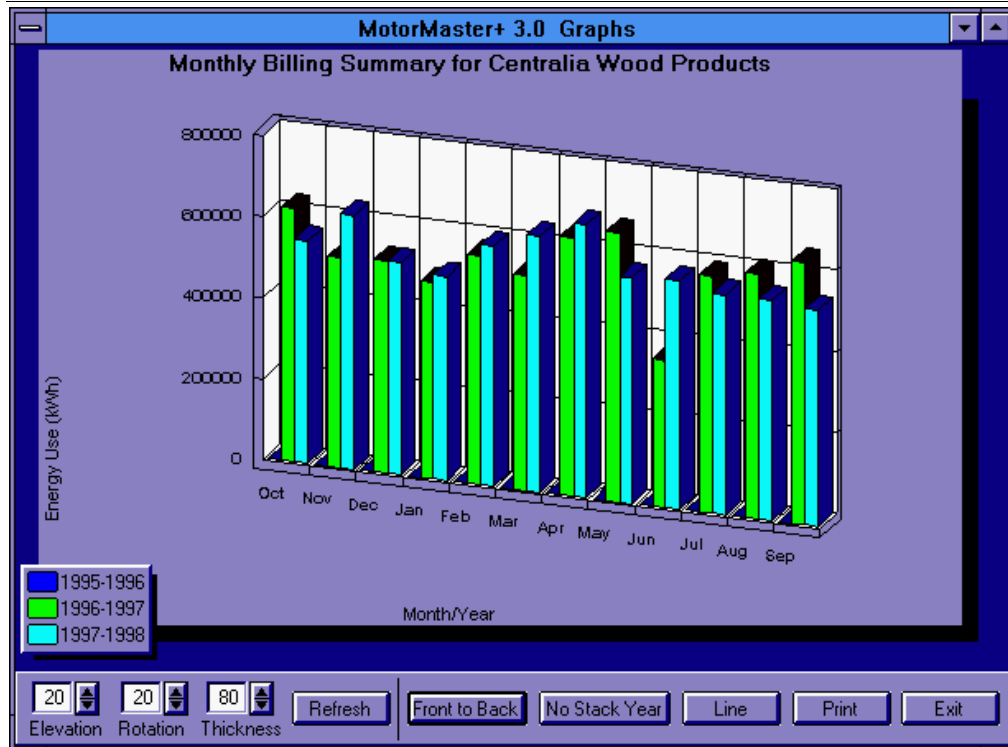
Note that the utility billing data is now represented in a monthly (month/year) format. *MotorMaster+* assumes uniform daily consumption during all billing periods and prorates billing data at the individual meter level by examining the number of billing days in the month of interest divided by the total number of days in the billing period. The monthly total (at the meter level) consists of all prorated consumption data assigned to the month of interest. The demand and capacity charge are assigned to the month that has the greatest number of days within the billing period. Monthly power factor is determined by weighting the reported billing period power factor by the portion of energy consumption in a given month. The last month in the billing history is highlighted in gray when incomplete data exists.

The utility billing data are prorated into monthly values for several reasons. First, different meters assigned to the same facility could be read on different dates and exhibit varying billing intervals (i.e. 27 days, 34 days). A plot of such utility billing data would fluctuate dramatically simply due to inconsistent reading intervals. *MotorMaster+* also can display monthly energy use and demand for ALL meters assigned to ALL facilities within a company. The software does this by computing and then summing the monthly energy and dollar values for all affected meters. Calculating the energy use on a monthly basis also allows for the linking of monthly energy consumption with monthly plant production data.

The **Monthly Billing Summary** can be routed to your printer by clicking on the **Print** button. Alternatively, the data may be examined in a graphical form. Click on any column to highlight it in blue, then click on the **Graph** button. Select the type of graph desired (bar, line, stacked bar) and a preview plot appears on screen. Click on the **Print** button to make a copy of the graph (Screen 39).



## Screen 39



## Energy Conservation Summary Report

Click on the **Energy Conservation Summary** checkbox and then click on the **Search** button to view a list of all **Energy Action** and **Energy Efficiency Improvement** records linked to the specified Facility, Department, and Process. The “All Facilities” choice can be made at the **Facility** combo box to obtain a record of all motor and motor-driven equipment conservation measures installed and/or efficiency improvement actions taken at the company level. Alternatively, the **Facility**, **Department** and **Process** combo boxes may be used to display a desired subset of **Energy Action** records. Use the “From” and “To” boxes to indicate the appropriate date range for your **Energy Conservation Summary** report.

The **Energy Conservation Summary Report** indicates the **Energy Action** date, title, type of action (motor replacement, rewind, systems improvement or process operating hours change); and the annual energy savings (kWh/year), instantaneous demand reduction (kW), and annual dollar savings (Screen 40).

Screen 40

Date	Motor	Title	Type	Energy Savings kWh/yr	Demand Savings kW	Total \$ Savings
03/06/97	Sec Boiler Fan	Install New Fan	Sys Improve	10065	2.4	\$ 559
03/06/97	Prim Boiler Fan	Boiler Fan Motor	Replace	5188	1.2	\$ 288
<b>CUMULATIVE SAVINGS</b>				15254	3.7	847

Cumulative Annual or Total Savings are displayed at the bottom of the screen. The **Energy Conservation Summary** report indicates the benefits due to operating your in-plant or company-wide energy management program.

You can click on any **Energy Action** to highlight it. Then click again to **View** or **Edit** the original record. You cannot edit the “before” and “after” energy use or calculated savings values. These numbers are based upon operating profiles and field measurements taken before and after installation of a conservation improvement and cannot be arbitrarily modified.

*Tip: Click on the **New Action** button at the **Savings Tracker Reports** screen to create a new “General” **Energy Action** record. This path is available so non-motor-related conservation investments such as lighting efficiency measures can be included in the **Greenhouse Gas Emissions Reduction** report. Indicate the facility, department and process to which the **General Action** record will be assigned. Then enter the measure, title, and date and indicate the measure costs, annual energy savings (kWh), and demand reduction (kW). Savings values are automatically determined using the rate schedule assigned to the selected Facility. Use the **Notes** field to provide supplemental information. Click on the **Save** button on the toolbar to save your **General Action** record, or click on **Cancel** to return to the **Savings Tracker Reports** screen.*

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The annual and cumulative dollar savings values shown on the **Energy Conservation Summary** report are based on CURRENT utility rates and operating schedules. The **Energy Action Records** are updated each time a rate schedule is edited at the **Utilities-View** screen or **Utility Service** tab of the **Facilities-View** screen. The annual energy and dollar savings are also automatically recalculated each time a motor or process operating profile is changed. Note that conserved energy (kWh) is expressed as the demand reduction (kW) times the annual operating hours for the motor or motor-driven equipment. Conservation savings decrease when hours of equipment operation decrease, and they increase if a facility converts from two to three shifts. **General Action Record** savings assigned at the process level are prorated in accordance with changes in process operating hours while savings assigned at the facility or department levels are fixed.

Click on the **Print** button to route your **Energy Conservation Summary** report to your printer. You can also click on the **Form EIA-1605** button to create a **Greenhouse Gas Emissions Reduction** report.

## Greenhouse Gas Emissions Reduction Report

Click on the **Form EIA-1605** button to create a **Greenhouse Gas Emissions Reduction** report for all **Energy Action** records created at your company or individual facility level. *MotorMaster+* then creates a short reporting form (**Form EIA-1605 EZ**) that provides a brief summary of specific emissions reduction projects. This form is the official reporting mechanism for a number of voluntary greenhouse gas emission reduction programs including *Climate Challenge* and *Climate Wise*. Under these programs, annual emissions reduction progress reports are submitted to the Energy Information Administration.

The **EIA-1605 EZ** form displays the greenhouse gas emissions reductions (lbs. CO<sub>2</sub>/year) obtained from efficiency improvements and investments in motor and motor-driven equipment conservation measures. The analysis covers the calendar year specified for the associated **Energy Conservation Summary** report.

*MotorMaster+* determines greenhouse gas emissions reductions by accessing an internal table of adjusted carbon dioxide emission factors by state (lbs. CO<sub>2</sub>/kWh produced). The annual energy conserved (kWh/year) for each energy action taken in a given facility is multiplied by the emission factor for the host facility's state. The result is a table of emission reductions achieved (lbs. CO<sub>2</sub>/year) for each motor and motor-driven equipment conservation measure and efficiency improvement (Screen 41). Total greenhouse gas emission reductions are indicated at the bottom of the table.

## Form EIA-1605EZ Voluntary Reporting of Greenhouse Gases

**Energy Information Administration  
U.S. DEPARTMENT OF ENERGY**

This report is voluntary and authorized by the Energy Policy Act of 1992 (Public Law 102-486). For the provisions concerning confidentiality of information submitted on this form, see "Can The information You Report Be Kept Confidential?" on Page 3 of the instructions. Public reporting burden for this collection of information is estimated to be 4 hours per response, including the time of reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the form. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing burden, to the Energy Information Administration, Office of Statistical Standards, EI-73, 1000 Independence Avenue, S.W., Washington, DC 20585; or to the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503.

**Schedule I. Reporter Information and Certification**

1. NAME OF INDIVIDUAL OR ORGANIZATION REPORTING:  
 Company General Distribution, Inc.  
 Facility Centralis Wood Products

Print Preview

**Schedule II. Project Information and Greenhouse Gas Emission Reductions for**

Project Description [A]	Proj Type Code [B]	Volun Pgm Code [C]	Project Size			Type of Reduction [G]
			Size Measure [D]	Qty [E]	Unit of Measure [F]	
Systems Improvement Log Chipper	310	MCP	System Improvement	1	-	
Motor Replacement Log Chipper	380	MCP	Motor Replacement	1	-	
<b>FACILITY TOTALS</b>		<b>MCP</b>		<b>2</b>		

To export the report data to an ASCII file compatible with the EIA1605 electronic data transfer format, click the Export EIA button.

Export EIA

Exit

*MotorMaster+* creates a completed **EIA-1605 EZ** form. Appropriate Project Type codes are entered (360 for Motor and Motor Drive Actions, 310 for systems or General Equipment Improvements.) The Motor Challenge Program (MCP) is indicated as the Voluntary Program name, savings measures are specified, savings are tabulated (kWh/year), and emissions reductions indicated. A **Schedule 1, Reporter Information and Certification** attachment is also filled in with information extracted from the **Company-View** screen. Click on the **Print** button to obtain your completed report form. Sign the Certification page and mail the form to the EIA at the address printed on the form. *MotorMaster+* prints the notation “Created by *MotorMaster+* Version 4.0, For Period ‘month/year to month/year’” at the top of the form.

## Reduction in Energy Consumption Report

The **Facility Reduction in Consumption** report is designed to supplement the **Energy Conservation Summary** report to provide the Energy Coordinator with a complete and accurate picture of the results of conducting an energy management program. While the **Energy Conservation Summary** report takes a “bottoms-up” approach by aggregating the savings from each recorded conservation action the **Reduction in Consumption** report takes a “top-down” approach.

Click on the facility of interest, select your date range, and then click on the **Search** button. The **Reduction in Consumption** report portrays energy use trends. Specifically, it presents the monthly facility energy use and cost over time (aggregated over all utility meters assigned to the facility). The report also displays plant production over time, and then indicates the monthly **Energy Use Index** (EUI, or energy use per unit of product produced), rolling average EUI, monthly energy cost per unit of production, and rolling average cost per unit (Screen 42).

