Portsmouth Fastener Manufacturing Workstation

Vincent J. Lee
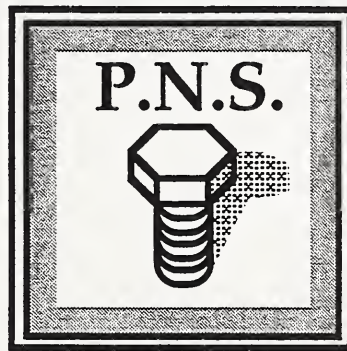Lisa Jean Fronczek
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NIST

PORTSMOUTH

FASTENER

MANUFACTURING

WORKSTATION

P.N.S.

USER'S

MANUAL

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Acknowledgment

Disclaimer

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CONTENTS

ABOUT THIS MANUAL

This manual contains two main sections. The first section contains a description of the fastener workstation and the workstation controller software.

The second contains step-by-step operating instructions for producing a batch of parts. It includes directions for preparing the bar stock and turning/milling center as well as using the software. The last two parts of this section describe two programs that are useful only to the system administrator as diagnostic tools and are not used during normal workstation operations.

Additional information for the normal operation of the workstation is included in Appendices A, B, and C.

Appendix A includes six flow charts that illustrate the algorithm of the workstation controller software.

Appendix B includes a list of NC programs used to make the fasteners. The list is divided up according to part type and includes NC program pathnames and manufacturing specifications for each part type.

Appendix C includes sample order form information for the three part types.

Appendices D, E, F, and G contain information used only by the system administrator.

Appendix D includes instructions for shutting down the computer.

Appendix E includes instructions on using the diagnostics modes of the help program.

Appendix F contains the mailbox names and ID numbers.

Appendix G lists the command and status messages that the processes use when communicating with each other.

Appendix H contains information on the operation, setting and maintenance of the Johnson gages used in measuring thread characteristics such as pitch diameter and functional size measurements.

Appendices I and J include manufacturer supplied information on using the thread gage equipment.

Appendix K includes information on troubleshooting.

Additional manuals you may want to refer to are the following:

- the *Portsmouth Fastener Manufacturing Workstation, Fastener Engraving System Operation Manual*, by Mahn Hee Hahn and Michael Huff,
- Pathtrace manuals,
- the Brown & Sharpe *MAF-42 Automatic Lathe Operation and Maintenance Manual*.

ABOUT THE FASTENER WORKSTATION

WHAT YOU WILL SEE IN THE WORKSTATION

This section contains a description of the fastener workstation.

Layout of the workstation equipment

The major components of the workstation include:
- the turning/milling center and bar feeder,
- the workstation controller computer system,
- the thread gaging system,
- the engraving system.

The workstation equipment setup is shown in the figure below:

Turning/milling center

Bar feeder

Workstation controller computer

Printer

Thread gages

Engraver computer

Engraver
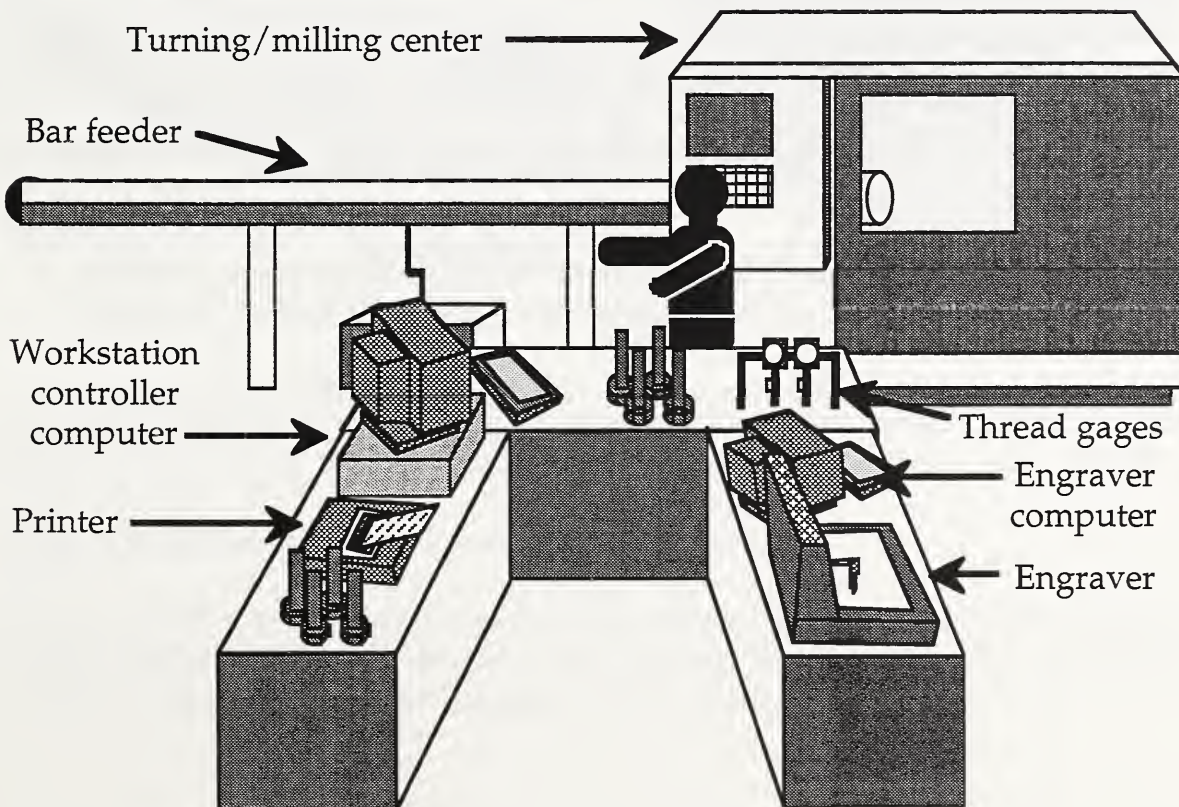
The parts of the thread gaging system are shown below:
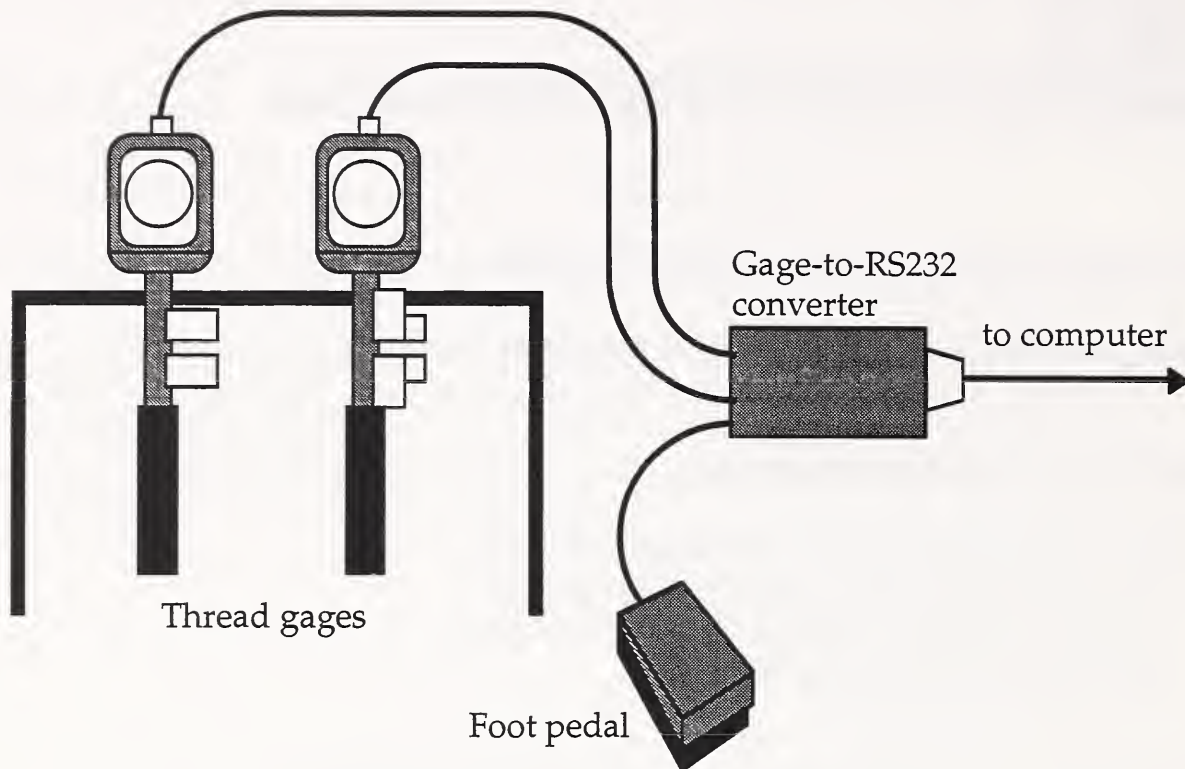
The two thread gages are used to measure the pitch diameter and the functional diameter of the machined parts. When making the measurements the foot pedal is used in conjunction with the workstation controller software to record the measurements. Instructions on using the thread gages are included in Appendix H, I, and J.

The engraver system is discussed in a separate manual, *Portsmouth Fastener Manufacturing Workstation, Fastener Engraving System Operation Manual.*

The workstation controller computer system is discussed in the next section.

USING THE WORKSTATION CONTROLLER COMPUTER

This section covers the procedures for starting the computer and getting the workstation controller software running for the execution of a batch order. Simple instructions and descriptions are given on how to get around the Open Desktop, how to use the mouse, how to use the windows, and how to use the icons.

Starting the computer

1. Turn the computer on by pressing the switch on the right-hand side of the computer chassis to the "on" position.
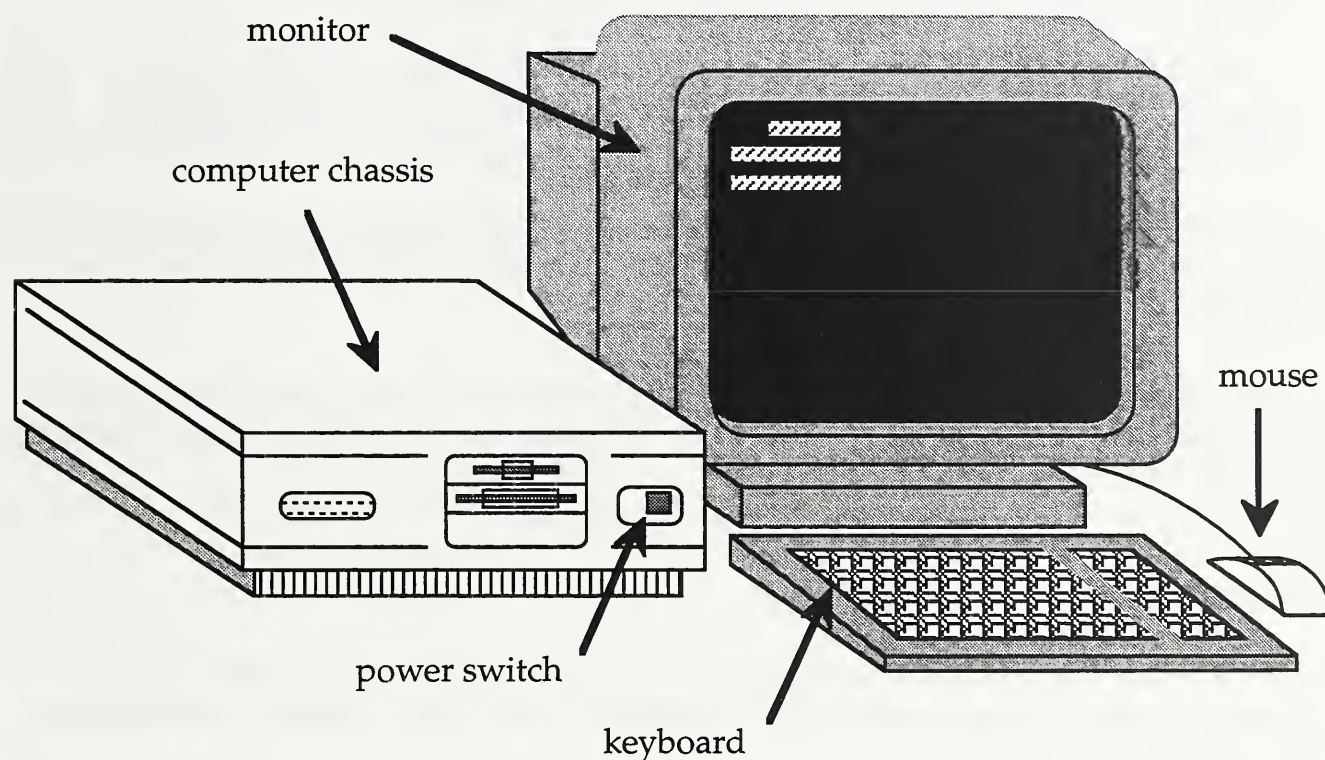
2. Turn the computer monitor on by pressing its power switch. Wait for the computer to check its memory (a display of numbers will count up to 24000).

3. Press the [Enter] key when you see "Boot:" prompt.

4. The computer may prompt you with the message, "There may be a system dump memory image in the swap device. Do you want to save it? (y/n)>". If it does, press N. The computer may not always ask you about this.

5. Press the **control-d** keys when prompted.

6. When prompted, enter the current time and date, if needed, otherwise press [**Enter**] to accept the current time and date.

Logging In

1. The computer will prompt you to "login". Type in the login name: **pnsy**. Then press [**Enter**].

2. The computer will prompt you to type in the password. After typing it in, press [**Enter**]. (Contact the system administrator for the password.)

3. The screen will clear and the Open Desktop will appear. An Icon window and a Desktop window will appear, as well as the workstation controller windows. The workstation controller windows will appear automatically when you login as **pnsy**.

Note that logging in as **pnsy** causes the workstation controller's windows to appear automatically. (This saves the step of double clicking on the PFMW icon after logging in.)

If you already know how to manuever your way around the Open Desktop, go to "The Workstation Controller" and "The Workstation Controller Primer" sections for information on using the software.

Getting Around the Open Desktop

Two windows appear automatically on the screen after you login as an Open Desktop user. The first window that appears is the "Icons" window, the second is the "Desktop" window.

The Icons window contains icons of the Desktop window and other windows that were brought up automatically (or manually by the operator). A window may contain a program that runs by itself or may act as a terminal. Each window is labelled with a title, in red, on the top of its frame.

The blue Desktop window contains the programs that you may run. The workstation controller, PFMW, is located here along with PFMW utilities, and PFMW help. Each is identified by its own individual icon.

The icons:

| P.N.S. |
| PFMW |

The workstation controller.

| P.N.S. |
| UTILITIES |
| PFMW-UTIL |

The utilities program.

| P.N.S. |
| FIRST AID |
| PFMW-HELP |
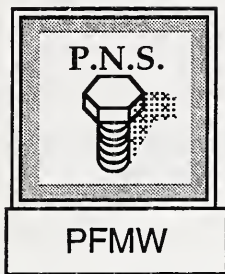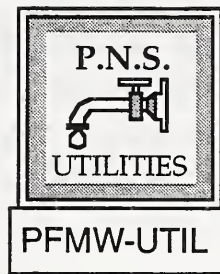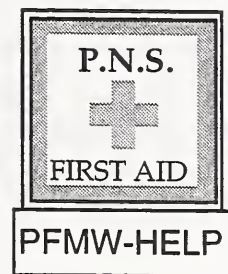
The help program.

You may use this window to start the workstation controller from its icon.

Either the keyboard or the mouse may be used as an input device. The movement of the mouse on the table controls the movement of the cursor on the monitor screen. Use the mouse to select which window you want to be active, to start a program, to make pop-up menus appear, or to make menu selections. Use the left button on the mouse to "click" once (that is, press the button) on any part of a window to make it active. When active, a window will accept input from the keyboard or, from the mouse if it has buttons, .

Use the left mouse-button
to activate windows, start
programs, click on buttons,
bring up menus, or
move windows.
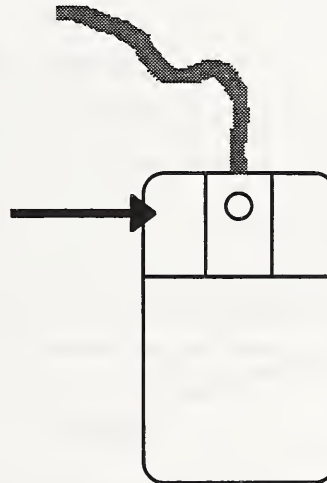
If you hold down the mouse's left button on the Desktop window's blue background, the Desktop's pull-down menu will appear. From this you can tidy up the icons in the window, and exit from the Open Desktop. If you hold down the left button on the root background (the part of the screen on which all the windows appear - the tiled part of the screen), "behind" the windows, the root pull-down menu will appear. From this you can open another window (a "SCOterm"), run client programs, or change the root background design, among other things.

The parts of the frame of any window in the Open Desktop have specific functions. The outermost parts of the frame are used to change the size of the window. The mouse's left button is used to grab hold of the frame to change the window's size. The title bar, which contains the windows title, is used to move the entire window anywhere you want with the left button of the mouse. You will not need to resize or move the windows under normal operations. An illustration of a typical window is shown here:

Use the title bar to move the window around the screen.

A_TYPICAL_WINDOW

Use this button to iconify the window, i.e., remove the window from the screen without closing it.

Use this button to enlarge the window to the size of the screen.

Use any of the corners and sides of the frame to change the size of the window.
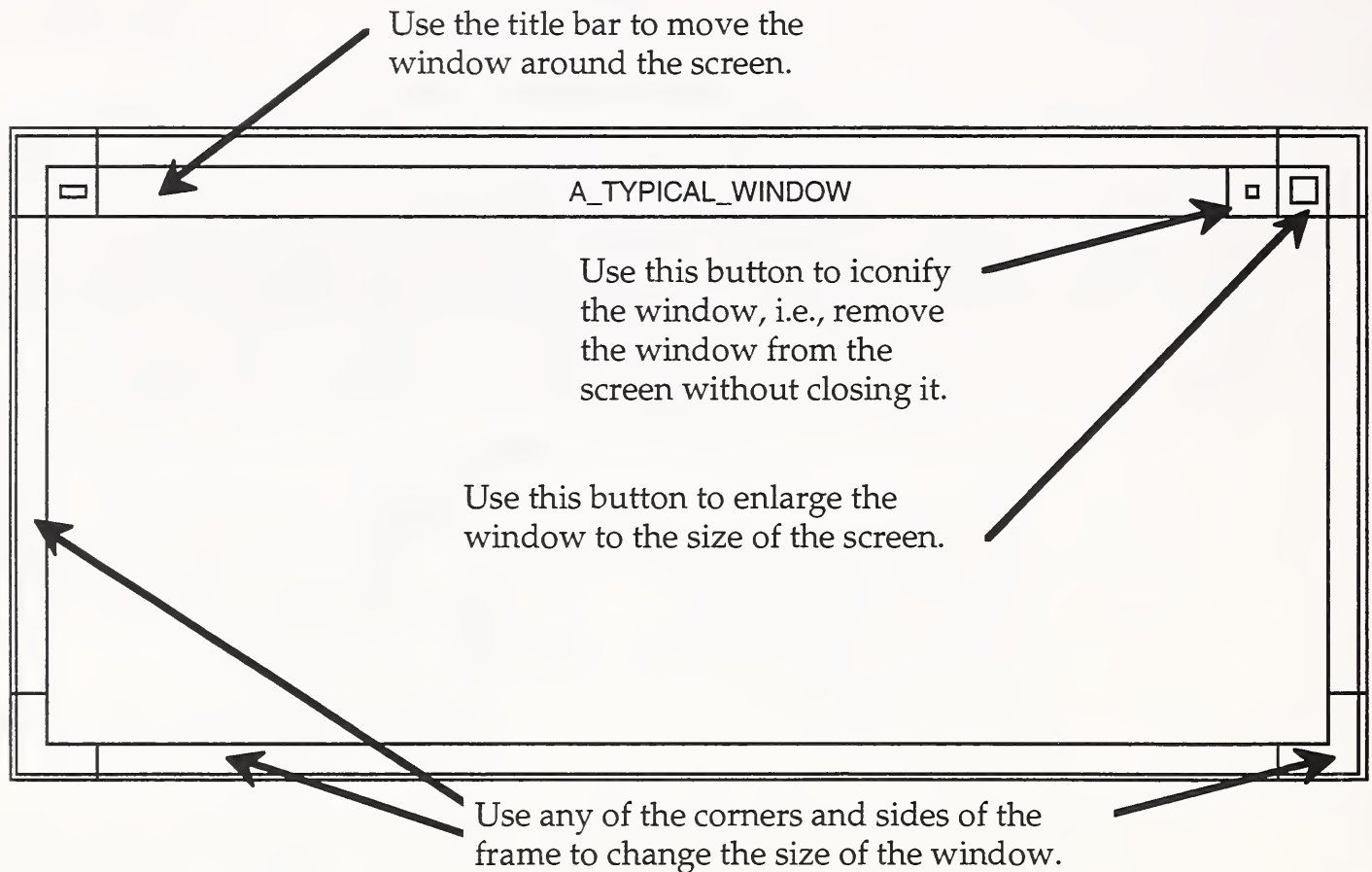
Each window has a pop-up menu which is used to manipulate the window's position on the screen, its size, and operation. Bring up the menu by using the mouse to click on the left button. Hold the button to move the cursor down to the option you want, then release it. The options available are in dark, clear letters. The options that do not apply are in fuzzy letters. They will not work.

The **Move** option allows you to move the window to another part of the screen; the **Size** option allows you to change the size of the window; the **Minimize** option allows you to iconify the window, i.e., remove the window from the screen without closing it; the **Maximize** option allows you to increase the size of the window up to the size of the screen; the **Lower** option allows you to put the window under all the other windows; and **Close** removes the window from the screen and stops the

program running in it. The pop-up menu is illustrated below:

Use this button to make the window's
pop-up menu appear.

A_TYPICAL_WINDOW		
Restore	Alt + 6	
Move	Alt + 7	
Size	Alt + 8	
Minimize	Alt + 9	
Maximize	Alt + 0	
Lower	Alt + minus	
Close	Alt + 4	

Use the mouse cursor to select an
option from the menu. Release
the mouse button when you
highlight the option you want.
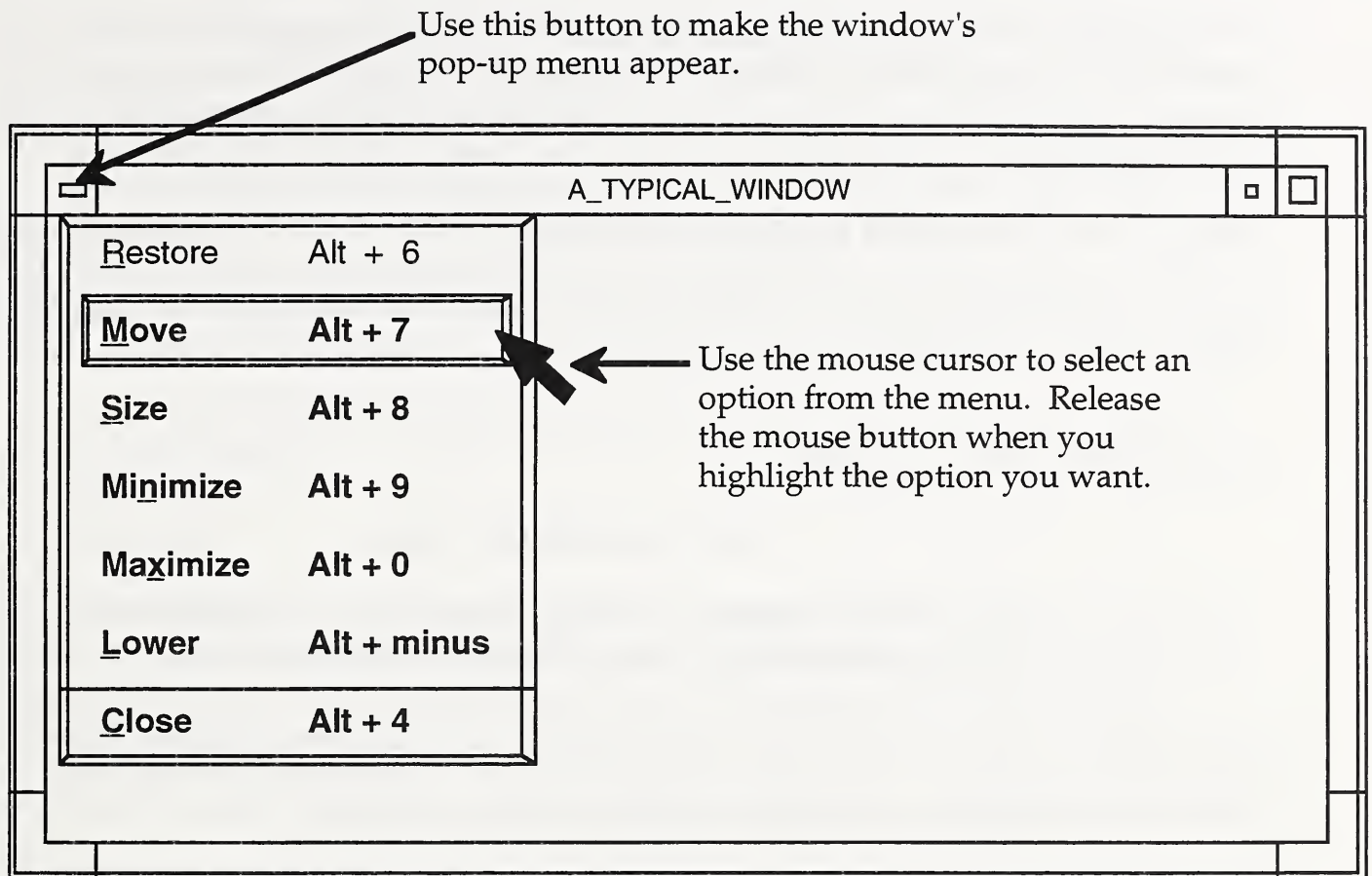
A window is active when its frame is darker in color. An inactive window is lighter
in color. Even if a window is inactive, the program in it is still running and will
still output data. The currently active window takes input from the keyboard or
mouse. Only one window is active at a time.

To start a program from an icon, activate the Desktop window with the mouse. Use
the mouse to double-click the program's icon. In the case of the workstation
controller, double-click the PFMW icon if the program is not already running. The
arrow cursor will turn into a lightning bolt cursor while the program is starting up.
The cursor will turn back into the arrow cursor in a couple of seconds. The
program's window will then appear and be ready for your input. For a description
of the workstation controller program, see "The Workstation Controller Software"
section. For basic instructions on running a batch, see "Using the Fastener
Workstation" section.

Logging out

When finished with the workstation, be sure that all programs you have been running have been properly stopped. Close any SCOterms that you may have opened. Log out from the computer by clicking on and holding the mouse on the blue background of the Desktop to bring up the Desktop menu. Select the Exit option from the menu by sliding the cursor down the menu and releasing. A window labeled **myni** will appear and prompt you for input. Use the mouse to click on **OK** if you want to exit, or **CANCEL** if you do not want to exit. After clicking **OK**, the Icons and Desktop windows will disappear, the screen will blank out, and the login prompt will reappear.

Shutting Down the Computer

!!!!!! WARNING !!!!!!

DO NOT SIMPLY TURN OFF THE COMPUTER
BY PRESSING THE POWER SWITCH OFF !

The computer runs on a UNIX operating system. There are set procedures for starting and stopping a computer running on UNIX. Turning off the computer without executing these procedures may cause the loss of data.

To the system administrator: See Appendix D for proper shutdown procedures.

THE WORKSTATION CONTROLLER SOFTWARE

This section describes how the workstation controller operates. For step-by-step instructions on how to use the workstation controller, refer to "Using the Fastener Workstation" section starting on page 28.

The Windows of the Workstation Controller - What you will see

There are four windows that appear in the workstation controller. Each has a specific purpose and is labelled with a descriptive name. They are:

> PORTSMOUTH_FASTENER_MANUFACTURING_WORKSTATION,
> DATA_BASE,
> ODT-DOS,
> MACH6.

The PORTSMOUTH_FASTER_MANUFACTURING_WORKSTATION window allows you to order, start, and cancel batches; abort running batches; list the batches on queue; print out the order form and setup information; and end a session. It contains the main menu.