### Screen 42

The screenshot shows the 'Savings Tracker Reports' window. The 'Select Report' section has 'Reduction in Consumption Report' selected. The 'Facility' is 'Centralia Wood Products' and the 'Production' is 'Wood Products (million board feet)'. The date range is from '04/1995' to '03/1997' with a 2-year interval. Below is a table of monthly data:

Mth/Yr	Energy Use (kWh)	Total Energy Cost	Production Units	Energy Use (EUI) per unit	Rolling Average Use/Unit	Total Cost per Unit	Rolling Average Cost/Unit
10/95	544047	\$ 30515	3.1	175499	161440	\$ 9844	\$ 7955
11/95	631000	\$ 35328	3.0	210333	165808	\$ 11776	\$ 8270
12/95	525840	\$ 29491	3.2	164325	166270	\$ 9216	\$ 8395
01/96	497374	\$ 27901	2.9	171508	169048	\$ 9621	\$ 8635
02/96	613751	\$ 34377	3.5	175358	167344	\$ 9822	\$ 8656
03/96	630296	\$ 35378	3.4	185381	171058	\$ 10405	\$ 8950
04/96	673303	\$ 37758	3.7	181974	172104	\$ 10205	\$ 9121
05/96	556515	\$ 31170	3.6	154588	171630	\$ 8658	\$ 9214
06/96	565539	\$ 31925	3.5	161583	173816	\$ 9122	\$ 9380
07/96	543814	\$ 31244	3.4	159945	172808	\$ 9189	\$ 9463
08/96	542341	\$ 30977	3.8	142721	170582	\$ 8152	\$ 9482
09/96	533226	\$ 30638	3.5	152350	168893	\$ 8754	\$ 9525

Click column to select graph data

---

The **Reduction in Consumption Report** examines conservation-related impacts on a macro- scale while capturing and illustrating efficiency gains through normalizing monthly energy use and cost by plant production. A declining EUI is indicative of an effective plant energy management program.

The rolling average EUI is calculated to enable the energy coordinator to observe energy management program results in facilities with variable or intermittent production or with seasonal operation. The rolling average EUI is determined by summing the energy use over the preceding 12 months and then dividing by the total production over the same time period. The **Reduction in Consumption** report does not begin to display a Rolling Average EUI or Rolling Average cost per unit of production until at least a full year's worth of utility billing and plant production data is available.

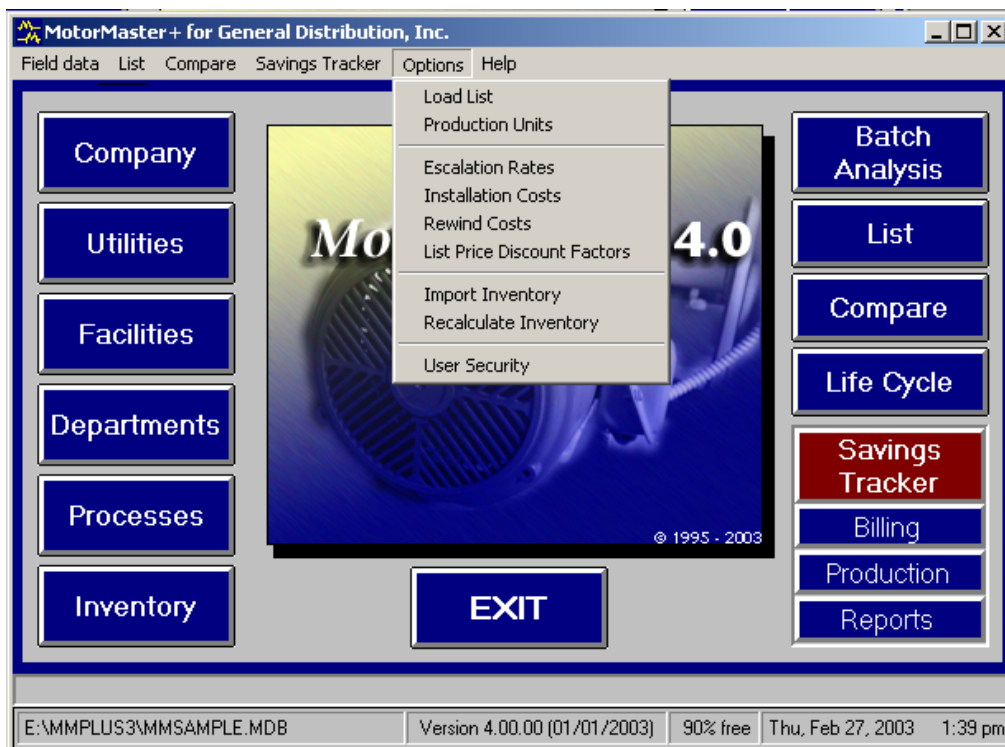
The **Reduction in Consumption Report** can be routed to a file or your printer by clicking on the toolbar **Print** button. Data can also be viewed in a graphical format. Click on any column to highlight it in blue, then click on the **Graph** button. Choose the type of graph desired (bar, line) and a preview plot appears on screen. Click on the **Print** button to produce the desired graph.

# Customizing MotorMaster+

Select **Options** from the **Main Menu** to build a customized list of load types for your plant, to create your own Motor Installation or Rewind cost defaults, or to create a table of production types (products) and monthly production units (i.e., million gallons or billions of board feet). You may also create a table of motor list price discount factors for each motor manufacturer, and to create files containing annual fuel, electricity, or electrical-demand escalation rates. These escalation rates may be selected and applied within the MotorMaster+ Life Cycle Cost Analysis.

From the **Main Menu**, click on **Options**. A pull-down menu appears (See Screen 43). Use the mouse to highlight your choice, then click or press **Enter**. Selections made throughout **Options** are retained from session to session. You can change them at any time.

Screen 43

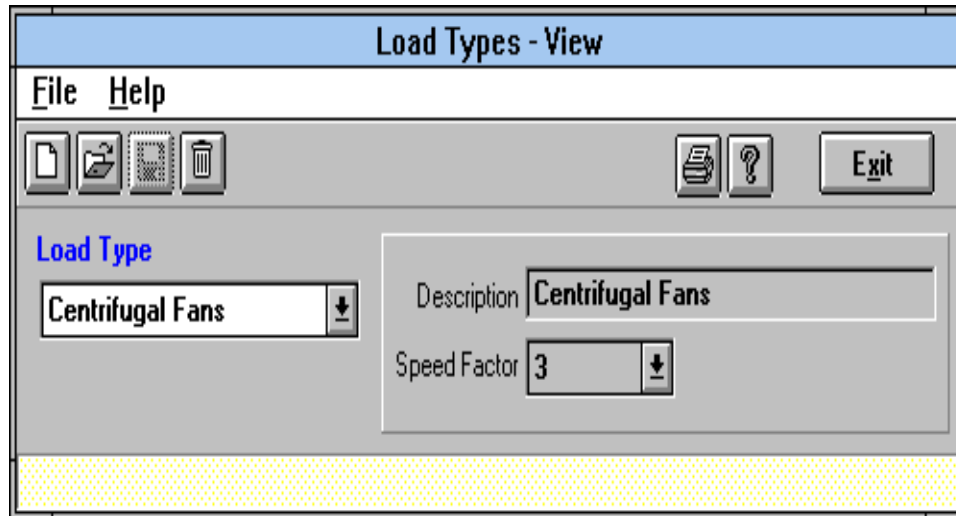


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## Load List

This feature (Screen 44) allows you to add, delete, or edit the load list that appears in your **Motor Inventory-View Operating Profile** screen. This same load list serves as a motor search criteria in your **Motor Inventory Query** screen. Customizing your load list allows you to rapidly display individual unit or summary information for critical components within your plant.

Screen 44



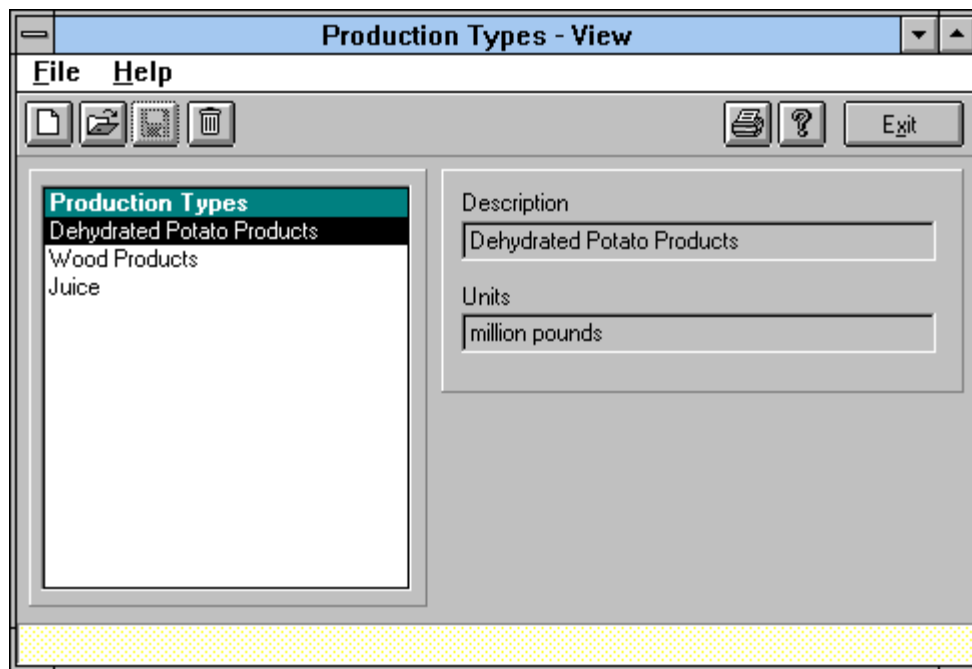
## Production Units

Click on **Production units** to create an index of products produced (i.e., dehydrated potato products) and monthly production rates (millions of pounds) which are specific to your facilities (Screen 45).

The appropriate finished product can now be assigned to your facility at the **Facilities-View** screen. Monthly facility production values are entered in the Production section of the **Savings Tracker** module. Facilities creating multiple products must aggregate their output streams in a common term, typically the combined-product dollar value. Review the **Savings Tracker** portion of this *User's Guide* to understand how facility production data is used when creating facility **Reduction in Consumption** reports.



## Screen 45



## Electricity, Demand, and Fuel Price Escalation Rates

Clicking on **Escalation Rates** on the **Options** pull-down menu allows you to create tables of variable annual electricity, demand, or fuel price escalation rates (See Screen 46). Click on the down arrow at the **Escalation Type** combo box, then select Fuel, Electricity, or Demand. Click on the **Add** button on your toolbar to create a new table. Then provide a table name at the **Description** box and indicate the year that the string of annual escalation rates commences. Fill in the table using the **Tab** and **Arrow** keys to move from year to year. You may provide a default escalation rate and use the **Fill Default** feature to complete the escalation rate table.

**Escalation Rates**

File
Help

Cancel

**Escalation Type** Electric Cost ▼

**Rate Table**  ▼

Default rate (%) 5.0

**Escalation Rate Information**

Description Electrical Energy Rate Table Fill Default

First Year 1996

Year	Rate (%)	Year	Rate (%)	Year	Rate (%)	Year	Rate (%)	Year	Rate (%)
1996	5.0	2006	9.0	2016	5.0	2026	5.0	2036	5.0
1997	5.0	2007	9.0	2017	5.0	2027	5.0	2037	5.0
1998	5.0	2008	5.0	2018	5.0	2028	5.0	2038	5.0
1999	5.0	2009	5.0	2019	5.0	2029	5.0	2039	5.0
2000	3.0	2010	5.0	2020	5.0	2030	5.0	2040	5.0
2001	3.0	2011	5.0	2021	5.0	2031	5.0	2041	5.0
2002	3.0	2012	5.0	2022	5.0	2032	5.0	2042	5.0
2003	3.0	2013	5.0	2023	5.0	2033	5.0	2043	5.0
2004	7.0	2014	5.0	2024	5.0	2034	5.0	2044	5.0
2005	7.0	2015	5.0	2025	5.0	2035	5.0	2045	5.0

## Motor Installation Cost Defaults

Click on **Installation Costs** to display the current set of default labor and materials costs associated with replacing an operable motor. Click on the **Edit** button to open the screen for editing. Installation costs may be modified for one or all motor horsepower, speed, and enclosure combinations. Click on the **Save** button to retain the modified installation costs. These values are provided automatically as defaults in future batch mode or individual **Compare-Replace Working** motor analyses.

## Motor Rewind Cost Defaults

Click on **Rewind Costs** to display the current set of default costs associated with rewinding a failed motor. Click on the **Edit** button to open a screen for editing. Updated rewind costs may be provided for one or all motor horsepower, speed, and enclosure classes. Click on the **Save** button to retain the modified rewind costs. These values are incorporated automatically as defaults into batch mode or individual **Compare-Rewind** motor analyses.

---

## List Price Discount Factors

Motor dealers rarely sell motors at the manufacturer's full list price. (Note: the full list price is shown when a **Motor Catalog Query** is made within the **List** module.) Customers are offered a list price discount, with Standard or Premium Efficiency motors typically selling for 45 to 85 percent of the manufacturer's stated list price. Obtain price quotations from vendors and use manufacturer-specific list price discount factors when performing **Compare** or **Batch Analyses**.

Within *MotorMaster+* the motor purchase price is the full list price times one minus the list price discount factor (in percent divided by 100). Click on **Options/List Price Discount Factors** to display and/or edit the current set of list price discount defaults. (List price discounts for all manufacturers are originally set at 35 percent.)

Click on the **Edit** button to open the screen for editing. Enter updated or regionally specific discount factors for one or more manufacturers. Click on the **Save** button to permanently retain the modified discount factors. These values will be incorporated automatically as defaults into **Batch** mode or individual **Compare** analyses.

## Select Manufacturers

Use the **Options/List Price Discount Factors** feature to select which manufacturer's motors are shown or highlighted on the **Manufacturer's** box within the **Motor Catalog Query-List**, **Motor Catalog Query-Compare**, and **Batch Analysis Setup** screens. Click on the **Hide** checkbox to remove a manufacturer's name from the manufacturers' list. Click on **Default Select** to highlight one or more manufacturers so that only their products will be displayed in Query reports. Selections will be retained until changed. Clicking on the **Setup** button at the **Batch Analysis Setup** screen will also access the **List Price Discount Factors** or **Manufacturer's** setup screen.

---

# Utility Rebate Program Support

*MotorMaster+ is designed to support utility-sponsored energy-efficient motor rebate programs. Rebate qualification criteria and incentive values can be retained for five different rebate program design approaches. When the motor you are purchasing qualifies for a rebate, the incentive is automatically incorporated into subsequent **Compare, Batch, and Life Cycle Cost** analyses.*

*MotorMaster+ provides access to utility-rate-schedule and rebate program design parameters through the **Utilities-View** screen. Click on **Utilities** to display, edit, or add to the list of utilities for which information is available, then click on **Rebate Programs** to view, edit, or add rebate efficiency qualification criteria and dollar values for each motor class. If the motor you will be buying qualifies for a rebate program, the rest of your activities throughout *MotorMaster+* will take the rebate value into account. Motors contained within the field data module **Inventory** are linked automatically to a facility, serving utility, and any rebate program offered by that utility. Note: Utility Premium Efficiency motor incentive programs are subject to change and to certain qualifications and limitations. Contact your utility for current information.*

*MotorMaster+ contains files with information on utility rebate programs, including the utility name and address, minimum qualifying efficiency ratings for each motor class, and rebate values. Contact your utility for current information about its rebate program and enter it here.*

Select **Rebate Programs** under the **Utilities-View** screen menu. A **Utility Rebate Program-View** window appears, displaying applicable rebate values for the designated utility. See Screen 47. Select a utility from the **Utility** combo box to view rebate program parameters. Clicking on the **Edit-Open** button allows you to Enter changes to an existing rebate program. When your changes are complete, click on the **Save** button to retain current data in *MotorMaster+* files. If you do not want to save your changes, click on **Exit**. The original information will be retained.

## Screen 47

Utility Rebate Program - New

File Help

Utility: Puget Power

Rebate Information: Type Fixed

Column Fill: All Part

HP	RPM	Encl	Eff(%)	\$		
1	900	ODP	78.0%	\$10.00		
1	900	TEFC				
1	1200	ODP				
1	1200	TEFC				
1	1800	ODP				
1	1800	TEFC				
1	3600	ODP				
1	3600	TEFC				
1.5	900	ODP				
1.5	900	TEFC				
1.5	1200	ODP				
1.5	1200	TEFC				
1.5	1800	ODP				
1.5	1800	TEFC				
1.5	3600	ODP				

Enter the rebate data for each qualified type of motor. Duplicate column values can be entered more quickly by using the "Fill Column" buttons.

To fill the entire column, enter the desired value anywhere in the column and click on the "All" button.

To fill in a range of empty column cells, enter the value in the first cell of the column range, position the cursor at the last cell in the range and click on "Part".

## Add Rebate Program Information

Add basic utility information by clicking on **File-New** or on the **Add** icon at the **Utilities-View** main screen. Then, click on **Rebate Programs** to fill in the new qualifications criteria and rebate value information obtained from the utility.

*MotorMaster+* supports various types of rebate approaches, including Fixed, Price, Efficiency Gain, Two-Tier, and Base-Plus-Bonus. Click on the **Type** combo box to illustrate your choices. Click on the appropriate rebate type to make your selection. Note that the data requirements and **Rebate Information** screen design varies depending upon the type of rebate program selected. You cannot Enter data, then elect to change the type of rebate program in midstream. Should you attempt to do this, *MotorMaster+* will respond with the warning "Changing the Rebate type will zero out the rebate arrays. Proceed?"

### **Rebate types include:**

- Fixed-Rebate values are dollars awarded for motors exceeding the stated minimum efficiency criteria.
- Price Rebate values are a percentage of the purchase (or discounted motor list) price, with a maximum rebate cap.
- Efficiency Gain values match the incentive to the degree of efficiency. They are calculated as dollars per horsepower times the actual motor horsepower times the percent of full-load efficiency gain over the minimum-qualifying efficiency.

- 
- Two-Tier rebates provide a greater rebate incentive when the purchaser selects a Premium Efficiency motor with a full-load efficiency value exceeding a second or more stringent set of minimum-efficiency values.
  - Base-Plus-Bonus rebates pay a fixed dollar amount plus a bonus dollar value for each percentage point of efficiency gain above the minimum-efficiency criteria.

When you add rebate values, *MotorMaster+* displays a table with one line for each motor class (each combination of horsepower, speed, and enclosure type). The boxes you can modify appear in white. Click on the box of interest, and then enter your motor's minimum qualifying efficiency and rebate values.

Use the **Tab** or arrow keys to move from one box to another. Use the **Column Fill** feature to copy entries from one motor class to another. Instructions for the use of the **Column Fill** feature are displayed on the left of the **Utility Rebate Program-View** screen (See Screen 47). This feature saves time when values remain the same for all motor types in each horsepower class.

#### ***For the Fixed type of rebate***

1. Enter the minimum percent nominal full-load efficiency that qualifies a motor for a rebate.
2. Enter the rebate value, in dollars.
3. Click on the **Save** button to retain utility rebate information. Whenever the motor you will be buying qualifies and is eligible for a serving utility's rebate program, the rest of your activities throughout *MotorMaster+* will take the rebate into account.

## **Edit Rebate Features**

To Enter changes to an existing rebate program, based on current information from your utility, select **Rebate Programs** from the **Utilities-View** window; indicate the utility of interest, then click on the **Edit** button. Enter changes to the **Rebate Information** display. Click on the **Save** button to retain information for future analyses.

## **Delete a Rebate Program**

Delete an obsolete rebate program from *MotorMaster+* to avoid inadvertently including it in a report or analysis. Select **Rebate Programs** from the **Utilities-View** window, select your utility from the **Utility** combo box, then click on the **Delete** button.

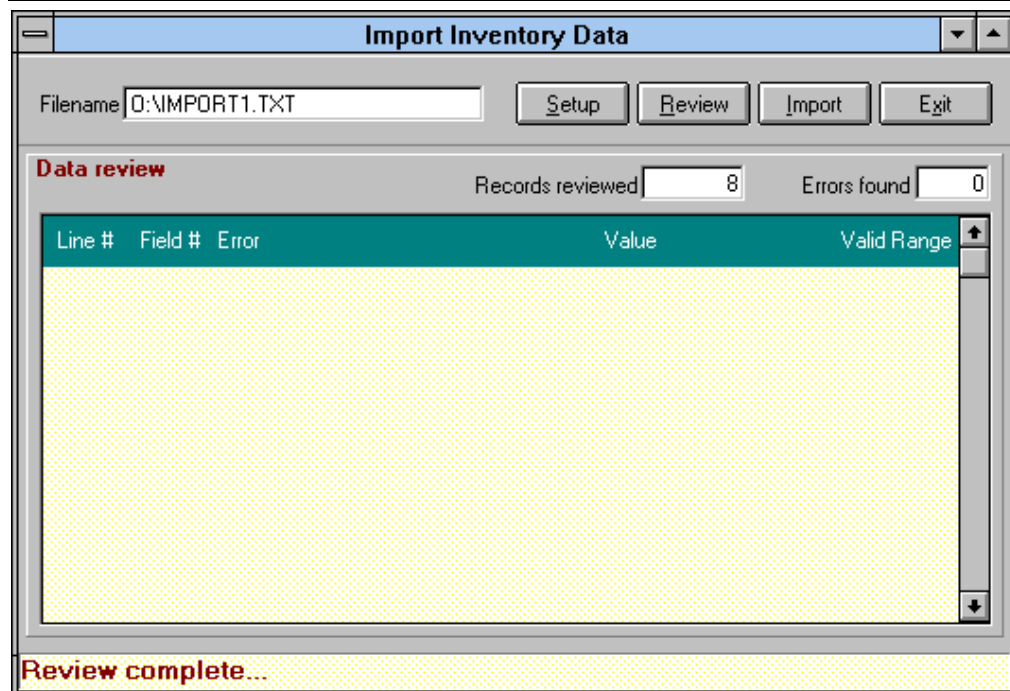
---

# Import Inventory

If you already have a database of motors, it is possible to import that data into the inventory table of *MotorMaster+* 4.0. This process is not for the faint of heart. The data must be provided in ASCII, comma-delimited format and generally requires some rather meticulous tinkering to get the data to match. *MotorMaster+* allows you to specify which fields that file will contain and in what order. Some fields are required, and many fields must adhere to a particular format or code.

To import inventory motors data into *MotorMaster+*, select the **Options** menu from the top of the **Main Menu** screen. Click on the **Import Inventory** (See Screen 48).

## Screen 48



The **Import Inventory Data** screen contains several items:

**Filename:** Enter the name of the ASCII (text) file containing the inventory data you wish to import. You may also select a file through the standard windows “browse” method by clicking on the small button to the right of the filename field.