At the DATA_BASE window, enter the information needed to order a batch.

The ODT-DOS window contains the Johnson Gage software which measures the part's threads.

In MACH6, you are able to edit the WS variables for the NC programs, and download the NC programs, as needed. In this window you can see what is happening between the Fanuc controller and the workstation controller.

Occasionally, when the workstation controller has a task for you, a window will appear. It is labelled OPERATOR_TASK and will tell you what task needs to be done. Tasks for the operator include setting up the turning center, pressing cycle start on the turning center, and gaging threads.

The Parts of the Workstation Controller - What they are for

The PORTSMOUTH_FASTENER_MANUFACTURING_WORKSTATION window:

In this window, the main menu looks like the following:

```
┌──────────────────────────────────────────────────────────────────┐
│ ┌──┬──────────────────────────────────────────────────┬────┬──┐  │
│ │ ▭│ PORTSMOUTH_FASTENER_MANUFACTURING_WORKSTATION    │ ▫  │▢ │  │
│ │  └──────────────────────────────────────────────────┴────┴─ │
│ │  MAIN MENU                                                    │
│ │                                                               │
│ │  [Q]uit session                                               │
│ │  [O]rder a batch                                              │
│ │  [L]ist batches                                               │
│ │  [S]tart a batch                                              │
│ │  [C]ancel a batch in queue                                    │
│ │  [A]bort a running batch                                      │
│ │  [P]rint batch setup forms/gaging forms                       │
│ │  [U]tilities                                                  │
│ │                                                               │
│ │  Enter your choice:                                           │
│ │                                                               │
└──────────────────────────────────────────────────────────────────┘
```
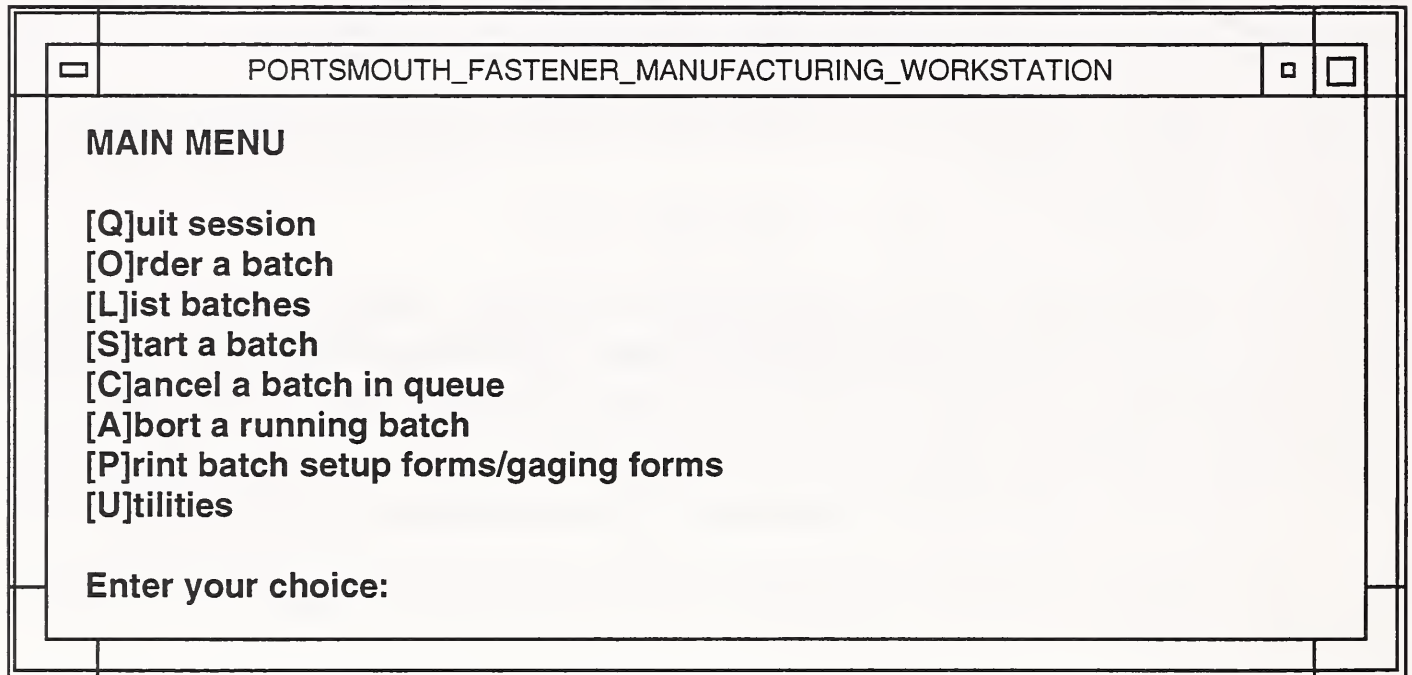
All basic workstation functions are started here in the main menu. The following are descriptions for these functions. Note that for all menus, unless specified, you can enter your choice in either upper- or lowercase letters.

[Q]uit session will cause the program to stop running. Use this when you are finished with the Portsmouth Fastener Manufacturing Workstation (PFMW). After entering a Q, you will be asked if you are sure you want to quit. If yes, type Y, if no, type N. If you do quit, this window will show that it is disconnecting from the database, killing workstation processes, and removing shared memory segments and semaphores. When done, all the PFMW windows will have disappeared. (The blue Desktop and Icon windows remain.) The background pattern will change from PNS tiles to a grey and white basket weave pattern. If you want to use the workstation controller after choosing this option, you will have to re-start it by double clicking on the PFMW icon in the Desktop window.

[O]rder a batch will allow you to enter all the information needed to complete a batch order. After typing **O**, go to the database window (directly below), activate it by clicking on it with the mouse. The database window will bring up the order form after a couple of seconds. When the form is up, enter the needed information.

When you are done with the order form, return to the main menu window by clicking on it. It will ask you if you want a print-out of the setup information. This print-out includes a copy of the order form and the tooling list used for this batch. If you want it, be sure that the printer is on and on-line. Type **Y** at the prompt. Otherwise, type an **N**.

To see the batches on the batch queue, use the [L]ist batches function. Type **L** and a listing of all the batches will appear, keyed by MLN number. The part type, quantity ordered, number of parts machined and number of good parts are included in the listing. Return to the main menu by pressing [Enter] as prompted. If a batch had just been completed or aborted, a prompt for your command to print out the batch's gaging history file will appear. This will give you the gaging results of all the parts that were made so far.

To begin running the batch, use the [S]tart a batch function (press **S**). A prompt for entry of the batch's MLN number will appear. If the batch exists on the queue, the main menu will return to the window after a second or two. If not, a message saying that it does not exist will appear. If you are not sure what the MLN number is, type **Q** to return to the main menu. You can see from the [L]ist batches function what the MLN number is.

If you order a batch and then decide you do not want to start, you may use the [C]ancel a batch on queue function (press **C**) to remove it from the batch queue. When using this function you will be prompted to enter the batch's MLN number. When the batch has been cancelled, a message indicating that the batch was cancelled will appear. If the specified batch does not exist in the queue, a message will appear saying that it does not exist in the batch queue. Note that cancelling a batch on queue does not remove the order information from the database. If you order another batch with the same MLN number the information associated with it will appear automatically in the order form.

The [A]bort a running batch function will allow you to stop a currently running batch before it is completed. Press **A** for this function. A prompt for the batch's MLN number will appear and, if the MLN given is valid, the batch will be marked as aborted in the database and the batch will stop running. The software will reset itself, all the windows of the workstation controller (except for the PORTSMOUTH_FASTENER_MANUFACTURING_WORKSTATION window and gaging window) will disappear and then reappear. If you list the batches, you will find that the batch you aborted is marked "ABORTED". It is best to do an abort

after you have made a part and gaged it. Otherwise, you will have a part that has no thread gaging data to accompany it. See page 37 for instructions on aborting a batch.

When you want to restart an aborted batch, use the [O]rder a batch function. When prompted to enter the MLN number in the order form, enter the aborted batch's MLN number. The information that was stored for this batch will appear. Use the [Tab] key to move the cursor down the order form. As you "tab" through, each item shown will be accepted by the database. When you get to the number of pieces, the number shown is the number of parts that were originally ordered. You will be prompted to press the [Enter] key to make the number of parts ordered equal the remaining number of parts to be made. See page 37 for instructions on re-starting an aborted batch.

When you get to the end of the order form, press F4 to save the values and leave the form. Run the batch by using the [S]tart a batch function.

If you change your mind about ordering a batch while you are in the order form, press F5 to leave the order form without saving any information. When you return to the main menu in the PORTSMOUTH_FASTENER_MANUFACTURING_WORKSTATION window, no batch will have been put on the batch queue.

The [P]rint batch setup forms/gaging reports function will allow you to print out a copy of the order form and tool list for the current batch, and the gaging history file for an existing batch. After typing P, a sub-menu will appear. Select the function you want and be sure that the printer is on-line. (See page 38 for step-by step instructions on doing this.) The sub-menu looks like:

Print:
[S]etup forms,
[P]arts listing for inspection purposes,
[T]hread gaging history for ALL parts made in a batch,
[R]eturn to main menu.

Enter your choice:
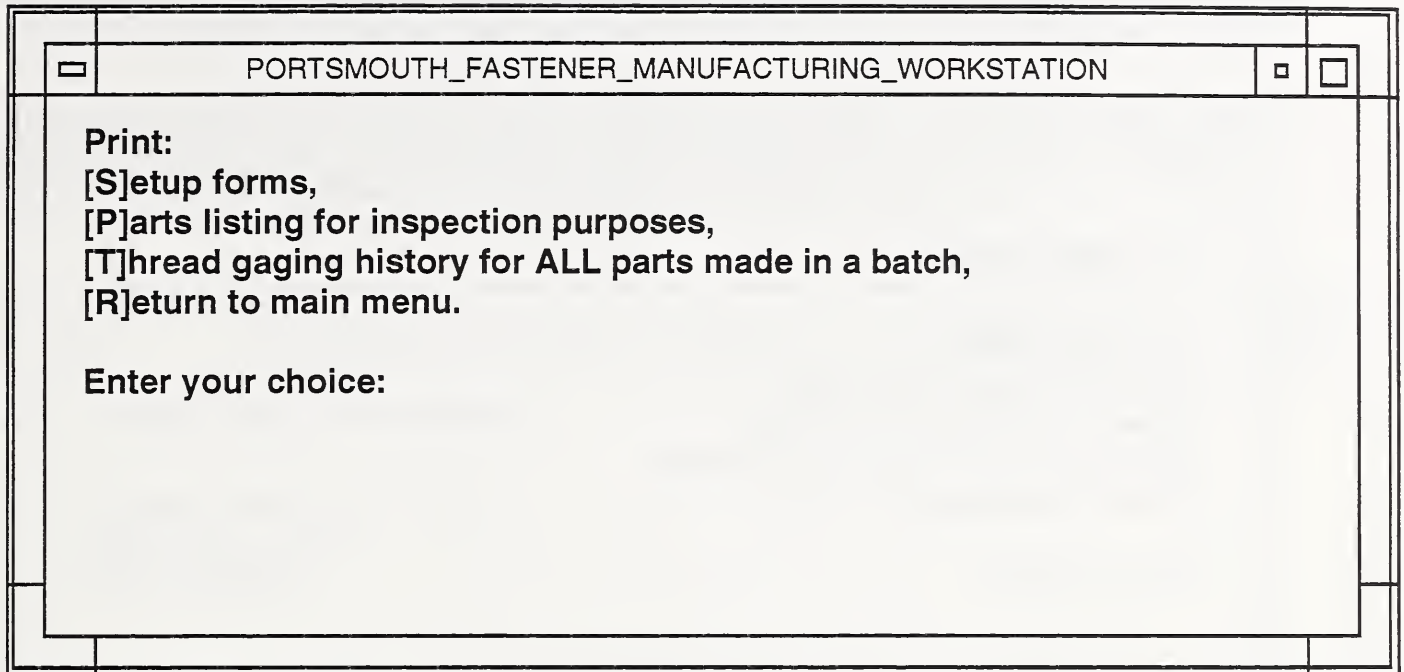
For the first three functions you will be prompted to enter the MLN number of the batch you wish to access. If the batch exists, the information will be printed out. Be sure the printer is on-line and ready for a print job. If the batch does not exist, a message will appear. Press [**Enter**]. The main menu will re-appear.

The [**S**]**etup forms** prints out a copy of the order form which you filled in when you ordered the batch and the tool list that was generated after the batch was ordered.

The [**P**]**arts listing for inspection purposes** is a compilation of the thread gaging results for only the good parts produced in the specified batch. This printed list includes the MLN number of the batch, the date of printing, the measured pitch and functional diameters and measurement date of each part, the calculated tool offset for each part, the minimum and maximum tolerances, the number of tools changed, and the total number of parts listed.

The [**T**]**hread gaging history for ALL parts made in a batch** function is a compilation of the pitch and functional diameters and calculated tool offset for all the parts produced - both good and bad - in the batch. It also includes the minimum and maximum tolerances for each part.

The [**R**]**eturn to main menu** function leaves this sub-menu and returns to the main menu.