Many databases have the ability to export data to this format. If your database does not, you will need to develop a method of conversion. “Comma delimited” means that each set of fields for a motor occupy a single row in the file. A comma separates each field in that row. For example, the following row contains three fields—the motor description, the horsepower, and the motor speed (RPM):

## “Planer Secondary”, 50, 1800

(Note that the first text field, “description,” is in quotes. All text fields MUST be enclosed in double quotes. Because a text field may contain any characters, a text field with a comma could be interpreted as two separate fields!)

- **Setup** button: Click on this button to go to the **Import Inventory Setup** screen, where you can define what inventory fields your file contains.
- **Review** button: Once you have setup your import process, click this button to have *MotorMaster+* scan your import file for errors. Some possible errors are discussed below. This is a good way to check the file to make sure your setup is correct. Any errors found will be displayed in the “Data Review” table on the lower half of the screen.
- **Import** button: When you are satisfied that the file and setup are in synch, clicking this button will begin the actual import process. Error checking will still occur, and motor data with conflicts will be excluded and listed in the Data Review table.
- **Exit**: Exit this screen when finished.

## Setup

The first step is to click on the **Setup** button to view the **Import Inventory Setup** screen (See Screen 49).

### Screen 49

Inventory Fields			Import File Fields			
Field	Type	Range	#	Field	Type	Range
NAMEPLATE			! 1	Facility user ID	Numeric	*
Spare?	Boolean		! 2	Department user ID	Numeric	*
Manufacturer	Numeric	1-18*	! 3	Process user ID	Numeric	*
Model #	Text (20)		! 4	Motor user ID	Text (15)	
Motor serial #	Text (20)		! 5	Motor description	Text (40)	
Motor type	Numeric	1-5*	! 6	Synchronous speed (RPM)	Numeric	
Definite purpose	Numeric	1-11*	! 7	Size (horsepower)	Numeric	
U-frame?	Boolean		! 8	Enclosure type	Numeric	0-6*
Vertical shaft?	Boolean					
C-face?	Boolean					
Voltage rating	Numeric	2-11*				
Voltage (wired)	Numeric					
Motor rewound?	Boolean					
Full-load amps	Numeric					
Full-load speed (RPM)	Numeric					
Full-load power factor(%)	Numeric	0-100				
Full-load efficiency(%)	Numeric	0-100				
Service factor(%)	Numeric	0-100				

! = required field  
\* = lookup table (right mouse)

Copy Buttons: << < > >>

Insert Placeholder



---

This screen displays two tables. The left table is a list of all the fields available to be filled in the *MotorMaster+* Inventory table. They are grouped according to the tab layout on the **Inventory** screen. The first column describes the field, the second indicates the type of field, and the third column shows a range of acceptable values, if appropriate.

The table on the right will contain the list of fields you will have chosen to represent the “layout” of your import file. This table is the same as the one on the left except for the addition of a “#” column, for convenience, to indicate the ordered number of the field in your file. This list is used by *MotorMaster+* to interpret the information you are providing in your file and to place that information in the appropriate fields in the Inventory table.

It is important to be aware of the “data types” of each value you supply in the ASCII file:

- **Numeric**—any number, with or without a decimal. Note, however, that some numbers should NOT have decimals. For instance, motor speed (rpm) is always a whole number. When *MotorMaster+* encounters a decimal value that is supposed to be a whole number, it simply drops the decimal part of the field.
- **Text**—ANY characters, up to a specified length (indicated in parentheses in the displayed tables). As noted above, *MotorMaster+* will only accept text fields enclosed in double quotes. Again, since text entries can contain ANY characters (including commas), enclosing them in double quotes will reduce the chance of misinterpretation.
- **Date**—must be in standard American format, mm/dd/yyyy OR substitute dashes for slashes.
- **Boolean**—refers to a “True/False” kind of value. For instance, if a motor has been rewound, the “Rewound?” field would contain any one of T, True, Y, Yes, or 1. If not, the field would contain any one of F, False, N, No, or 0. If no value is supplied, False is assumed.

Note that some fields are marked by an exclamation point (!). This mark indicates those fields that are required by *MotorMaster+*. If you don’t provide data for those fields, you can’t import.

Also note the asterisk (\*) in many of the Range cells. Click the right mouse button over one of these fields to view a list of valid values for that field and the description of what that code means. For example, click on the “Enclosure” row. A list of valid enclosures will be displayed. Values supplied outside the indicated range are rejected.

---

## Required fields

### ***Facility, Department, and Process codes***

In order for *MotorMaster+* to properly assign the imported motor to its hierarchical location, these must be identified. These unique codes can be input on the appropriate screen and can be any combination of up to 15 characters. They provide a useful way to uniquely identify these entities and ensure that the imported data will go to the appropriate location. Make sure ALL the target entities have been so identified ahead of time. If the combination indicated in the file is not present in the company structure, an error will be indicated and the record rejected.

### ***Motor Code***

This code is similar to the unique codes for Facility, Department, and Process, though its function is reversed. *MotorMaster+* uses this field to prevent importing duplicates. If the code supplied is already in the database, an error is indicated, and the record is rejected. This rejection is especially important if you do multiple imports and lose track of what motors you've already processed. This field is the ONLY way that *MotorMaster+* can ensure that you won't import the same motor more than once.

Note: Though *MotorMaster+* does not require that the above codes be entered in the main part of the program, they serve a very useful function. These codes provide the user with another search method for inventory motors (see the **Inventory** screen), as well as enabling smoother importing of motor data from other databases.

### ***Motor Description***

This field is the primary method of identification in lists of motors, etc.

### ***Synchronous Speed (RPM)***

*MotorMaster+* allows ANY speed to be entered into inventory data, though the standard speeds of 900, 1,200, 1,800, and 3,600 allow for greater search-and-compare flexibility.

### ***Size (Horsepower)***

Here too, *MotorMaster+* allows ANY horsepower in inventory.

### ***Enclosure Type***

Note that the range of valid values is listed under the Range column. This field, as with all similar fields, can ONLY contain one of these numbers.

Two other fields merit further attention. If you don't supply the Motor type, *MotorMaster+* will assume the motor to be NEMA Design B. If you don't supply "Total yearly operating hours," *MotorMaster+* will automatically assign the operating schedule for the process to which the motor is assigned.

Of course, the more fields you provide, the more you can take advantage of the many features of the program.

---

## Adding and Deleting Fields

For convenience, refer to the left-hand table—the list of available Inventory fields—as Table 1, and the right-hand table—the list of fields you are providing for import—as Table 2.

To add a field to your import list, double-click on the desired field in Table 1, OR highlight that row and click on the button with a single “>” character. This action copies the field from Table 1 to Table 2 and deletes the field from Table 1.

By the same token, to delete a field from Table 2, double-click or click on the button with the single “<” character. This action will remove the item from Table 2 and reinsert it into its appropriate position in Table 1.

You can copy ALL the fields from Table 1 to Table 2 by clicking on the “>>” button. Clicking on the “<<<” button, however, only copies back those fields that are NOT required.

## Ordering Fields

You can change the relative order of the fields you’ve selected for Table 2 by pointing the mouse at the item you wish to move, holding the left mouse button down, and moving the item to the desired position. This action gives you some flexibility in creating the ASCII file.

## Placeholders

If your ASCII file contains fields not contained in the *MotorMaster+* inventory table, but it is inconvenient to remove them from the file, simply position the highlight row in Table 2 to the position of the extraneous field, and click on the **Insert Placeholder** button located near the lower left corner. When *MotorMaster+* imports the file, it will ignore these fields.

When you think you have accurately described the structure or format of your import file, click on the **OK** button to return to the **Inventory Import** screen. This action saves the format information for future use.

## Reviewing the Import Data

Now that you have set up your import format, click on the **Review** button.

*MotorMaster+* will scan the file, checking to see if any of the fields “break the rules.” Here are the rules:

- **Too Few Fields**

For instance, you’ve listed 23 fields in your file setup, but the file only contains 21 fields.

- **Too Many Fields**

A row (record) in the import file contains more fields or entries than are specified by the import definition.

---

- **Data Type**

If you have indicated that the third field is supposed to be a number (say, horsepower), and that field contains alphabetic characters, an error will be indicated. See the description of data types in the Setup section, above.

- **Out of Range**

If the field listed on the Setup screen gave an accepted range, and the value found for that field in the file is outside that range, an error will be indicated. For example, if your file contains a “9” for Enclosure Type, you will get an “Out of Range” error.

- **Hierarchy**

If any of the Facility, Department, or Process codes do not exist in the database OR if the combination of these codes does not match the company’s hierarchical structure, an error is indicated. For instance, suppose a record in your file has a process code of “P3” with a department code of “D2”. *MotorMaster+* looks up the Process record with code “P3” and finds that it belongs to the department with code “D1”. This record will be rejected.

- **Motor Already Exists**

*MotorMaster+* will check for the existence of a motor through the motor code field. If it does exist, *MotorMaster+* will indicate an error, preventing the creation of duplicate entries.

If any errors are found, they will be displayed in the table in the lower part of the screen. Each error indicates the line number in which the error occurs, which field is in question, what the supplied value is, and a brief description of the error. Errors may occur because of problems in the ASCII file, in which case you should make corrections to the file and run Review again. Or, you may have erred in setting up the process. Check the **Import Inventory Setup** screen to be sure you have specified the required fields in the correct order.

## Importing the Data

Once you are satisfied that the setup and file are “in synch,” click on the **Import** button. *MotorMaster+* will read the data and store it to the Inventory table of your current company database. Any errors found will be listed, as well as the number of records actually stored.

You always have the option to Import even if you did not eliminate all the errors in the Review process. *MotorMaster+* imports all problem-free rows only, skipping those with errors.

After importing, go to the **Inventory** screen and call up any of the new motors. (The easiest way is to search via the Motor ID field.)

---

# Printing

You can print from any screen by clicking on the **Print** button, usually labeled with a printer icon. A standard screen is displayed with several fields. The first title is supplied according to the report requested, although you may change it. You may also enter a second title, the name of the person preparing the report, and the name of the person to receive the report (See Screen 50).

## Screen 50

**Print Reports**

**Select Report**

- Current Inventory Motor Record
- Motor Measurements History
- Motor Action History
- Motor Maintenance History

**Report Setup**

Title 1

Title 2

Prepared for

Prepared by

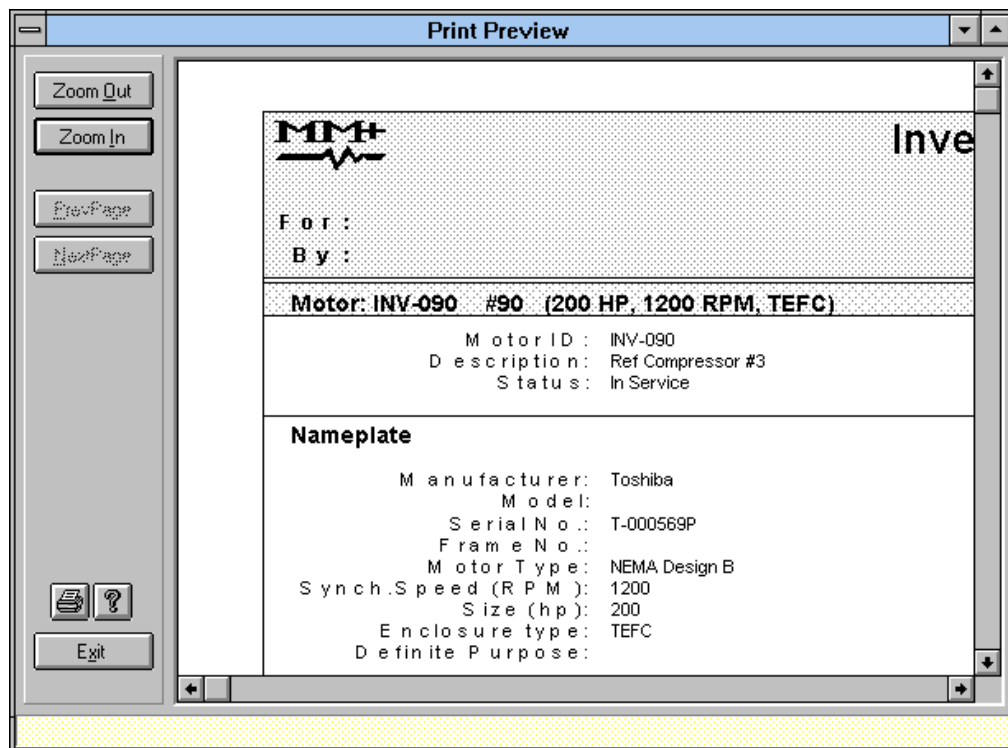
# Copies

**Printer**

Several reports have multiple options, displayed at the top of the screen. For instance, when printing from the **Facilities** screen, you will have the option of printing data for the current facility, or data for ALL facilities. Just click on the desired option.

When you click on the **Print** button, a **Preview** screen appears on which a graphic image of the report is displayed (See Screen 51). Buttons are available to “page” back and forth through a multipage report, or to “zoom” in or out on each page for closer scrutiny.

## Screen 51



Previewing allows you to check the report before actually printing. Click on the **Print** button to send the report to your printer. A small screen will appear indicating the progress of the print job.

This **Print Preview** screen has additional functions when running the **Batch Analysis** report. The standard **Batch Analysis** report is displayed first, with results of the comparisons of selected Inventory motors to motors of like class in the motors Catalog. Note the additional three buttons on the left side of the screen. The first, **Report**, simply runs the standard report again. The second, **Detail**, runs the analysis but produces a report with details of the comparison performed. In other words, for each of the top three Catalog motors found for a particular Inventory motor, three complete comparison analyses will be printed. This printout allows the user to review the details of each comparison.

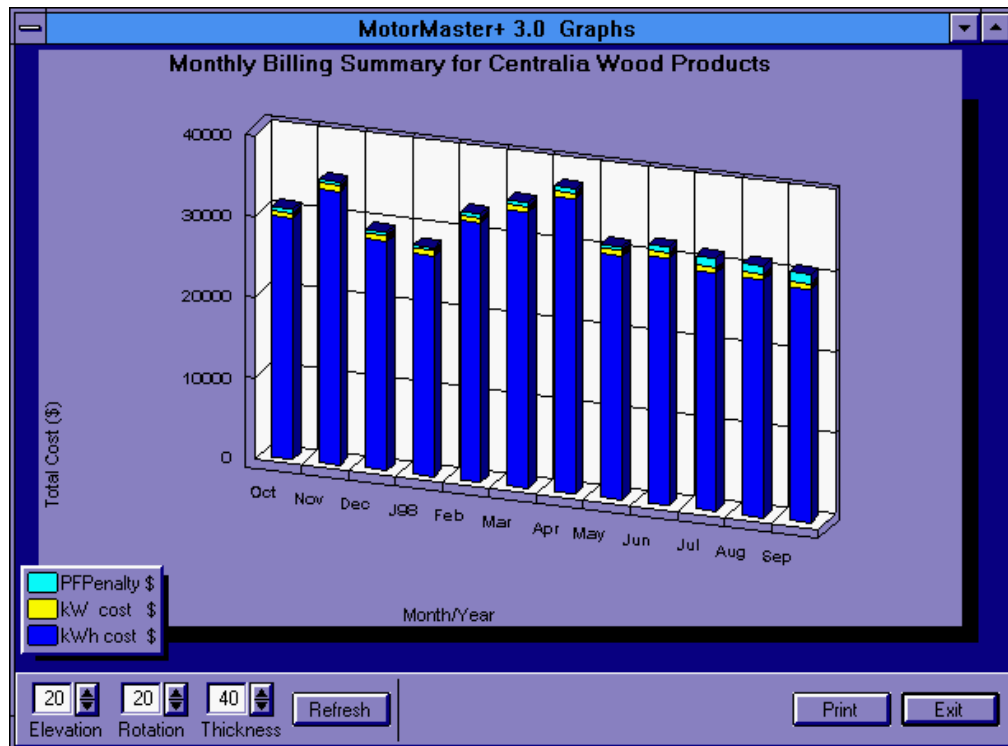
A third button, **Lifecycle** takes the user to the **Lifecycle Setup** screen, where cost and installation totals for all the best case comparisons in the **Batch Analysis** are plugged into a Lifecycle analysis. Select other economic parameters for the project and click on the **Calc** button to view the results. When you click on the **Print** button, you will be returned directly to the **Print Preview** screen to see the resulting report. At any time, you can click any of the three buttons mentioned above to flip among the reports for **Batch Analysis**.

Click on the **Exit** button to return to the **Report Setup** screen.

# Graphs

Graphs may be produced from two of the **Savings Tracker** reports, **Monthly Billing Summary**, and the **Reduction in Energy Consumption Report**. Refer to the **Savings Tracker** section for a description of these options.

Once you have produced a set of data in the table in the bottom part of the **Savings Tracker** screen, you can highlight a column you want to graph by clicking with the mouse. For instance, you have selected Monthly Billing Summary, listing data for the last two years. At first, the “Total \$” column is highlighted in blue. Suppose you want to view a graph of the kW column. Click on the kW column to highlight it, then click on the **Graph** button on the toolbar at the top of the screen. A bar graph will be displayed showing the kW data for each month (See Screen 52).



Screen 52

You have several options for altering the display:

- **Elevation:** Increasing this value presents the data from an increasingly “higher” position.
- **Rotation:** Increasing this value presents the data more and more from a sideways angle.
- **Thickness:** This value controls the thickness of the bars in the graph.

- 
- **Side-by-Side/Front-to-Back:** For data over multiple years, this button toggles between showing data from each year side by side, or front to back if you have chosen to “stack” the years.
  - **Stack-Years/No-Stack-Year:** For data over multiple years, clicking on this button presents the data in one long sequence (in which case, the side-by-side/front-to-back toggle is not applicable).
  - **Line:** Click this button to view the data as a flat-line graph.
  - **Print:** Click this button to print the graph.

Experiment with the options to set up the graph the way you like it.

Graphs operate in the same manner for all data from the **Monthly Billing Summary** and **Reduction in Energy Consumption Report**, with the exception of the “Total \$” column from **Monthly Billing Summary**. In this case, “stacked” bars are displayed showing kWh costs, kW costs, PF penalty, and total cost for each month in the time period selected. Note that the line graph is unavailable for this case.

## On-line Help

Click on the question mark button at any screen to gain access to context-sensitive **Help** or the main **Help** menu. Click on any **Help Menu** topic to view instructions or explanations. Clicking on hypertext words (*italicized and underlined*) provides additional information.



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# Tutorial: Traversing the *MotorMaster+* Field Data Module

## Sample Company Database—MMSAMPLE.MDB

*MotorMaster+* comes with a sample Company Database to help you learn the program by experimenting with already existing data. The filename for the database is MMSAMPLE.MDB. The company name is General Distribution, Inc. This database is the default Company Database when you first run the program after installation. The following instructions will take you through some of the *MotorMaster+* screens using this sample Company Database, illustrating the different ways the program will help you maintain and use this information.

### Company

From the main screen, click on the **Company** button. The **Company -View** screen, with general information about the company (name, address, etc.) will be displayed.

#### *Editing*

To edit this information, click on the **Edit** button on the toolbar at the top of the screen, or select **Edit** from the **File** menu. The company data fields will be converted to edit mode by displaying a white background.

Edit information as you wish. To save information, click on the **Save** button, or select **Save** from the **File** menu. To cancel editing without saving, click on the **Cancel** button at the upper right of the screen. In this case, the original company information will be restored to the screen.

Later, when you decide to create your own Company Database, you will click on the **New** button on the toolbar.

### *Motor Efficiency Data*

Click on the middle tab (labeled **Motor Efficiency Data**). You will see a display of all the motors for this company, sorted as Premium Efficiency, Energy Efficient, and Standard and grouped by horsepower. If the data for any motor have been changed since the last compilation of this information, the **Data Not Current** box will be checked.

If you click on the **Recalc** button, the program will quickly scan and evaluate all the motors in this database and update the display. You cannot edit this display, nor do you need to save the recompiled information.

---

## ***Printing***

To print the Company information, click on the **Print** button on the toolbar. The **Report Setup** screen will appear. Enter your title, subtitle, who the report was prepared for, and the preparer's name. To print to the default printer, click on the **Print** button.

The **Print Preview** is exactly how the report looks when sent directly to the printer. This is a good way to review reports before actually printing. Click on the **Print** button to make a copy of this report.

Click on the **Exit** button to return to the **Print** screen, then **Exit** again to return to the **Company** screen.

## ***Browse***

Click on the **Browse** button. A standard **Windows File Dialog** box will be displayed. Other company databases (once they've been created) may be searched for and selected from this screen.

Most users will never have a need for this option, since they will probably be using only one company database. Perhaps, however, a company database has been created on another computer. To view it on your computer, copy it via disk or network to a desired subdirectory, and use the Browse feature to find and select it as your company database.

Click on the **Cancel** button to return to the **Company** screen.

## ***Creating a New Company***

We recommend that you continue with this tutorial before creating a company. When you are ready to try it, see the section **Creating a Company Database**.

## ***Exit***

Click on the **Exit** button to return to the Main Menu.

## **Utilities**

From the main screen, click on the **Utilities** button. The screen has the standard toolbar at the top, a Utility combo box containing the list of utilities in the *MotorMaster+* Master Database, and a panel with the current Utility information displayed.

It is important to understand that utilities are not part of the Company Database. Utility information (with rate and rebate schedules) is stored in the Master Database (MMW.MDB). This storage means that the same utility information may be used for several company databases.

It's a good idea to enter utility and pertinent rate schedule information before creating your Company Database. You'll use these rate schedules to establish average demand

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and energy charges at the facility level. These charges will be used for energy use calculations throughout the program.

### ***Editing***

Basic utility information is mostly for convenience. The utility name is the only required data and is used as the primary identifier throughout the program.

Click on the **Edit** button on the toolbar to change the information displayed.

Click on the **Save** button to make changes permanent or on the **Cancel** button to restore the original information.

### ***Creating a New Utility***

Click on the **New** button. The Utility Information fields will be cleared and ready for editing. Enter a utility name (and address, if desired).

To save, click on the **Save** button. Note that the new utility name is now included in the Utility combo box.

Once you have created a utility, you will need to set up at least one rate schedule, as well as a rebate schedule if appropriate.

## **Rate Schedules**

Click on the **Rate Schedules** button near the lower left of the **Utilities** screen. The **Utility Rate Schedules** screen appears. Each utility may have multiple rate schedules.

Note that as you select a utility from the **Utility** listbox, the list in the **Rate Schedule** listbox changes. For example, select the utility “Pacific Power and Light Company” from the list of utilities. Then select “Schedule 24-General Service” from the list of rate schedules.