The [U]tilities function allows access to programs and functions that are useful for running the workstation controller. It has a sub-menu which looks like:

```
┌─────────────────────────────────────────────────────────────────────┐
│ ┌───┬───────────────────────────────────────────────────────┬───┬──┐ │
│ │ ▭ │   PORTSMOUTH_FASTENER_MANUFACTURING_WORKSTATION        │ ▫ │▢ │ │
│ ├───┴───────────────────────────────────────────────────────┴───┴──┤ │
│ │                                                                   │ │
│ │  UTILITIES MENU                                                   │ │
│ │                                                                   │ │
│ │  [L]eave utilities                                                │ │
│ │  [T]ool change notification                                       │ │
│ │  [S]end NC program to Fanuc                                       │ │
│ │  [R]eceive NC program from CAM                                    │ │
│ │  [O]ther functions                                                │ │
│ │                                                                   │ │
│ │  Enter choice:                                                    │ │
│ │                                                                   │ │
│ │                                                                   │ │
└─────────────────────────────────────────────────────────────────────┘
```
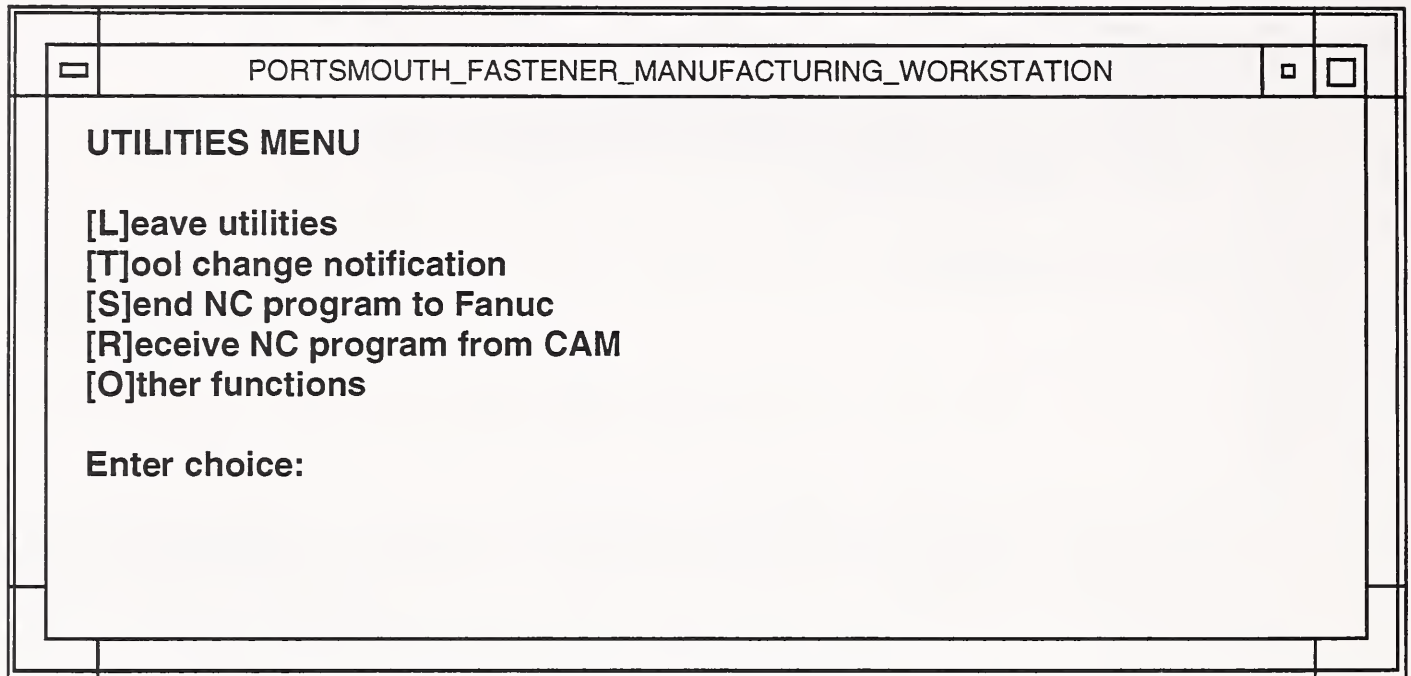
The [L]eave utilities function leaves this sub-menu and returns to the main menu.

The [T]ool change notification function tells the software that you have changed the finish thread tool and/or the finish-turning tool. Note that this is not available in the current running version of the software (dated June 1992). It is to be implemented in the version II software.

The [S]end NC program to Fanuc function downloads an NC program (without previously ordering a batch) to the Fanuc machine controller via the DNC link. When prompted enter the entire pathname of the file you wish to send, not just the filename itself. A sample pathname would be:

/user1/pnsy/fanuc_nc/5931

The program will read from the filename you specified. If the file does not exist, no program will be downloaded to the Fanuc controller.

The [R]eceive NC program from CAM function receives an NC program sent by the CAM computer. The program is sent from the CAM computer by the Pathtrace software program. (See Pathtrace documentation for instructions on sending programs.) The NC program that is received is stored in the directory /user1/pnsy/nc_temp under the filename specified by this program. The filename

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will have the extension "NC". If a program was not transmitted successfully, the file /user1/pnsy/nc_temp/bad.NC will be created.

The [O]ther functions function leads to another sub-menu. This sub-menu includes functions not needed by the operator in normal operations. It includes functions used for diagnostic purposes. This sub-menu looks like:

```
┌─────────────────────────────────────────────────────────────────────────┐
│ ┌──────┐                                                         ┌──┐ ┌─┐ │
│ │  ▭   │  PORTSMOUTH_FASTENER_MANUFACTURING_WORKSTATION          │ ▫│ │□│ │
│ └──────┘                                                         └──┘ └─┘ │
│                                                                           │
│   OTHER FUNCTIONS MENU                                                     │
│                                                                           │
│   [L]eave special functions                                               │
│   [M]ailbox access                                                        │
│   Enter choice:                                                           │
│                                                                           │
│                                                                           │
│                                                                           │
│                                                                           │
│                                                                           │
└─────────────────────────────────────────────────────────────────────────┘
```
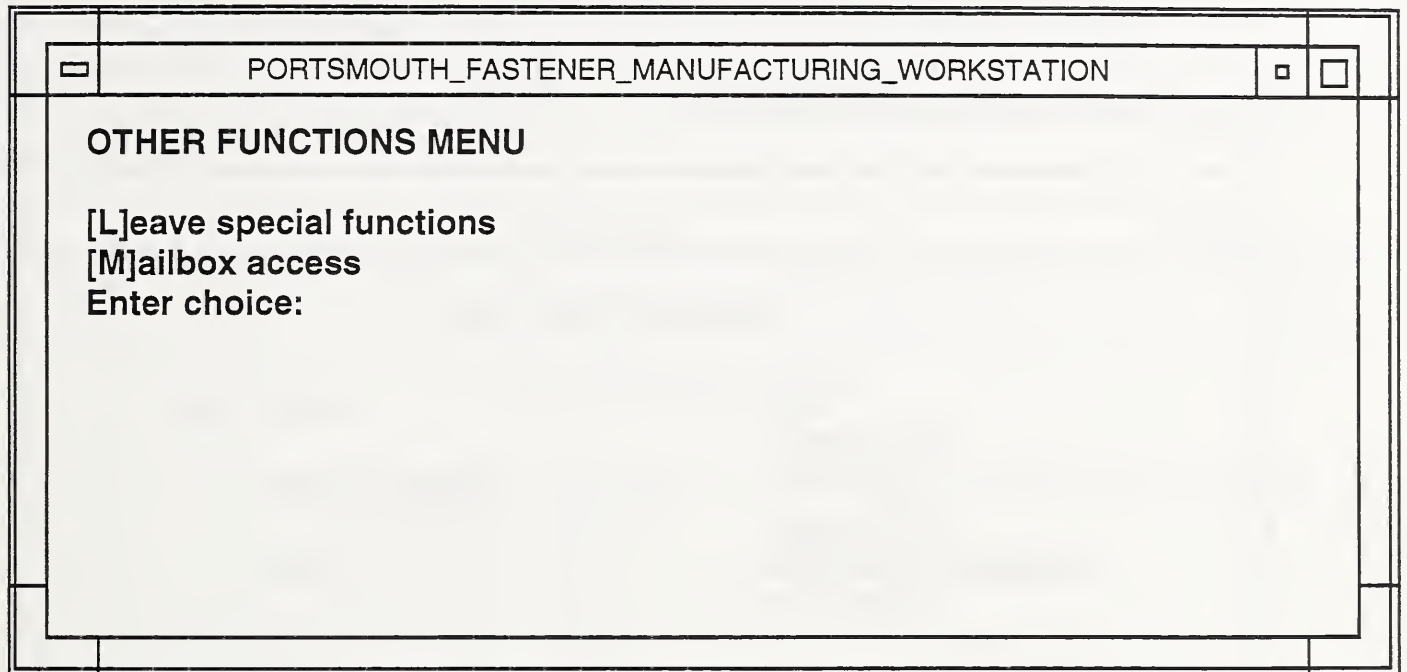
Use the [L]eave special functions option to return to the utilities menu.

If you are the system administrator, the [M]ailbox access option may be useful. It is the same as the one in the PFMW utilities program. See "The Utilities Program" section of this manual for more information.

The DATA_BASE window:

In this window enter information for the batch after you select the **[O]rder a batch** option in the main menu. There is no menu to select from in this window. After activating the window by clicking on it with the mouse, start entering information when the order information form appears in the window. (Refer to Appendix C for examples of filled-in order forms.) The window is active when the frame is darker in color than the others.

The order information form looks like:

```
┌─────────────────────────────────────────────────────────────────┐
│ ┌─────────────────────────────────────────────────────────────┐  │
│ │ ▭              DATA_BASE                            ▫   □    │  │
│ ├─────────────────────────────────────────────────────────────┤  │
│ │                                                               │  │
│ │                    ORDER INFORMATION                          │  │
│ │                                                               │  │
│ │                                                               │  │
│ │                 SWI:                    DATE: now             │  │
│ │           JOB ORDER:                                          │  │
│ │              KEY OP:              OPERATOR ID:                │  │
│ │           KEY EVENT:                                          │  │
│ │   NUMBER OF PIECES?:                     MLN:                 │  │
│ │            LEVEL 1 #:                                         │  │
│ │                                                               │  │
│ │                    FASTENER TYPE:                             │  │
│ │                                                               │  │
│ │                                                               │  │
│ │   NOMINAL DIAMETER:          TPI:      THREAD SERIES:  UNC    │  │
│ │        THREAD CLASS:                          LENGTH:        │  │
│ │      MATERIAL TYPE: KMONEL          STOCK DIAMETER:          │  │
│ │                                           NYLOCK?:  N         │  │
│ │                                                               │  │
│ │   GAGE SAMPLING PERIOD: 1                                     │  │
│ │   MANUFACTURE SPECIFICATION:                                  │  │
│ │                                                               │  │
│ │   COMMENTS:                                                   │  │
│ │                                                               │  │
│ │                                                               │  │
│ │   SAVE_ORDER(F4)        QUIT(F5)                             │  │
│ └─────────────────────────────────────────────────────────────┘  │
└─────────────────────────────────────────────────────────────────┘
```

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The cursor first appears at the date entry of the order form. Note that the field is filled with the word "now". If you press the [Tab] key, the current date is automatically entered into the field. (Otherwise, you could type in the field yourself - the format is date month year time.) After entering your operator ID and batch MLN, the cursor moves to the left starting at the SWI and proceeds down to the comments field. All the information entered is used to specify what kind of part the batch will make.

When ordering a stud fastener, the order form is augmented by the stud information form. This form appears in its own rectangle on top of the order form when you reach the thread series of the order form. The stud information form looks like this:

```
┌──────────────────────────────────────────────────────────────────┐
│ □ │                    DATA_BASE                      │ □ │ □ │
├──────────────────────────────────────────────────────────────────┤
│                      ORDER INFORMATION                             │
│                                                                    │
│              SWI: 020340R2          DATE: 04-jul-1992 08:19:23      │
│        JOB ORDER: 2034WX                                           │
│           KEY OP: 23            OPERATOR ID: 23409                  │
│        KEY EVENT: 2304                                             │
│  NUMBER OF PIECES?: 100                MLN: P1020                   │
│          LEVEL 1 #: 2309                                           │
│                                                                    │
│                   FASTENER TYPE: STUD                              │
│                                                                    │
│    NOMINAL┌──────────────────────────────────────────────┐        │
│       THR │            STUD INFORMATION                   │        │
│       MAT │ TYPE:                                         │        │
│           │ HARDNESS:                                     │        │
│ GAGE SAMPL│ STYLE:                                        │        │
│ MANUFACTU │ NUT THREAD CLASS:      NUT THREAD SERIES:      │        │
│           │ SET THREAD CLASS:      SET THREAD SERIES:      │        │
│ COMMENTS: └──────────────────────────────────────────────┘        │
│                                                                    │
│                                                                    │
│  SAVE_ORDER(F4)      QUIT(F5)                                      │
└──────────────────────────────────────────────────────────────────┘
```

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After filling in the stud information form, press function key **F4** to save the data. The thread series and thread class fields on the main order form will be automatically filled with asterisks which signify that these fields do not pertain to the stud.

If you order a batch that was previously ordered (and was not finished), you would enter in the date and operator ID as usual, but after specifying the MLN the other fields are automatically filled in by the database. All that remains to be done is to move to the end of the form using the **[Tab]** key. You will be prompted at the "number of pieces" field to press the **[RETURN]** key (same as the **[Enter]** key) so that the quantity will be automatically changed to the remaining number of parts to be made.

After entering information, you have the choice of saving the information and leaving the order form, or, of not saving the information and leaving the order form. To save the information, you would press the function key **F4**. This would save the information you entered in the database and enter the batch in the batch queue of the main menu (where you had pressed **o** to order a batch). If you choose to leave the order form and not save the information, press **F5**. This tells the database to not save the order information and no batch is put on the batch queue of the main menu.

The ODT_DOS window:

This window contains the Johnson Gage thread measurement software. It is here that you choose the measurements you want to make on the threads, specify the tolerances you want to use to measure the threads, and record the actual thread measurements.

Because this window emulates DOS, the screen will change colors when the window is activated. This color change tells you that the DOS window is active and ready for your input. All the UNIX windows will turn dark in color and the ODT_DOS window will appear bright.