### ***Editing***

Click on the **Edit** button on the toolbar. Try editing the name of the schedule. Change the start month and day for each “season.” Note that the number of months for each season, as well as the average demand and energy charges, are recalculated.

Try changing a demand or energy charge (note that energy charges may be established for up to three tail blocks). These charges will be available when you assign a utility and rate schedule to a new facility. They will then be applied to all inventory motors created or edited within that facility to calculate annual energy costs.

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Save the edited data by clicking on the **Save** button, or cancel changes by clicking on the **Cancel** button. If you elect to **Save** the new information, *MotorMaster+* will respond with an "Attention" warning. The warning asks if you wish to use the newly entered energy and demand charges to determine annual motor operating costs. Select "Yes" and the software automatically updates records for all motors in facilities using the edited rate schedule. Note that **Cancel** restores the screen to its original data.

### ***Creating a Rate Schedule***

From the **Utility** combo box, select the utility you created in the Utilities section above. Note that there are no rate schedules in the **Rate Schedule** listbox.

Click on the **New** button to enter edit mode and enter some typical rate schedule data. After saving this information, your new utility is accessible by new and existing facilities. Note also that this utility (as with all utilities) will be available for use with any number of company databases.

Exit the **Rate Schedule** screen by clicking on the **Exit** button. Then exit the **Utilities** screen in the same way. You should now be back to the **Main Menu** screen.

## **Facilities**

From the main screen, click on the **Facilities** button. Open the **Facility** combo box by clicking on its down arrow. Select one of the three facilities listed for this company. The data for each facility selected will be displayed.

### ***Edit***

As in Company, click on the **Edit** button (toolbar) to Enter edit mode and modify the data for the selected facility. Facility data are displayed on four tabs:

- **Facility Information**

This tab contains general information about the facility. It is the primary identifier throughout the program. If you change the name and save, the new name will be reflected in the Facility combo box entry.

- **Utility Service**

This tab contains information about the utility servicing this facility. It is important to specify the utility and rate schedule for each facility because these rates are used in operating cost calculations for all motors in this facility.

When in edit mode, select "Pacific Power and Light Company" from the list. The rate schedules for that utility will be loaded into the Rate Schedule listbox. Select the first rate schedule, "Schedule 24-General Service." The number of months for each operating season, plus demand charges and energy block rates are displayed, as Entered on the **Utility Rate Schedules** screen.

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You can change the number of months of service for each season (to a number less than or equal to the default) and specify which seasonal energy charge tail block best applies to this facility. For instance, Enter 5 months for Season 1, and click on the second block for Season 1 and the third block for Season 2. The average demand and energy charges are recalculated and displayed to the right. These values will be used to calculate energy use costs for individual motors in this facility in other parts of the program.

To accommodate unusual circumstances, you can also edit these averages directly. An asterisk (\*) will mark user-edited averages. But they will be automatically recalculated if you change any of the other rate data on this screen.

#### ■ **Motor Efficiency Status Report**

This information is similar to that under the second tab on the **Company** screen, except this list only includes motors in the current facility. You cannot edit this screen. As on the **Company** screen, if motor data for this facility have changed, the **Data Not Current** box will be checked. Click on the **Recalc** button to update these data.

#### ■ **Energy Use by Load Type**

This tab provides a display showing the total connected motor horsepower or the total load served by load type. You cannot edit this screen. Click on **Exit** to return to the **Facilities-View** screen.

#### **Save**

Click on the **Save** button on the toolbar to make all changes permanent. Or click on the **Cancel** button to restore the original data.

#### **Delete**

Click on the **Delete** button. Because of the hierarchical structure of the company database, deleting a facility necessarily implies deleting all its departments, processes, and motors! So the program checks for the existence of these entities and displays the counts of each, with a warning of the consequences of deleting the facility. Click on the **No** button to cancel the deletion.

#### **Search**

You will usually select a facility from the **Facility** combo box. However, you can also select from the **Hierarchy** screen by clicking on the **Hierarchy** button in the middle of the toolbar. This button is available at the **Facilities**, **Departments**, **Processes**, and **Inventory** screens and will default to displaying to the appropriate level. In other words, when you enter the screen from **Facilities**, the company facility hierarchy will be displayed at the facilities level.

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In this case, there are three facilities displayed. Click on the **Departments** option at the top of the screen. The display will change to include departments under each facility. Do the same with **Processes** and **Inventory**. Note that the **Heirarchy** display allows you to select the **Process** or **Motor** of interest. This screen is an excellent way to view the Company Database hierarchy.

To select a facility, double-click on the appropriate row or highlight the row and click on the **Select** button on the toolbar. The screen will disappear, and the selected facility information will be displayed on the **Facility** screen.

### **Printing**

Click on the **Print** button. In this case, you have two options—Current Facility Record and ALL Facility Records. Select one of these options, and then click on the **Print** button. The **Print Preview** screen appears. Click on the **Print** button to prepare a **Facility Information** report. Now click on **Exit** back through the screens until you return to the **Main Menu** screen.

## **Departments**

Click on the **Departments** button to bring up the **Departments** screen. This hierarchy level is really not necessary for it contains no data relevant to program calculations. But the level does serve a useful organizational purpose, especially for large facilities. In any case, every facility must have at least one department. Even for a small facility, you will need to create one dummy department. The name is all that is required.

Creating, editing, saving, and printing departments are performed in the same way as utilities and facilities. And, as with Facilities, if you choose to delete a department by clicking on the **Delete** button, the program will warn you of any processes or motors belonging to the department, which would necessarily be deleted as well.

Also, you can select a department from the company's hierarchical listing by clicking on the **Hierarchy** button in the middle of the toolbar.

## **Processes**

From the **Main Menu** screen, click on the **Processes** button. Select a process by selecting from the **Facility** listbox, the **Department** listbox, and then the **Process** listbox. Each set of listbox choices is dependent upon the previous choice(s).

Select "Centralia Wood Products" from the **Facility** listbox, then "Lumber Curing" from the **Department** combo box. The **Process** combo box should contain two elements, "Boilers" and "Kilns."

Select "Kilns," and click on the **Edit** button on the toolbar. Process data consist of an identifying name and an operating schedule divided into three daily shifts over weekdays and weekends. This schedule will be used as a default for all motors assigned to this process. The yearly hours calculated from this schedule will be used to calculate total use and therefore energy consumption and cost for each motor. Add an 8-hour shift to the weekend, with a total of 80 weekend days. Note that calculations occur automatically.

Save these data by clicking on the **Save** button. An "Attention" warning appears.

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Select "Update Inventory Schedules Only"; then click on "OK" to proceed.

Now click on the **Hierarchy** button in the middle of the toolbar. The **Hierarchy** screen appears with a complete ordered list of facilities, departments, and processes. Note that in this case processes are in boldface. The current process, Kilns, should be highlighted.

Try selecting another process by moving the highlight bar and double-clicking or clicking on the **Select** button at the top of the screen. You will be returned to the **Process** screen with the selected process data displayed, including the appropriate Facility and Department.

Again, Creating, Deleting, and Printing are executed in the same way as the previous screens. Return to the **Main Menu** screen by clicking on the **Exit** button.

## Inventory

From the **Main Menu** screen, click on the **Inventory** button to display the **Inventory** screen. This is the heart of the Field Data module.

The **Inventory** screen is divided into several sections. At the top is the standard toolbar with the addition of a **Query** button flanked by two directional buttons. Also present are **Motor** (Maintenance) **History** and **Measurements** buttons. Below this toolbar are four listboxes: **Facility**, **Department**, **Process**, and **Motor**.

The actual data are contained below these, with a section containing two ID fields, motor description and status, and four tabs labeled **Nameplate**, **Operating Profile**, **Load Status**, and **Field Measurements**. Click on these four tabs:

- **Nameplate** data contain general characteristics of the motor as found on the motor's nameplate.
- **Operating Profile** contains data that describe the motor's operation in the context of the Process it serves: operating schedule, type of load, etc.
- **Load Status** contains information about the load type, load modulation, motor starter, grease type, and bearing type, brand, serial number, and size.
- **Field Measurements** contains the set of last-recorded voltage, current, power factor and speed measurements of the motor, if any, and contains data calculated from the fields on the previous tabs. None of the **Calculations** fields are entered by the user.

Note the facility's marginal energy price and demand charge is displayed in the last tab, along with the name of the utility serving the facility containing the current motor. These values, along with the motor's load, efficiency at its load point, and hourly use, are used to determine the annual operating costs for this motor.

When creating your own Company Database, it is important to be as complete as possible. Complete data will allow for maximum use of the analytical capabilities of *MotorMaster+* and enable you to make informed decisions about your motor population.

### **Selecting an Inventory Motor**

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There are several ways to select a motor:

- As in previous screens, select the appropriate “parents” of the target motor— Facility, Department, and Process. If you have followed the instructions in the **Processes** section, above, “Centralia Wood Products,” “Lumber Curing,” and “Kilns” should be displayed. If not, go ahead and select these. The **Motor** listbox should now contain four motors, “Kiln #1-5,” “Kiln #10,” “Kiln #11,” and “Kiln #6-9.” Select the first of these, and the data for that motor will be displayed below.
- As in Facilities, Departments, and Processes, you can click on the **Hierarchy** button on the toolbar to display a complete list of the company’s hierarchical elements. Note that “Kiln #1-5” is highlighted. Click on the **Cancel** button to return to the Inventory screen without selecting.
- The field labeled “ID Search” is available for your own motor coding scheme. When you enter your own **in-plant motor inventory**, you can assign unique IDs to your motors for your own quick searches. For example, if you use the mouse to select this field, then type **INV-058** and press **Enter**, the data for the motor with that ID (the Boiler Fuel Hog motor) will appear, including its Facility, Department, and Process.
- The “#” field, just to the right of this search field, contains the system-assigned ID number for the displayed motor. If you know the number of the motor desired, you can enter it here and press **Enter**. For instance, the system number for the motor “Kiln #1-5” selected earlier is 51. By typing this number in the # box and pressing **Enter**, the data for that motor will be retrieved and displayed.
- By clicking on the **Query** button on the toolbar, you can access the **Motor Inventory Query** screen, which allows you to specify any of a large number of parameters for searching the Inventory data. We will cover this option later.

### **Editing**

Before proceeding with editing, make sure motor #51 (“Kiln #1-5”) is displayed (type **51** in the # field and press **Enter**).

As in other data entry screens, you can edit the currently displayed data by clicking on the **Edit** button on the toolbar. In this case, however, an **Edit Motor Inventory** screen is displayed, asking you for the reason for editing. After you create your own Company Database, you will want to record changes you make to your inventory as Energy Actions—changes that improve motor efficiency and provide energy cost savings for your company. These Energy Actions are divided into six categories:



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- **Motor Replacement**—replacing an existing motor with a new or spare motor.
  - **System Improvement**—a change to the operating environment of the motor that decreases load without necessarily sacrificing performance, such as a change in load or operating schedule.
  - **Motor Rewind**—the motor has been rewound and performance increased or decreased.
  - **Operating Schedule Change**—a change in the operating schedule increases or decreases the motor’s energy consumption.
  - **Maintenance Log/Motor**—a convenient log of motor maintenance actions or predictive-maintenance test results.
  - **Maintenance Log/System**—a log of maintenance actions for a motor or driven equipment.

(One other option on the list is **Complete Pending Action**. See the following section on **Motor Replacement**.)

An Energy Action records energy use and cost BEFORE the action as well as energy use and cost AFTER the action. The first three categories above imply a change in motor performance, requiring new measurements. (Selecting any of these options will delete the old measurements.)

Normally, such an action would be recorded in *MotorMaster+* after the actual change had taken place and new measurements taken. However, even if new measurements have not yet been completed, you can still record the action as “pending” and complete it later when measurements are obtained (see the following **Motor Replacement** example.)

Now look at the **Edit Inventory Motor** screen again. In many cases, you will merely want to complete data entry or make corrections to previously Entered data without actually recording an Energy Action. In this case, you would accept the default “Routine Data Update” by clicking on the **OK** button. This action would allow normal editing and saving of the motor record.

In this case, however, select “Operating Schedule Change” by clicking on that option, then clicking on the **OK** button. You will be returned to the **Inventory** screen in edit mode.

Click on the **Field Measurements** tab. Note that “Annual energy use” is 25,464 kWh. Now click on the **Operating Profile** tab.

Let’s say you have eliminated the weekday night shift. Delete the hours of operation in that field. The total number of annual hours of operation calculated should now be 4,160. Click on the **Field Measurements** tab again. The value for “Annual energy use” should now be 16,976 kWh.

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Click on the **Save** button. *MotorMaster+* will inquire whether the reduction in operating hours is due to an energy efficiency improvement or plant schedule change. If the response is “Energy efficiency improvement,” the edited data will be saved, and an **Energy Action** screen will be displayed. The old and new energy use, demand charge, and associated costs are shown, along with calculated savings.

The current date is entered as a default on the screen. Edit to record the actual date the measurements were taken. You can then enter a more detailed description of the action performed in the **Notes** box. You can also enter any miscellaneous costs associated with this action.

Enter the Energy Action "Title"; then save the **Energy Action** record by clicking on the **Save** button. You will then be returned to the **Inventory** screen.

### ***Motor Replacement***

It will be helpful to try another Energy Action, **Motor Replacement**. Click on the **ID Search** field previously described, under the **Process** listbox. Enter 21 in the ID Search "#" box and press **Enter**. The “Line #3 Remixer” motor should be displayed.

Rather than clicking on the **Edit** button, however, select **Energy Action** from the top menu. A menu list of the available Energy Actions described above will pop down. Select “Replace Motor.” The only difference in this method is that this will bypass the **Edit Inventory Motor** screen described in the last example.

Now, however, you are presented with another screen, **Replace Inventory Motor**. A general description of the Current Motor is displayed on the left. On the right is a blank space for the Replacement Motor information and a button to proceed with the selection.

You can specify whether the replacement motor will come from the Catalog of new motors, or from a list of spares. In this case, leave it at the selection “From Catalog” and click on the **Select Replacement** button.

The **Motor Catalog Query** screen will appear, with the horsepower, rpm, enclosure type, and voltage of the inventory motor already specified as search parameters (at this point, they should be 150 hp; 1,800 rpm; 460 volts; Totally Enclosed).

A search is automatically initiated and the resultant list of available replacement motors displayed. (For further description of this screen, see the section on **List**).

Select a motor from this list by scrolling through the list and either double-clicking on the desired motor or clicking on the **Select** button on the toolbar. In this case, select “Baldor Super E, Chem.” The **Motor Catalog Query** screen disappears, and the **Replace Inventory Motor** screen now shows the selected motor in the right panel.

Before you click on **OK** (or **Cancel**, to cancel the whole process), you must specify whether the old motor is to be deleted from the **Inventory** database or assigned to "spare" status. "Assign old motor to spares" and click on the **OK** button.

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You will be returned to the **Inventory** screen in Edit mode, with the new motor data inserted in the appropriate **Nameplate** fields, and the old measurements (and consequently, the calculated data) eliminated. If you already have the new measurements, you can fill them in, save the motor data, and finish by completing the Energy Action screen, as before.

However, suppose you have not taken measurements yet. Go ahead and save the information without entering measurements. The **Energy Action** screen will appear with the label “\*Action Pending \*” plus a description of the old and new motors in the “**Notes**” field. You can add to this description for your own records.

Any time you perform one of the first three Energy Actions (“Replace Motor,” “System Improvement,” or “Motor Rewind”), a change in measurements is implied. In fact, in these three cases the old measurements are zeroed out and must be filled in with new values in order to complete the **Energy Action**. As this case illustrates, however, you can create an “Action Pending” record, with the intent of completing the entry of new measurements later.

Notice that in addition to entering the date, title and description, you can also enter motor purchase and installation costs.

Save the **Energy Action** by clicking on the **Save Action** button. You will be returned to the **Inventory** screen, where the new motor will be labeled as “Action Pending.”

Later, when you have had a chance to gather the new measurements, select **Complete Pending Action** from the **Edit Inventory Motor** menu, Enter the measurements, and click on **Save** to complete the action.

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***Tip:** To locate motors with pending actions, go to the **Motor Inventory Query** screen by clicking the **Query** button on the **Inventory** screen toolbar. Click on the **Clear** button to clear all search criteria. Click on the **Other Criteria** button on the toolbar to display the **Additional Inventory Query Parameters** screen. Near the lower left of this screen is a checkbox labeled “**Energy Actions Pending**”. Click on this, then click on the **OK** button to return to the **Motor Inventory Query** screen. The search is automatically initiated, and a list of all motors with pending actions will be displayed.*

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## **Spares**

Spare motors are either specified in data entry by clicking on the **Status** button or are assigned in the process of motor replacement. Spares are automatically assigned to the facility only. They do not appear in the Hierarchy list, nor in the normal kinds of inventory queries regarding the in-service motor population.

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Spares can be found by specifying the facility of interest at the **Motor Inventory Query** screen, selecting "Other Criteria," then selecting **Spare** at the **Status** listbox on the **Additional Inventory Query Parameters** screen. Click on **OK** to create a list of all spare motors at your facility. This list can be arrayed based upon your **Sort Column** listbox choice (efficiency, hp, speed, or voltage). Look at the list, and you should see the motor we just replaced, "Line #3 Remixer." Select this motor from the combo box list by double-clicking on it, and you will see that the old data (operating profile and measurements) have been cleared out. A status of "Spare" is now assigned.

Return to the **Main Menu** screen by clicking on the **Exit** button.

## Batch Analysis

This button could also be labeled **Inventory Query**; it is the same screen accessed from the **Inventory** screen for creating and selecting from a list of inventory motors using a variety of parameters. Click on this button to bring up the screen.

### **Search Criteria**

Most of the criteria available are obvious. Experiment by selecting different combinations of criteria and clicking on the **Search** button.

Note that after a search, the **Search** button is light gray, like all the other buttons. But as soon as you change one of the search criteria, the button turns dark gray. This change informs you that the currently displayed list is NOT the result of the currently displayed criteria.

You can clear the criteria by clicking on the **Clear** button on the left of the toolbar. This clears ALL criteria (even "Other Criteria," described next), and is a convenient way to "start from scratch."

### **Other Criteria**

In the center of the screen is a large box labeled "Other Criteria". It should have "Status In-Service" as a default. By clicking on the **Other Criteria** button on the toolbar, you gain access to another screen, **Additional Inventory Query Parameters**, with additional search criteria. Most of the items are obvious. But try a few items to get familiar with what is available. For instance, notice the three selection items to the left of the "Load Modulation" box. Use of these boxes is a quick way to find rewind motors, motors with missing measurements, or motors with energy actions pending.

Please note that these filter or selection criteria are not exclusive but act in combination (using "and" versus "or"). In other words, selecting a priority of "High" and clicking the "Rewound" checkbox means that you will find all rewind high priority motors, NOT all high-priority motors plus all rewind motors.

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The **Clear** button is used here to clear the fields on this screen only. If you change your mind about these criteria, you can always return to the previous screen without any changes by clicking on the **Cancel** button.

Once you have specified the desired criteria, click on the **OK** button. You will be returned to the **Motor Inventory Query** screen where the search is automatically initiated and the list of qualifying motors displayed. Notice that the criteria specified on the **Other Criteria** screen are summarized in the box in the upper right of the screen.

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***Tip:** don't forget to "start from scratch" by clicking on the **Clear** button. If you forget that you have criteria on one or the other screens, you may be specifying too narrow a search to find any motors at all.*

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### **Printing**

Click on the **Print** button to bring up the standard **Print Reports** screen. In this case, you have three report options:

1. **Motor Inventory Query List**—a simple listing exactly like the list on the **Motor Inventory Query** screen.
2. **Measurements/Calculations**—the measurement data and resultant calculation data for all inventory motors on the query list.
3. **Complete Inventory Data**—all motor inventory data for each motor in the query list. This is the same report generated from the **Inventory** screen, only applied to a batch of motors generated from the **Inventory Query** screen.

Try printing these reports. Then return to the **Motor Inventory Query** screen by clicking on the **Exit** button.

### **Run Batch**

This is where the batch analysis is actually accomplished. Set up a list of inventory motors, for instance display a list of all motors coupled to the load type "Centrifugal Fans." Then click on the **Run Batch** button on the toolbar. The **Batch Analysis Setup** screen will appear (see the section on **Batch Analysis** for further discussion of this screen).

Select the "Replace Existing" motor analysis. Input a default load of 70.0%, a Payback of 10 years, with 12 peak months. Choose "No upgrade" without "Auto downsizing." You can complete a batch analysis and determine potential replacement motors from "All," one, or any combination of manufacturers. Then click on the **Batch Run** button. The **Print Reports** screen will appear.

Click on the **Print** button to bring up the **Print Preview** screen. Each of the motors in the retrieved list will be compared with all potential replacement motors from the Motors Catalog. The top three (lowest time required for payback) Catalog motors satisfying the batch analysis criteria will be identified. Use the arrow buttons and the **Next Page** button to view your report. The total annual energy demand and dollar savings are summarized at the bottom of the report, assuming that the best available replacement motor is always selected.

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## Compare

Click on the **Compare** button on the **Main Menu** screen. The **Motor Comparison** screen will be displayed. For a more detailed explanation of what this screen makes possible, see the section on **Compare**.

Whenever you first enter this screen, default standard and energy-efficient motor data are displayed. There are three possible scenarios for comparative analysis:

- New Motor,
- Rewind
- Replace Existing.

In the cases Rewind and Replace Existing, you can select motors from your own company inventory to use as the "Existing Motor" in the analysis.

Click on the **Replace Existing** button in the upper portion of the **Compare** screen. In the middle of the left panel labeled "Existing" is a button labeled **Inventory**. This button provides access to the **Motor Inventory Query** screen (note that the corresponding button in the right panel is labeled "Catalog," which accesses the **Motor Catalog Query** screen, the route for selecting new motors from the motor manufacturers' database).

Click on the **Inventory** button. Select an inventory motor by specifying appropriate search criteria, clicking on the **Search** button, and selecting a motor from the list. You will be returned to the **Compare** screen. The data for the selected motor will be displayed in the fields in the left panel. The fields in the top of the panel are no longer available for editing. Also, these values are automatically copied to the right panel to keep the two motors in synch.

You can leave the new motor information as average data, or you can select a motor from the **Motor Catalog Query** screen. Note that default "dealer discount," Motor Purchase Price, and Installation cost values are entered. Of course, the user can change these values. When the values are as you like, click on the **Savings** button to see the energy, demand and dollar savings associated with replacing your existing inventory motor with a new energy-efficient model.

The energy use and costs for the existing motor are displayed in the left column while those for the replacement motor are on the right. The **Energy Savings** screen also displays the **Simple Payback** on investing in the energy-efficient motor. Click on the **Life Cycle** button to initiate a life cycle cost analysis. Review the "Conducting a Life Cycle Cost Analysis" portion of this User's Guide for setup and results interpretation details.