Whenever you are expected to enter information at this window, the window's background will change from black with white letters to a colored screen. You can enter information after you click-on the window with the mouse to activate it. When you are finished with the task in this window, the window's background will change back to black. Use the mouse to click on any other window to return the screen back to the UNIX format and continue on. The inactive ODT-DOS window looks like this:

ODT-DOS

```
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet          ⟵——— white characters
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet                  black background
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet
cmd  semaphore does not exist yet
```

Before measuring parts you will have to perform a couple steps. The first step occurs in the setup of the workstation after starting a batch. The black screen of the ODT-DOS window will change to the following screen:

```
┌──────────────────────────────────────────────────────────────┐
│ ■                          ODT- DOS                      ■  □ │
├──────────────────────────────────────────────────────────────┤
│                                                                │
│          The Johnson Gage Company SPC Thread Analyzer          │
│  ────────────────────────────────────────────────────────     │
│                                                                │
│       Computed Specifications for:  0.325-18  UNC-2A           │
│                                                                │
│                   Major Dia.      Pitch Dia.      Minor Dia.   │
│                                                                │
│         MAX:      │ 0.3113 │        0.2752          0.2431      │
│                                                                │
│         MIN:        0.3026          0.2712          0.2351      │
│                                                                │
│         TOL:        0.0087          0.0040          0.0080      │
│                                                                │
│                                                                │
│   (Note: Max MnD H28 (1969) differs from ASME B1.1 (1989) value)│
│                                                                │
│     Tolerance fields are automatically updated for Max/Min changes.│
│                                                                │
│  ────────────────────────────────────────────────────────     │
│   <F1>   = Help                                                │
│   <F10>  = Save changes to specifications and go to Main Menu  │
│   <Esc>  = Exit, do not save chagnes to specifications         │
└──────────────────────────────────────────────────────────────┘
```

Here you can either accept the default values of the part diameters by pressing function key **F10**, or edit the values by using the cursor keys to highlight the specification you wish to change, then type in the value you want to use. After changing the values, press function key **F10** and the screen will return to black.

The second step occurs just before you measure the first part. After you have machined the first part, a window will appear and prompt you to measure the part's threads. The tile background will change from grey and white to red and white. The ODT-DOS window will change to the following screen:

```
┌──────────────────────────────────────────────────────────────────────┐
│ ▬                          ODT- DOS                             ▪  ◻  │
├──────────────────────────────────────────────────────────────────────┤
│  ┌──────────────────────────────────────────────────────────────────┐ │
│  │          The Johnson Gage Company SPC Thread Analyzer            │ │
│  ├──────────────────────────────────────────────────────────────────┤ │
│  │                                                                    │ │
│  │        Thread Designation:  0.325-18  UNC-2A                       │ │
│  │                                                                    │ │
│  │     PDmax and FDmax     = 0.2752        MjDmax     = 0.3113        │ │
│  │     PDmin and FDmin     = 0.2712        MjDmin     = 0.3026        │ │
│  │     Tolerance           = 0.0040        Tolerance  = 0.0087        │ │
│  │                                                                    │ │
│  │  SN: ┌─────────────┐   Leading       Center       Trailing        │ │
│  │      └─────────────┘                                               │ │
│  │                                                                    │ │
│  │  Pitch Diameter       ┌─────────┐  ┌─────────┐  ┌─────────┐        │ │
│  │                       │ USED    │  │ USED    │  │ USED    │        │ │
│  │                       └─────────┘  └─────────┘  └─────────┘        │ │
│  │  Functional Dia.      ┌─────────┐  ┌─────────┐  ┌─────────┐        │ │
│  │                       │ USED    │  │ USED    │  │ USED    │        │ │
│  │                       └─────────┘  └─────────┘  └─────────┘        │ │
│  │  Major Diameter                    ┌──────────┐                    │ │
│  │                                    │ NOT USED  │                   │ │
│  │                                    └──────────┘                    │ │
│  │                                                                    │ │
│  ├──────────────────────────────────────────────────────────────────┤ │
│  │  <F1>: Help  <SPACE>: Toggle USED/NOT USED  <F10>: ACCEPT  <Esc>: Use Defaults │ │
│  └──────────────────────────────────────────────────────────────────┘ │
└──────────────────────────────────────────────────────────────────────┘
```

You are prompted to choose the measurements to be made on the part's threads. The default values, as shown, will require three measurements per diameter. You will only be measuring the pitch and functional diameters - the major diameter will not be measured.

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If you will not be measuring, for example, the center of the threads, use the arrow key to highlight the center measurement for the pitch diameter. Press the [SPACE] bar to change the **USED** to **NOT USED**. Do the same for the functional diameter. When you decide what you want, press the **F10** function key to accept the arrangement. The screen will finally change to one where you will measure the part's threads. This screen appears as follows:

```
┌──────────────────────────────────────────────────────────────────────┐
│ □                            ODT- DOS                          ▪  □   │
├──────────────────────────────────────────────────────────────────────┤
│                                                                        │
│          The Johnson Gage Company SPC Thread Analyzer                  │
│                                                                        │
│        Thread Designation:  0.325-18  UNC-2A                           │
│                                                                        │
│        PDmax and FDmax    = 0.2752        MjDmax     = 0.3113           │
│        PDmin and FDmin    = 0.2712        MjDmin     = 0.3026           │
│        Tolerance          = 0.0040        Tolerance  = 0.0087           │
│                                                                        │
│    SN: ┌──────────────┐  Leading        Center       Trailing   Setting│
│        │      1       │                                                 │
│                                                                        │
│    Pitch Diameter    ┌──────────┐   ┌──────────┐  ┌──────────┐ 0.2752  │
│                      │ 0.0000   │   │ 0.0000   │  │ 0.0000   │         │
│                                                                        │
│    Functional Dia.   ┌──────────┐   ┌──────────┐  ┌──────────┐ 0.2752  │
│                      │ 0.0000   │   │ 0.0000   │  │ 0.0000   │         │
│                                                                        │
│    Major Diameter                   ┌──────────┐             NOT USED  │
│                                     │          │                       │
│                                                                        │
│                                                                        │
│                                                                        │
│  ┌──────┐                                                              │
│  │ OKAY │         Sample Count = │ 0 │     Reading Status: │ DYNAMIC │  │
│  └──────┘                                                              │
└──────────────────────────────────────────────────────────────────────┘
```

You will notice that the "SN" field is highlighted. Press the **[Enter]** key to accept the value in the box. The leading measurement in the pitch diameter row will then be highlighted, here the first measurement is made. Notice that this field is highlighted by a shorter rectangle. Use the foot pedal to make a dynamic thread measurement.

When the measurement is taken for this position, the center (if used) measurement for the pitch diameter will then be highlighted and is ready for this measurement. Next, measure the trailing measurement for the pitch diameter and the following measurements for the functional diameter. When all the measurements are made a menu will appear on the top of the screen. Press [Enter] to accept the measurements.

If you feel that you need to re-measure the part, you have the option of doing so. Just select that option from the menu and re-measure as you had before.

The OPERATOR_TASK window:

As mentioned above, this window appears on the screen whenever the workstation controller has a task for you to perform. The window that tells you to set up the workstation equipment appears as follows:
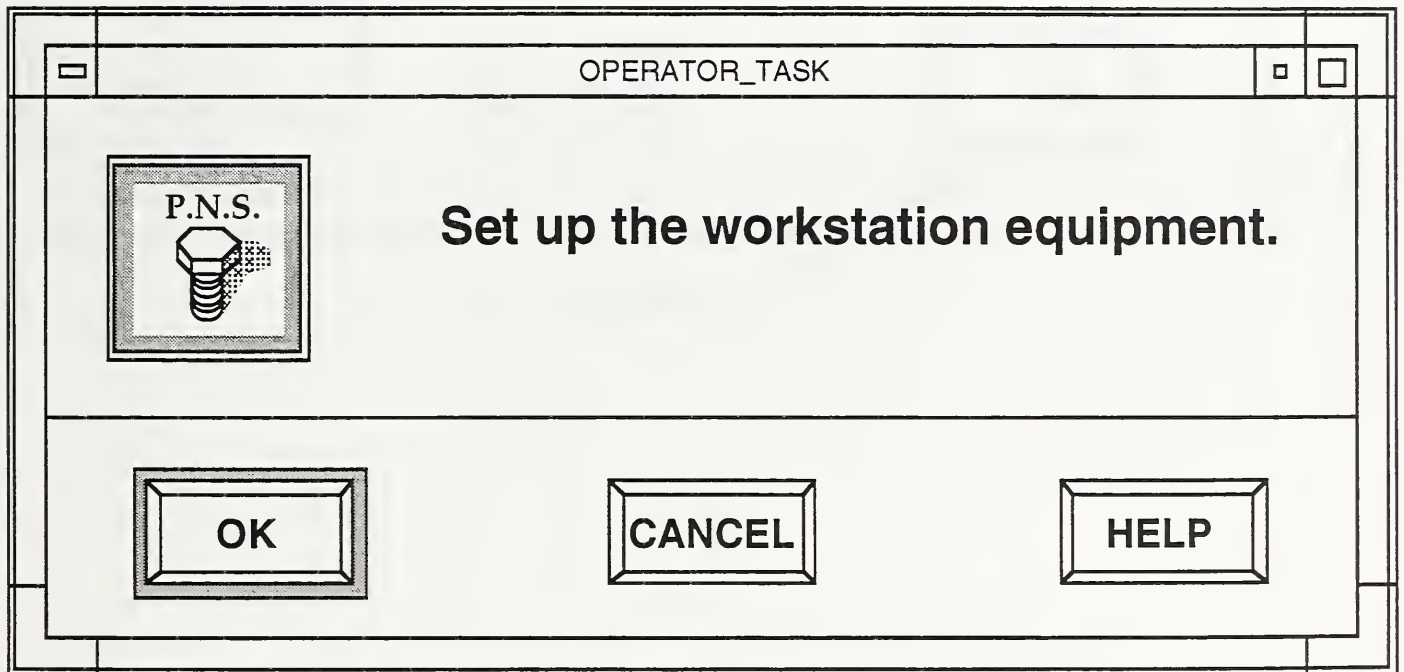
The window is practically the same as the other windows except that it contains buttons. Instead of typing in information on the keyboard, use the mouse to "click" on a button to enter your response.

There are three buttons illustrated above. Use **OK** if the task was completed successfully, **CANCEL** if not completed successfully, and the **HELP** button if you need more information.

You will notice that the **OK** button is highlighted - it has an extra frame around it. This means that the **[Enter]** key can be used to "press" the **OK** button instead of using the mouse. The highlight button is indicated in the following:

| □ | OPERATOR_TASK | □ | □ |

P.N.S.

Set up the workstation equipment.

| OK | CANCEL | HELP |

highlighted button
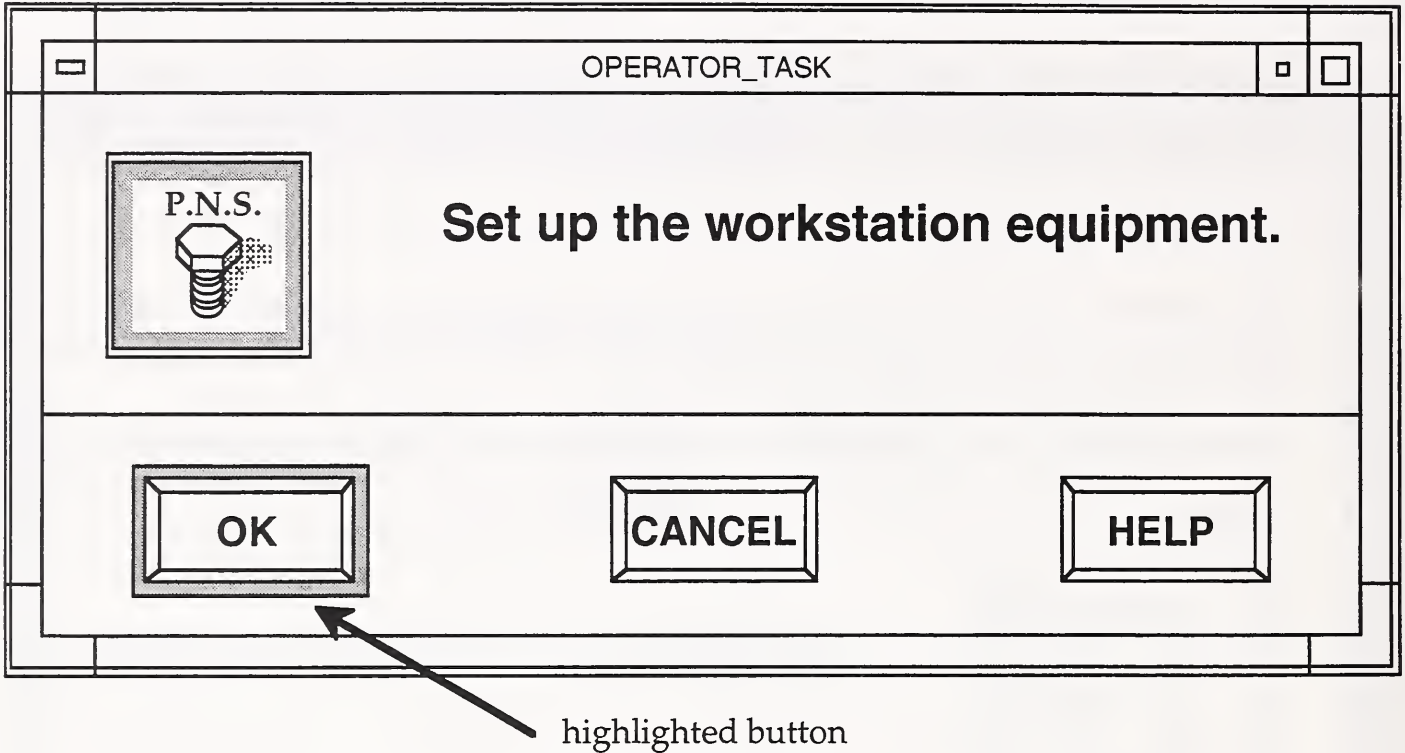
Some pop-up windows may appear just to give information. For these, click on the
OK button to acknowledge the message. The following is an example:
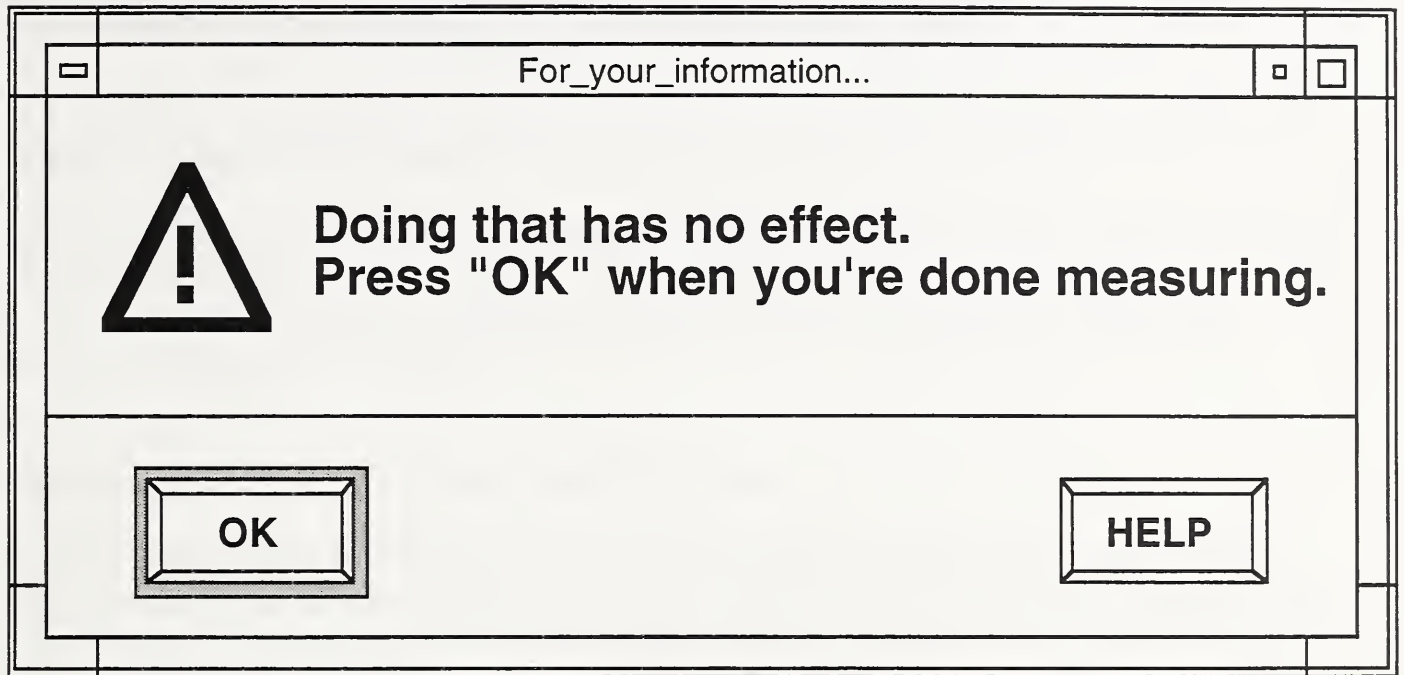
[This page left intentionally blank.]
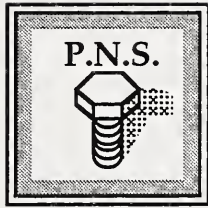
USING THE FASTENER WORKSTATION

MAKING A BATCH OF PARTS

Here are step-by-step instructions on how to prepare bar stock, order, start, and end a batch using the fastener workstation. For a description of the workstation and of how the workstation software works and looks, refer to the section, "About the Fastener Workstation" on page 3.

Preparing bar stock and the turning/milling center

The bar stock and the turning/milling center must be prepared before they can be used to make the fasteners. One end of the bar stock must be chamfered before it can be machined. These steps can be done in less than 10 minutes. To do this, perform the following steps:

1. Measure the bar stock diameter to determine the collet to be used.

2. Change the collet in the spindle to the needed size.

3. Change the stock tube to suit the stock size.

4. Change the spindle tube to suit the stock size.

5. Put the stock into the tube and feed the stock into the spindle then clamp.

6. At the turning/milling center program menu, select the *chamferstock* program and load it to head 1.

7. Change variable 137 to the stock size.

8. Select **HEAD 1** switch.

9. Turn the bar feeder on to accept "bump".

10. Press the **CYCLE START** button at the turning/milling center.

11. Run the program until done chamfering.

12. Retract the bar feeder.

13. Unchuck the collet.

14. Manually unclamp and retract the bar feeder head.

15. Take the bar stock out of the bar feeder and wipe excess oil off the stock.

16. Flip the bar stock over.

17. Manually load the bar stock into the feeder with the chamfered end away from the turning/milling center.

18. Engage the bar feeder close to the spindle. Move the stock until it clears the collet.

19. Manually push the stock tube assembly to the back of the spindle and lock it in place.

20. In the turning/milling center, manually push the stock flush with the collet then clamp.

21. Power the bar feeder on.

22. Select the **HEAD 1 & HEAD 2** mode.

23. Call the programs to run on head 1 and head 2.

To "home" the turning/milling center, perform the following steps:

1. In MDI mode, select **HEAD 1 & HEAD 2**.

2. For head 1, enter G65P997.

3. For head 2, enter G65P996.

4. Select the **AUTO** mode.

5. Press the **CYCLE START** button. Both heads will move to machine zero.

Starting the Workstation Controller Software

If you login as **pnsy**, then the workstation controller will start automatically. If you are already logged in but the workstation controller is not running, start it by double-clicking on its icon in the Desktop window as you would for the other Desktop programs. Wait for the program to set up. The root background will be covered with PFMW icon tiles. The four workstation controller windows will appear. If you have the Icons window open, you will see icons appear as each part of the workstation controller starts up.

Ordering, Starting, and Running a Batch to Completion

1. Activate the main menu window by clicking on it with the mouse.

2. Press **O** at the main menu window.

3. Activate the database window with the mouse. Wait for the order form in the database window to appear.

4. When the order form appears, press the [**Tab**] key to get the current date. Refer to Appendix C to see what the order information may look like.

5. Type in your operator ID.

6. Type in the MLN.

7. Type in the SWI.

8. Type in the job order number.

9. Type in the key op.

10. Type in the key event.

11. Type in the number of pieces.

12. Type in the level 1 number.

13. Type in the fastener type.

14. Type in the nominal diameter. For all decimal number input use 4 decimal places - e.g. use 0.6125 instead of 0.613 or 0.612.

15. Type in the threads per inch (TPI).

16. Type in the thread series.

17. Type in the thread class.

18. Type in the length of the fastener.

19. Type in the material type.

20. Type in the stock diameter.

21. Type in the nylock option - **Y** for nylock, **N** for no nylock.

22. Type in the gaging sampling period - just tab through this, 1 is the default.

23. Type in the manufacturing specification. These must be typed in exactly as shown in Appendix B for each part type.

24. Type in any comments or notes you may have for this batch (optional).

25. Tab through the form as needed to make any changes or corrections before saving the form.

26. When you are done, press the function key **F4** to save the information in the form for this batch.

27. Use the mouse to click on the main menu window.

28. Answer the prompt

Do you want a printout of the batch setup information now (y/n)?
by pressing the **Y** key or **N** key.

29. If **Y**, make sure that the printer is on-line. The order form and tool list will then be printed. The main menu will re-appear in its window.

30. If **N**, the main menu will appear.

31. Press **L** at the main menu to list the batches on queue. A sample looks like:

```
BATCHES ON QUEUE
MLN  STATUS     PART_TYPE  QUANTITY  PARTS_DONE GOOD_PARTS
Z5001 Not started    BOLT          200

Press [RETURN] to continue ...
```

32. Press **[Enter]** to return to the main menu.

33. Before starting the batch, be sure that the turning center is ready for production. Start the batch by pressing **S**.

34. At the prompt, type the MLN:

Enter the MLN of batch to start:

then press **[Enter]**. After a couple of seconds, the main menu will re-appear.

35. In the ODT-DOS (Johnson Gage) window, press function key **F10** to accept the specifications or edit them when prompted.

36. Click on the MACH6 window. It will say:

The Machine Controller is up.
Received command from TCC to perform the setup (setup)
Do you want the threading offset adjusted automatically (y/n)?
[Normally 'yes']

However, it may be desired (e.g., for testing purposes) to not have the workstation automatically adjust the threading tool wear offset. For these exceptions, enter **N**. The operation will proceed as usual, but the wear offset (tool #5, head 2, x-axis) will not be changed.

37. It will then ask:

Do you want to answer all the questions (y/n)?

If this is the first time running this batch press **Y**. You will then be allowed to edit the NC program variables. If you do not need to edit the NC program variables or download the program, press **N**. If you changed the WS variables, make note of them in your logbook, because you will need to make these same changes every time you restart this batch.

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38. If you press **Y** and want to edit the NC program variables , two things will happen:

     a. In the MACH6 window a list of WS variables appear, followed by the question:

          Are these values acceptable? (y/n)

     b. A large blue window containing descriptions of the WS variables in the MACH6 window pops-up. A sample entry looks like:

          WS2 = 3.000   (Nom. Length   ----!----)

The "----!----" following some of the values indicates that this is a value that should be double checked. All of the WS variables should be verified before accepting the values. DO NOT BLINDLY ACCEPT THE VALUES AS CORRECT WITHOUT CHECKING THEM FIRST.

39. At this time, you may change the WS variables, if needed. To change, answer **N** (no) to the question, "Are these values acceptable?" in the MACH6 window.

Using the example displayed in the window, make the desired changes. When done, press **[Enter]** a final time, and the values will be displayed again. The ones that were changed will have a "C" (for "change") in place of the "=" sign, i.e.,:

          WS10   C   0.325

Because the controller cannot check your changes for you (it cannot think for you!) use this time to double check the values that you changed!

40. Go through this procedure as often as necessary, and when done, answer **Y** (yes) to:

          Are these values acceptable? (y/n)

The large blue window containing the WS variables can be closed whenever desired. Activate the window and close it by using the pull-down menu or by just pressing **[Enter]** as prompted.

NOTE: The blue WS variable window will not reflect any of the variable changes you may have made in the MACH6 window.

41. If you want a printout of the values, press **Y** at the prompt:

> Would you like a printout of the values? (y/n)

42. The next message:

Sending GETSTAT out to Fanuc ...
will be followed, when the communication line wakes up, by:

> ... done ... Fanuc OK.

You may have to reset the Brown & Sharpe interface ("interface box"). If so, these messages will appear:

> Please reset the B&S interface.
> When ready, hit "d" to continue.
> .
> .
> Thank you.
> .
> .
> OK ... continuing.

The B&S interface refers to the gray interface box located on the left side of the Brown and Sharpe turning center as you face it.

43. If the Fanuc **MODE SELECT** switch (**EDIT, AUTO, MDI**, etc.) is not in **AUTO MODE**, this message will appear:

> ERROR! The Fanuc MODE SELECT switch must be in AUTO mode.
> If it's already in AUTO MODE, press the RESET button.
> When done, hit "d" to try again.

(The reset button is on the Fanuc control panel.)

Otherwise, the message:

> OK ... continuing.

will appear.

44. After the communication line is up, and the MODE SELECT switch is in correct position, this message will appear:

Do you want to download NC programs (y/n)?
If no, the controller will continue to download variables #558, #587, #588, and #593 to the Fanuc. If you answer yes, the programs for heads #1 and #2 will be downloaded and set active. After completion, you will see this message:

... done ... finished downloading.

NOTE: The workstation software checks the threading tool wear offset (head 2, x-axis, tool 5, wear) for incorrect or out-of-bound values. It does this before gaging is completed. If it detects a value of 0.0000, OR a value beyond +/-0.0300 inches for this offset, a message will appear in the MACH6 window. The operator should check the offset before continuing.

45. At the OPERATOR_TASK window, click on **OK** or press **[Enter]** to the prompt:

Setup workstation equipment.

and the window will disappear.

46. When ever your response is needed at the OPERATOR_TASK window the background tiles turn red and white. After entering your response, it turns back to gray and white.

47. At the OPERATOR_TASK window, answer the prompt:

Press cycle start.

by pressing **[Enter]** or clicking on the **OK** button with the mouse.

48. Begin machining the part.

49. When the part is done, you will be prompted to measure the parts threads. The OPERATOR_TASK window will appear and say:

Measure the part's threads.

Click **OK** or press **[Enter]** when done. The window will disappear.

50. The gaging screen in the ODT_DOS window will appear - activate it by clicking on it with the mouse. The other windows will turn dark. If this is the first part, you will be asked to select the number of measurements that are needed for the functional and pitch diameters. Select them by doing the following:

a. Since the default states for each measurement is **USED**, press **F10** to accept them if you want to use all three measurements.

b. If you do not wish to use a measurement, use the cursor key to highlight the one you do not want. Press the **SPACE** bar to toggle the **USED** or **NOT USED**.

c. When done, press function key **F10** to accept the setup.

51. The screen used to measure the part's threads will appear. To measure the part, press [**Enter**] at the serial number box to accept it. The cursor will move to the first box in the pitch diameter row. Make your measurements for pitch and functional diameters by clicking on the thread gage's foot pedal.

52. When done, a menu at the top of this window will appear. Press [**Enter**] to save the measurements made.

53. Go to the OPERATOR_TASK window and click **OK** or press [**Enter**] when you are done measuring.

NOTE: At this time, before downloading the offset adjustment, the workstation software checks the threading tool wear offset (head2, x-axis, tool 5, wear) for incorrect or out-of-bound values. If it detects a value of 0.0000, **OR** a value beyond +/-0.0300 inches for this offset, an error message will appear in the MACH6 window. The operator should check the offset in the Fanuc before continuing.

54. Meanwhile, the next part has been started. Measure this one as you did the first one when prompted.

55. When the whole batch is done, the batch queue will look like:

```
BATCHES ON QUEUE
MLN  STATUS     PART_TYPE  QUANTITY  PARTS_DONE  GOOD_PARTS
Z5001 Completed    BOLT        200        200          200
Press [RETURN] to continue ...
```

56. After machining for the day, to end the session, press **Q** (for quit) at the main menu. You will be prompted with:

Are you sure you want to quit? (y/n)
If no, press **N** and the main menu will reappear. If yes, press **Y**: the windows will disappear and the main menu window will say:

> Disconnecting from the database ... database stopping ... database stopped
> Killing control processes ...
> Removing shared memory segments and semaphores ... done.

and then disappear. The tile background will change to a gray, black, and white pattern.

Different Ways to End a Running Batch

There are two ways to end a running batch. One way is to allow the batch to run until all the parts have been made (to completion) or, if this is impractical, the other way is to abort the batch. When you abort a batch, you can restart the batch at a later time. The database keeps a tally of the number of good parts made in the batch. The preferred time to abort a batch is after machining and gaging a part and before machining another. See page 13 for a discussion on aborting a batch.

To abort a running batch:

1. Press **A** at the main menu prompt.

2. You will be prompted to enter the MLN of the batch you want to abort. Type it in.

3. If the batch exists in the batch queue the MACH6 and DATA_BASE windows will disappear and reappear. They have been reset and are ready for another batch. At the main menu you can list the batch queue (menu option **L**) and the status of the batch will be "Aborted".