This concludes the tutorial on navigating the sample Company Database. Now it is time to create your own. Go to the section **Creating a Company Database**, near the beginning of this manual.

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# Glossary

**Amps.** The measure of electrical current. Amp ratings indicate the average motor input current. There are three common motor amp ratings:

- No-load amps is the current draw when the motor is unloaded.
- Full-load amps is the current required during full-rated load operation.
- Locked-rotor or start-up amps is the current when the motor rotor is stopped or locked and indicates the maximum amount of current that could be expected during the first few seconds of startup.

**Catalog number.** A number assigned by the manufacturer to a specific motor or motor class. Not all manufacturers use catalog numbers, but if one is provided, it should be used when asking about or ordering a motor.

**Demand charge.** This charge is usually based on the highest 15- or 30-minute period of energy consumption each month. Demand charges are becoming common for industrial and commercial customers, ranging as high as \$17 per kilowatt per month in the United States.

**Design.** There are four standard motor designs: A, B, C, and D. NEMA Design A and B motors are for general use in relatively low-torque applications, such as centrifugal pumps, fans, and steady-torque machines. Designs A and B are identical, except that Design B has a limit on startup current. Design C and D motors produce high startup torque and are designed for use in conveyers, cranes, lifts, punch tools, and other high-torque applications.

**Drive system.** The electrical supply, electric motor, speed controls, gear box, or belt system.

**Efficiency.** Mechanical output energy divided by electrical input energy. There are several methods of measuring motor efficiency, but the standard that should be used exclusively in the United States is the IEEE 112-B (nearly the same as NEMA MG1-20.52). This standard specifies a test protocol that uses a dynamometer to test motor output under specific load levels. All efficiency values stored in the *MotorMaster+* database and used in calculations by the software are nominal efficiencies based on IEEE 112-B.

**Enclosure.** Different motor enclosures are designed to withstand various levels of exposure to moisture, particles, and chemicals. The four most common types of enclosures are:

- **Open Drip Proof (ODP)** allows air to blow directly through the motor, but has a cover that prevents drops of liquid from entering. ODP motors are suitable for protected environments.

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- **Totally Enclosed Fan Cooled (TEFC)** motors are designed to prevent outside air from flowing into the frame. Fins and a fan provide cooling. TEFC motors can function outdoors and in dusty or contaminated environments.
  - **Totally Enclosed Nonventilated (TENV)** motors are not equipped for cooling by means external to the enclosing parts.
  - **Explosion Proof (EXPL)** is a type of TEFC motor designed to prevent sparks or explosions within the motor from igniting flammable materials outside.

**Energy efficient motor.** A motor with a nominal full-load efficiency rating that meets or exceeds the NEMA Table 12-11 standard. Many manufacturers sell motors with efficiencies significantly higher than the NEMA standard and designate these as Premium Efficient motors. NEMA Premium Efficiency™ motors must have full-load efficiencies that equal or exceed the minimum values given in Table 12-12 of NEMA MG 1-1998, Rev 2.

**Frame size.** NEMA-defined standard motor frame dimensions. Select a new motor with the same frame size as your existing motor, unless you plan to modify the motor mounting. For example, replace a motor with a NEMA frame size designation of 286T with another motor with the same frame size.

**Load factor.** A measure of the ratio between a motor's operating output and its design output. For example, a 10-horsepower motor driving a 7.5-horsepower load has a 75 percent load factor.

**Manufacturer.** Motor manufacturer's company name. There are 18 manufacturers included in the *MotorMaster+* database.

Note that some manufacturers have divisions that market motors with different brand names, such as A.O. Smith/MagneTek/Century and U.S. Motors/Emerson/Leroy Somer.

**Model name.** The name given by the manufacturer. If no specific name is provided, it is listed as "Standard."

**Nominal efficiency.** An average value based on testing of a population of motors per IEEE 112-B. Since small variations in actual efficiencies are statistically expected, some motors will test a little higher or lower than their nominal ratings. NEMA has established Guaranteed Minimum efficiency values for each nominal efficiency to take into account this variation. All values in the *MotorMaster+* database are nominal rather than guaranteed minimum efficiencies.

**NEMA (National Electrical Manufacturers Association).** A trade organization of motor manufacturers. NEMA sets standards and publishes information used extensively in the motor industry.



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**NEMA's address is:**

NEMA  
2101 L Street NW  
Washington, DC 20037  
Phone: (202) 457-8400

**Peak demand.** Peak demand typically measured as the maximum 15 or 30 minutes of kW consumption each month.

**Power factor.** A measurement of the phase relationship between voltage and current in an electrical system. Induction loads, such as electric motors, tend to reduce power factors. Most three-phase motors have a power-factor rating to indicate how much impact they impose on the system. Significantly low power factors can reduce the efficiency of an entire electrical system, so many utilities charge extra to industrial facilities whose power factor is low. Capacitors can be used to correct this problem.

**Power quality.** The conditions of voltage level, phase balance, power factor, and harmonics in the power supply. Poor power quality reduces the efficiency and reliability of electrical equipment, including that of motors. Various strategies, such as transformer adjustments and modifications to circuit loads can be used to optimize voltage levels and phase balance, raise the power factor, and minimize harmonics in the electrical distribution system.

**Service factor.** A multiplier that indicates a motor's ability to produce more than its designated full load. A 10-horsepower motor with a 1.15 service factor could run continuously with an 11.5-horsepower load without overheating, although operating a motor above rated load reduces efficiency and service life.

**Simple payback.** The time required for the energy savings from investment to repay its initial costs with no interest or cost of capital considered.

**Speed.** Electric motors have two speed ratings:

- **Synchronous speed.** The speed at which the motor's magnetic field rotates. The database includes motors with synchronous speeds of 900, 1,200, 1,800, and 3,600 rpm.
- **Full-load rpm.** The actual speed that a motor turns under its full-rated load, which is typically about 2 percent slower than the synchronous speed. Since even a small change in operating speed can affect the efficiency of pumps and fans, select a replacement motor with a similar full-load rpm for these applications.

**Thrust.** This is a measure of the downward force on the bearings of a vertical shaft motor.

**Torque.** A measure of torsional or twisting force measured in foot-pounds (pounds of weight on a 1-foot lever arm). Three torque ratings are included in the *MotorMaster+* database:

- **Full-load torque** is the torque measured at full load.
- **Starting- or locked-rotor torque** is the maximum torque that the motor can

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produce from a complete stop or “locked rotor.”

- **Breakdown torque** is the maximum torque that the operating motor can produce before stalling.

**Voltage rating.** A motor’s designed operating voltage level or levels.

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## For More Information

Electrical Apparatus Service Association, *Understanding A-C Motor Efficiency*, 1994.

Industrial Electrotechnology Laboratory, *HorsePower: Implementing a Basic Policy for Industrial Motor Repair/Replacement*, Advanced Energy, Raleigh, N.C., February 1998.

Industrial Electrotechnology Laboratory, *Metric Motors*, Advanced Energy, June 1997.

Industrial Electrotechnology Laboratory, *Motor Survey How-To Guide*, Advanced Energy, January 1997.

McCoy, Gilbert A. and Douglass, John G., *Energy-Efficient Electric Motor Selection Handbook*. Report No. DOE/GO-10096-290, U.S. Department of Energy Motor Challenge Program, August 1996.

McCoy, Gilbert A., and Douglass, John G., *Energy Management for Motor-Driven Systems*, Report No. DOE/MC-10021, U.S. Department of Energy Office of Industrial Technologies, June 1997.

Xenergy, Inc., "*United States Industrial Motor Systems Market Opportunities Assessment*", U.S. Department of Energy Office of Industrial Technologies, December, 1998.

U.S. Department of Energy, Motor Challenge Program, *Motor Challenge Sourcebook: A Compendium of Current Activities and Resources in the Industrial Motor Systems Markets*, 1996 Edition.

*Vaughen's Complete Price Guide for Motor Repairs and New Motor*. Available from Vaughen's Price Publishing Co., 809 Oak Road, Bradford Woods (Pittsburgh), PA 15015-9713, (412) 935-5660.

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### ***OIT Information Clearinghouse***

*The objective of the U.S. DOE Office of Industrial Technologies Information Clearinghouse is to provide timely, accurate information and technical assistance on energy-efficient motors, motor drives, steam and process heating systems, and motor-driven equipment. To contact the OIT Clearinghouse, call (800) 862-2086 between the hours of 6 a.m. to 5 p.m. PST.*

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# Motor Manufacturer Address List

**ABB Industrial Systems**

Drive Products and Systems  
P.O. Box 372  
Milwaukee, WI 53201  
(414) 789-3416  
www.abb.com

**A.O. Smith/Magnetek**

531 North Fourth St  
Tipp City, OH 45371  
(937) 667-2431  
www.aosmithmotors.com

**Baldor**

P.O. Box 2400  
Fort Smith, AR 70902-2400  
(479) 646-4711  
FAX: (479) 648-5792  
www.baldor.com

**Dayton/Grainger**

Dayton Motor Division  
Emerson Motor Technology Center  
8050 W. Florissant Avenue  
P.O. Box 36912  
St. Louis MO 63136-9012  
(314) 595-8125

**General Electric (G.E.)**

1635 Broadway  
Fort Wayne, IN 46802  
(219) 439-5413  
www.ge.com

**Hemco USA**

Technical Center  
2201 Oakwood Pl.  
Charleston, IL 61920  
(217) 581-6267  
FAX: (217) 581-6607

**Lafert North America**

2283 Argentia Road #22  
Mississauga, Ontario, Canada  
L5N 5Z2  
(800) 661-6413  
www.lafert.com

**Leeson Electric**

2100 Washington Avenue  
Grafton, WI 53024-0421  
(262) 377-8810  
FAX: (262) 377-9025  
www.leeson.com

**Lincoln Motors**

22800 St. Clair Avenue  
Cleveland, OH 44092  
(800) 668-6748  
www.lincolnmotors.com

**Marathon**

100 East Randolph Street  
P.O. Box 8003  
Wausau, WI 54401  
(715) 675-3311  
FAX: (715) 675-8030  
www.marothonelectric.com

**Reliance**

Rockwell Automation  
6040 Ponders Court  
Greenville, SC 29615  
(864) 297-4800  
www.reliance.com

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**Siemens**

4620 Forest Avenue  
Norwood, OH 45212  
(513) 841-3100  
FAX: (513) 841-3101  
usa.siemens.com

**Sterling**

16752 Armstrong Avenue  
Irvine, CA 92714  
(800) 654-6220  
FAX: (714) 474-0543  
www.sterlingelectric.com

**Teco/Westinghouse**

6877 Wynnwood  
Houston, TX 77008  
(713) 864-5980  
FAX: (713) 864-9502  
www.teco.wmc.com

**Toshiba**

13131 W. Little York Road  
P.O. Box 40906  
Houston, TX 77041  
(800) 231-1412  
FAX: (713) 466-8773  
www.tic.toshiba.com

**U.S. Motors**

8000 W. Florissant Avenue  
St. Louis, MO 63136  
(314) 595-8408  
www.usmotors.com

**WEG**

1327 Northbrook Parkway  
Peachtree North, Suite 490  
Suwanee, GA 30024  
(800) 275-4934  
www.wegelectric.com

**Westinghouse Motor Company**

P.O. Box 277  
Round Rock, TX 78680-0277  
(800) 451-8798