To restart an aborted batch:

1. Select **O** from the main menu. (You have to order the batch again.)

2. Activate the database window by clicking on it with the mouse.

3. Wait for the order form to appear.

4. When the order form appears, tab through the date.

5. Enter your operator ID.

6. Enter the MLN. The rest of the batch information will appear!

7. Tab through all of this information to the end of the form. At the number of pieces, press [Enter] as instructed to accept the new quantity.

8. Press F4 to save the form and continue to the main menu.

9. Activate the main menu window by clicking on it with the mouse.

10. Run the reordered batch with the [S]tart a batch function and continue the batch. NOTE: You may need to edit the NC program variables if you had done that before.

Getting a Hard Copy of the Parts List for Inspection Purposes

When you are done making all the parts (good and bad) in a batch, you can get the thread gaging results for all the good parts made by using the print function of the main menu. See page 14 for a discussion on using the print function.

1. Press P for the [P]rint batch setup forms/gaging forms function at the main menu. The print sub-menu will appear.

2. Press P at the print sub-menu to select [P]arts listing for inspection purposes.

3. Enter the MLN number of the batch you want when prompted.

4. If the batch exists, the list will be printed out. If not, a message will appear saying so. Make sure that the printer is on-line.

5. Press [Enter] to return to the sub-menu.

6. Press R to return to the main menu.

USING THE UTILITIES PROGRAM

This program allows you to see the communication between workstation controller processes, check workstation processes existence, and communicate with the Fanuc controller. These are used **ONLY** by the system administrator for diagnostic purposes.

To activate the program, double click on the PFMW-UTIL icon in the Desktop window. A window will appear with the following menu:

> PFMW Utilities Menu:
>
> [L]eave utilities
> [C]heck workstation processes existence
> [c]ommon Memory Display
> [M]ailbox Access
> [F]anuc communication

Enter your choice:
To stop running the utilities program, press L. The utilities window will disappear.

To check if all the workstation controller processes are running, use the **[C]heck workstation processes existence** function. To use this, press **shift-C** to get an upper-case C. This will print out the results in the utilities window. If any process is missing its name will be displayed. Note this in the log book along with the surrounding circumstances. You will need to restart the workstation controller. Refer to the "Using the Help Program" section for instructions on restarting.

The **[c]ommon Memory Display** function allows you to see the messages being sent back and forth between the workstation processes. Press c (to get a lower-case c) for this function. A window will appear with its own menu. You will be able to display the contents of the common memory, print out the display to the printer, or reset the contents of the common memory. A reset of common memory clears out all information in the common memory mailboxes. **Do not use this unless you intend to clear the common memory.** You will lose useful information and will not be able to continue with workstation operations.

To display the contents of the common memory, type **D** and press **[Enter]** at the common memory menu prompt:

> [Q]uit, [D]isplay, [R]eset values, [P]rint display   Enter your choice:

A sample of the display looks like:

MBOX_NAME	ID	MGRAM_#	ECHO_#	MSG_#	MESSAGE	LOT_ID	OTHER
TCC_WSC_COMM	0	1	0	1	make_parts	P1030	100
TCC_WSC_STAT	1	10	1	10	busy	P1030	0 0
TCC_MACH_COM	2	1	0	1	setup	P1030	
TCC_MACH_STAT	3	1	1	1	busy	P1030	
TCC_DB_COM	4	0	0	0			
TCC_DB_STAT	5	0	0	0			
TCC_OP_COM	6	0	0	0			
TCC_OP_STAT	7	0	0	0			
TCC_SPC_COM	8	1	0	1	setup	P1030	
TCC_SPC_STAT	9	1	1	1	busy	P1030	
MC_OP_COM	10	0	0	0			
MC_OP_STAT	11	0	0	0			
MC_DB_COM	12	1	0	1	get_data1	P1030	
MC_DB_STAT	13	1	1	1	busy	P1030	
SPC_DB_COM	14	0	0	0			
SPC_DB_STAT	15	0	0	0			
WSC_DB_COM	16	1	0	1	coll_info		
WSC_DB_STAT	17	2	1	2	done	P1030	1230985 xzcv2398asdf....

Common_Memory

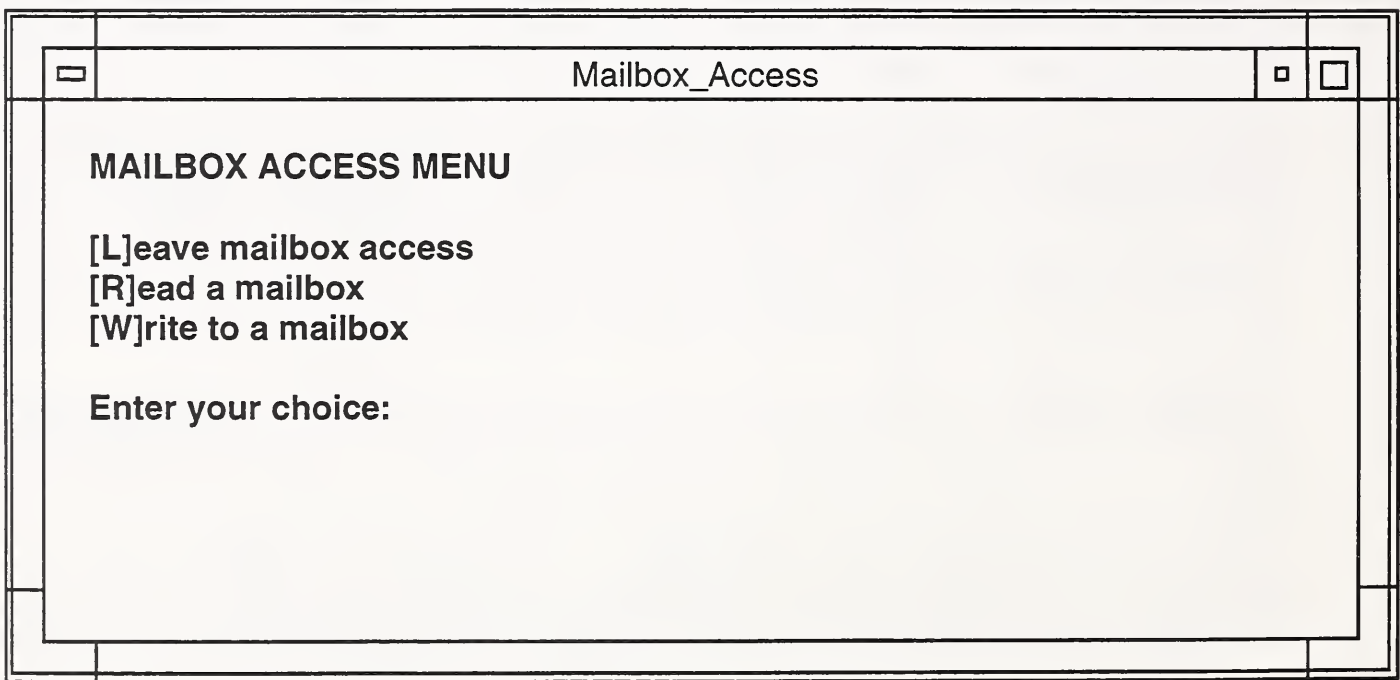[Q]uit, [D]isplay, [R]eset values, [P]rint display   Enter your choice:

If you want a paper copy of the display, choose the [P]rint display option by typing P and pressing [Enter] at the common memory menu. Be sure that the printer is on-line and ready to print. Choose the font and point size at the printer's control panel before you print the display .

When finished with the common memory display program, type Q and then press [Enter]. The common memory program will stop running and its window will

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disappear. You can run the program again by selecting it from the PFMW utilities menu.

The reset function of the common memory program is used only for debugging and development purposes. If you choose to reset the common memory values, you will wipe out all the mailboxes' contents. You will not be able to continue with workstation operations from then on. You will have to restart the workstation software by double clicking on the PFMW icon and re-order the batch you were working on. Depending on where you were in the workstation operation, the reset function may cause data not to be saved in the database. Use the [R]eset values function with **CAUTION!** To reset the values, type **R** at the common memory menu prompt and press [**Enter**].

The [M]ailbox Access function allows you to read from or write to a common memory mailbox. Press **M** for this function. A window will appear and display the following menu:

```
┌─────────────────────────────────────────────────────────────┐
│ ┌─────────────────────────────────────────────────────────┐ │
│ │ ▭         Mailbox_Access              ▫ □ │ │
│ ├─────────────────────────────────────────────────────────┤ │
│ │                                                         │ │
│ │   MAILBOX ACCESS MENU                                   │ │
│ │                                                         │ │
│ │   [L]eave mailbox access                                │ │
│ │   [R]ead a mailbox                                      │ │
│ │   [W]rite to a mailbox                                  │ │
│ │                                                         │ │
│ │   Enter your choice:                                    │ │
│ │                                                         │ │
│ │                                                         │ │
│ │                                                         │ │
│ └─────────────────────────────────────────────────────────┘ │
└─────────────────────────────────────────────────────────────┘
```

With this function, press **L** to end this program, **R** to read what's in a mailbox, or **W** to write a message into a mailbox.

If you press **L**, the mailbox access program will end and its window will disappear. Use the mouse to activate the window you want to work in next.

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If you press **R**, you can **read from a mailbox**. You will be prompted with:

Enter the mailbox index:

Type in the ID number of the mailbox you want to read. Use the common memory display to get this number or refer to Appendix F. A sample of the information you will see is displayed in the following:

```
mailbox name:        MC_DB_STAT
mailbox ID:          13
mailgram_no:         24
echo_cmd_no:         20
message_no:          24
message length:      17
message:             done
```

Hexadecimal dump of message: 20 20 20 20 20 20 64 6F 6E 65 00
50 31 30 33 30 00

Press [RETURN] to continue...

When you are done reading the information, press the [**Enter**] key. The mailbox access menu will re-appear.

If you want to **write to a mailbox**, press **W**. You will encounter a series of prompts. The first one is:

Enter the mailbox index:

Type in the ID number of the mailbox you want to write to. You can get this number from the common memory display or from Appendix F.

After entering a valid number you are prompted with:

Enter the message number:

Type in the appropriate message number.

At the prompt:

Enter echo command number (0 if not applicable):

type in the command number of the message you are responding to. (Use the

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common memory display program to determine the "command number" of the command message. If you are sending a command message, just enter **0** since commands do not have echo command numbers.

The next prompt is:

> Enter command/status message:

This will contain the 10-character-long command or status you want to send. Refer to Appendix G for valid commands and statuses. If you do not send a message that the process can understand, it will not be able to process your message.

At the prompt:

> Enter MLN:

type in the MLN number of the batch that is currently under execution. Refer to the common memory display for the MLN or list the batches on queue in the Portsmouth_Fastener_Manufacturing_Workstation window.

After entering the message number, echo command number, command or status message, and the batch MLN, you will be prompted to enter any parameters that are needed for your message. The first of these prompts is:

> Will the next value be a:
> 5-digit quantity, or
> 5-digit error number (y/n) ?

If you have no parameters to send, press **N** to this question and the prompts, "Another 5-digit value (y/n)?" and "More to enter (y/n)?". You will get back to the mailbox access menu. If you do have parameters to send, answer with a **Y**.

If you press **Y**, this prompt will appear:

> Enter 5-digit value:

Type in the 5-digit number and press [**Enter**].

Next, this prompt will appear:

> Another 5-digit value (y/n) ?

If you want to send another value, press **Y** and enter the value at the prompt

Enter 5-digit value:

If not, press **N**. Either way you will get back to the mailbox access menu.

If you do not send a 5-digit value, you will get another prompt. This is:

Will the next value be a command /status qualifier
(e.g. state_tbl, prog_data, tool_offst) (y/n) ?

If you do send a 5-digit value, press **Y** and enter the (10-character maximum) qualifier string at the prompt:

Enter qualifier string (10 char max.):

A final prompt for parameters is:

More to enter (y/n) ?

If you have more, press **Y** and type in your parameter (any number of characters long) at the prompt:

Enter the string:

If no more, press **N** and you will get back to the mailbox access menu.

The [F]anuc communication function allows you to send commands to the Fanuc controller. Press F for this. This window will appear:

```
┌─────────────────────────────────────────────────────┐
│ ┌───┐          Fanuc_Communication          ┌─┐ ┌─┐ │
│ └───┘                                        └─┘ └─┘ │
│ ┌─────────────────────────────────────────────────┐ │
│ │                                                  │ │
│ │   CMD>>                                          │ │
│ │                                                  │ │
│ │                                                  │ │
│ │                                                  │ │
│ │                                                  │ │
│ │                                                  │ │
│ │                                                  │ │
│ │                                                  │ │
│ │                                                  │ │
│ │                                                  │ │
│ │                                                  │ │
│ └─────────────────────────────────────────────────┘ │
└─────────────────────────────────────────────────────┘
```
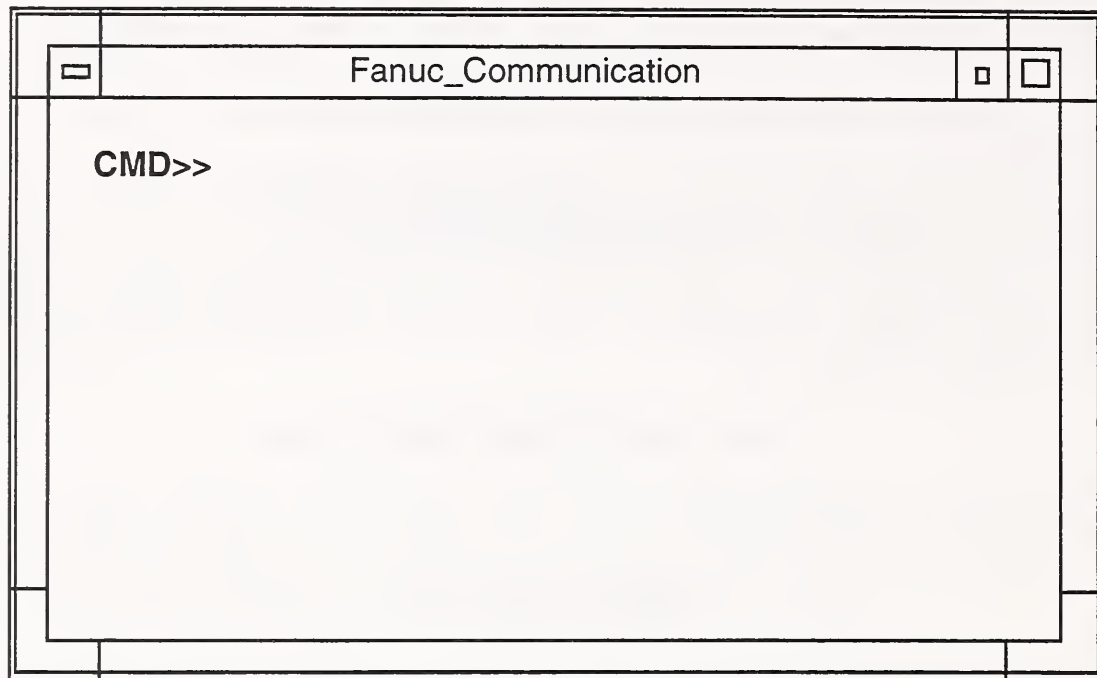
To use this program, type at the **CMD>>** prompt any of the commands listed below. You will be prompted to enter parameters for the command, if needed. After typing a command or parameter, press [ENTER].

To stop using the program, type **quit** at the prompt. The program will end and the window will disappear.

When entering a tool offset or variable value, use the format ±**xxx.xxxx**. Leading or trailing zeroes are not necessary.

Make sure that the Fanuc **MODE SELECT** switch is in the **AUTO** mode position for all commands except the command GETPROG.

The following are low level commands that involve communication between the Fanuc and the MACH6 process.

1. **PUTPROG**: The purpose of this command is to download an NC program from a file in the workstation computer to the Fanuc controller, and then wait for confirmation. The filename is the file with the NC code; device is the serial port.

- Type: PUTPROG[Enter]
- Enter the filename as prompted.

2. **GETPROG**: The purpose of this command is to upload an NC program from the Fanuc controller to a file in the workstation controller computer.

- First, switch the **MODE SELECT** switch on the Fanuc to the **EDIT** mode.
- Type: GETPROG[Enter]
- Enter the program name when prompted.
- Enter the filename when prompted.

3. **PUTTO**: This command writes a certain tool offset value to the Fanuc, given the head, the offset_type, the tool offset number, and the offset axis.

- Type: PUTTO[Enter]
- Enter the head number **1** (for head #1) or **2** (for head #2) when prompted.
- Enter the offset type **G** (for geometry), **W** (for wear) when prompted.
- Enter the offset axis, **X** (for the x axis), or **Z** (for the z axis), when prompted.
- Enter the tool offset number, **1** to **16**, when prompted.
- Enter the tool offset value when prompted.

4. **GETTO**: This command gets a certain tool offset value from the Fanuc, given the head number, the offset type, offset number, and the offset axis.

- Type: GETTO[Enter]
- Enter the head number **1** (for head#1) or **2** (for head#2) when prompted.
- Enter the offset type **G** (for geometry) or **W** (for wear) when prompted.
- Enter the offset axis, **X** (for the x axis) or **Z** (for the z axis), when prompted.
- Enter the tool offset number, **1** to **16**, when prompted.

5. **PUTVAR**: This command changes the value of a variable stored in the Fanuc, given the variable offset number, and the value of the variable.
- Type: PUTVAR[Enter]
- Enter the variable offset number, **550** to **599** (head 1 only) when prompted.
- Enter the variable value when prompted.

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6. **GETVAR**: This command retrieves the value of a variable stored in the Fanuc given the variable offset number.

- Type: GETVAR[Enter]
- Enter the variable offset number, **550** to **599** (for head 1 only) as prompted.

7. **GETSTAT**: This command checks the status of the Fanuc and returns the following information: status = 1, **EDIT** mode; status = 2, **AUTO** mode.

- Type: GETSTAT[Enter]

8. **$T**: This command de-activates the serial line between the Fanuc and the MACH6 process.

- Type: $T[Enter]

9. **$WRP**: This command activates the serial line between the Fanuc and the MACH6 process.

- Type: $WRP[Enter]

10. **SLEEP**: This command closes down the Fanuc communication line.

- Type: SLEEP[Enter]

11. **WAKEUP**: This command brings up the Fanuc communication line. It calls the command WRP which waits for a response. After issuing this command you will see the message *** 11tt ready *** in the window.

- Type: WAKEUP[Enter]

12. **SETACTPROG**: This command sets different programs active on the two heads. In **AUTO** mode the program is updated on the screen immediately, while in **EDIT** mode the change is not apparent until you switch to **AUTO** mode.

- Type: SETACTPROG[Enter]
- Enter the program number as prompted.
- Enter the head number (**1** or **2**) as prompted.

USING THE HELP PROGRAM

This program allows you to re-start the workstation controller program in case of a lock up and activates a diagnostic feature of two workstation processes.

To activate this program, double click on the PFMW-HELP icon in the Desktop window. A window will appear with the following menu:

PFMW First Aid Kit Menu:

[L]eave first aid kit
[R]estart all PFMW software
[D]iagnostics mode enabler

Enter your choice:
The [L]eave first aid kit option stops the help program. Use this when you do not want to use the help program anymore. If you press L, the first-aid kit window will disappear.

The [R]estart all PFMW software should be used only when you are locked out of the workstation controller program. This will stop the workstation controller completely and re-start the program from scratch. Any batches that were put in the batch queue will be wiped out. You will have to re-order the batches. Note that the information that was stored for the parts made and gaged during the execution of the batch will not be lost. However, no information will exist on a part machined but not gaged. To use this option, do the following:

1. At the PFMW First Aid Kit Menu, press **R** on the keyboard.

2. Answer the prompt

Are you sure you want to do this ? (y/n)

with a **Y** if you want to re-start, or a **N** if you don't want to re-start.

3. If you answer **N**, nothing will happen. Press **[Enter]** to continue on to the menu and press **L** to leave the first aid kit.

4. If you answer **Y**, you will see the workstation windows disappear.

5. The workstation controller program will start up as usual.

The [D]iagnostics mode enabler allows the system administrator to activate the diagnostics modes of the turning center controller (TCC) and machine controller (MACH6) processes. It allows the system administrator to see what is going on in those processes. It should only be used by the system administrator for debugging purposes. Refer to Appendix E for instructions on using this function.
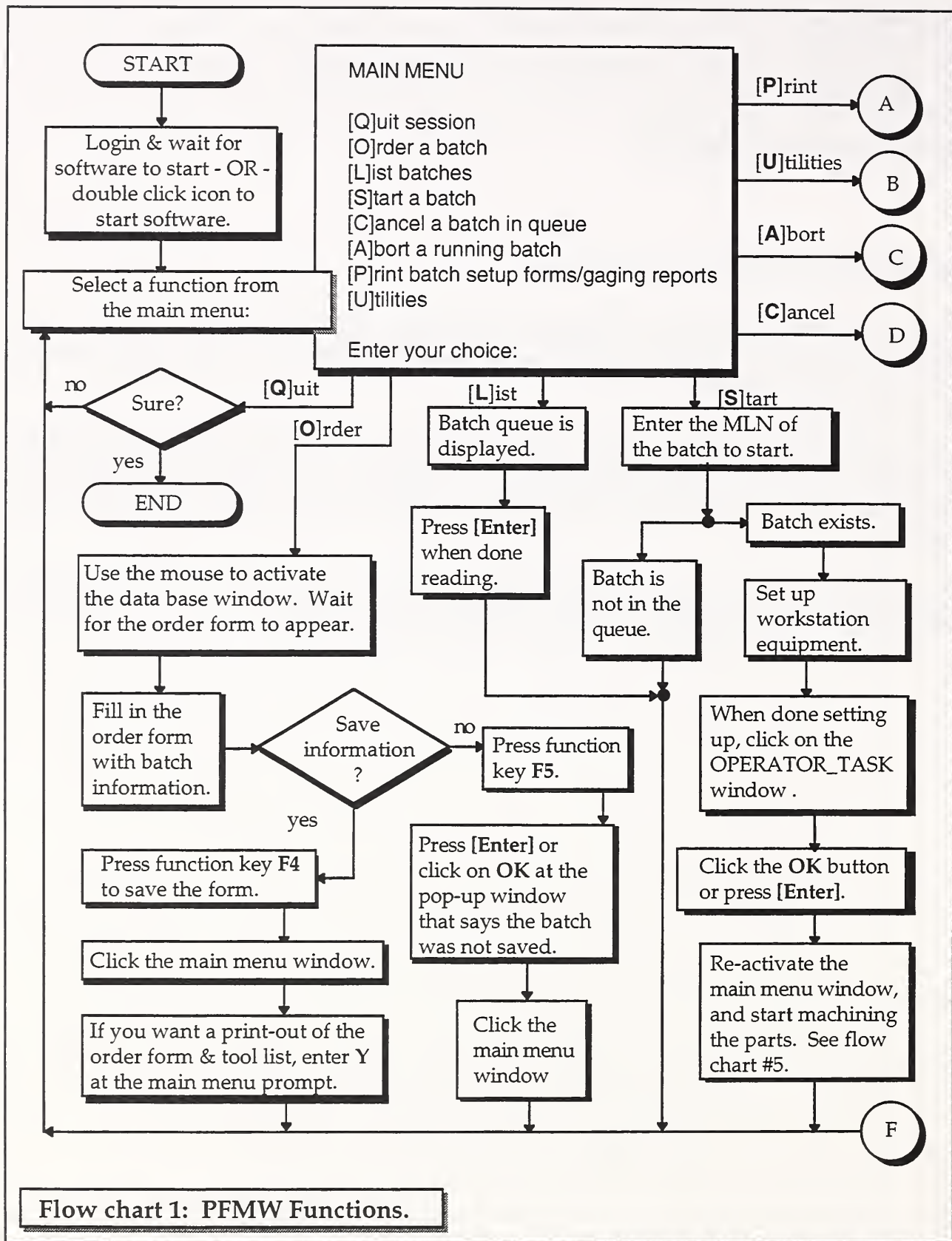
APPENDIX A

PFMW Control Algorithm Flow Charts

Use flow charts 1 through 6 as a guide to maneuvering through the PFMW software. They show you the functions of the main menu, the option paths, and the operator decision points.
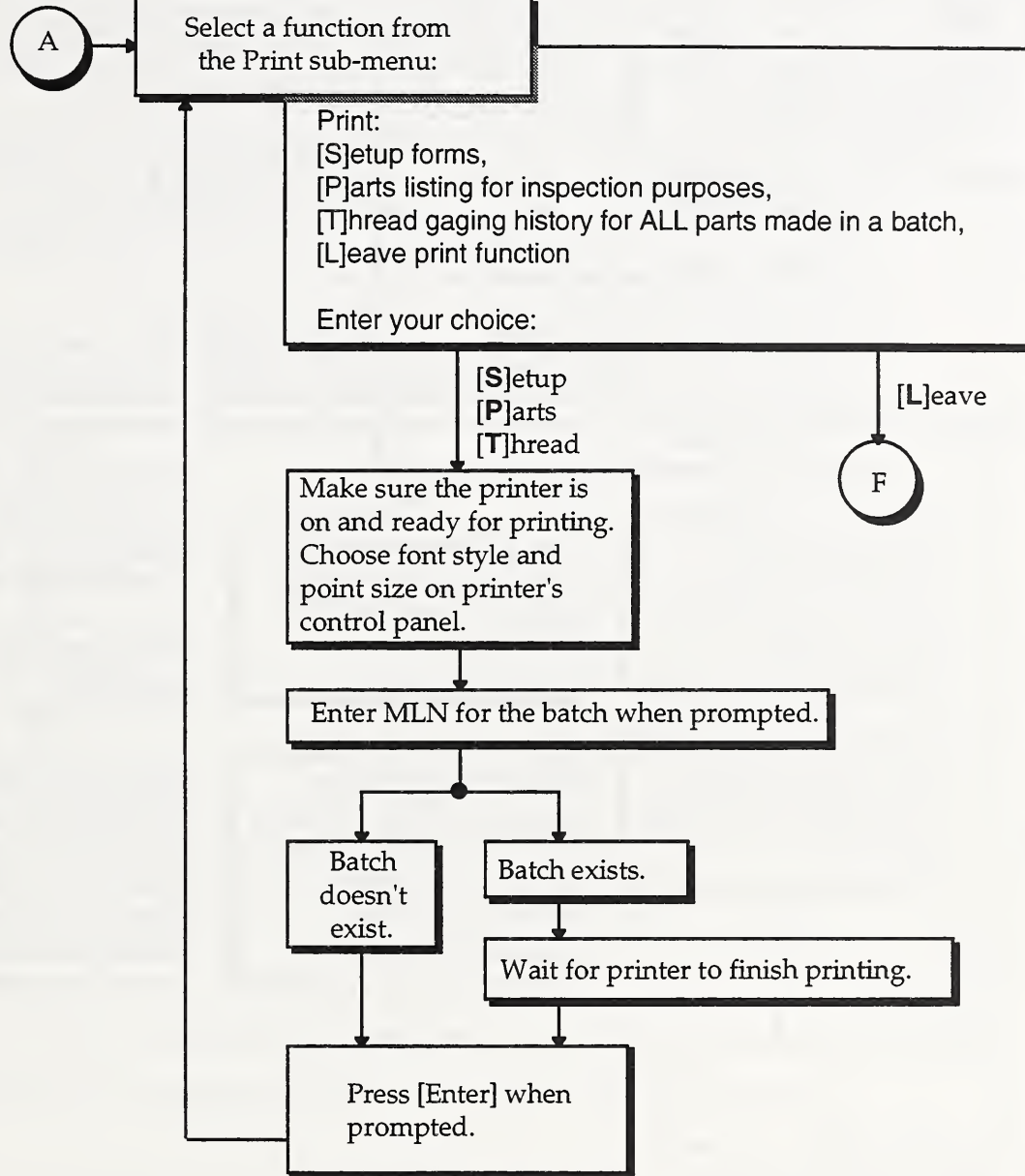
Use flow charts 5 and 6 to see what happens between the PFMW software and the Fanuc 11TT controller as the fasteners are being made. Use them as a guide when machining fasteners. On page 55 is a table of definitions for items used in the flow charts.

When a path in a flow chart leads to a circle with a letter in it, look in the other flow charts for the matching letter. The path continues from there.
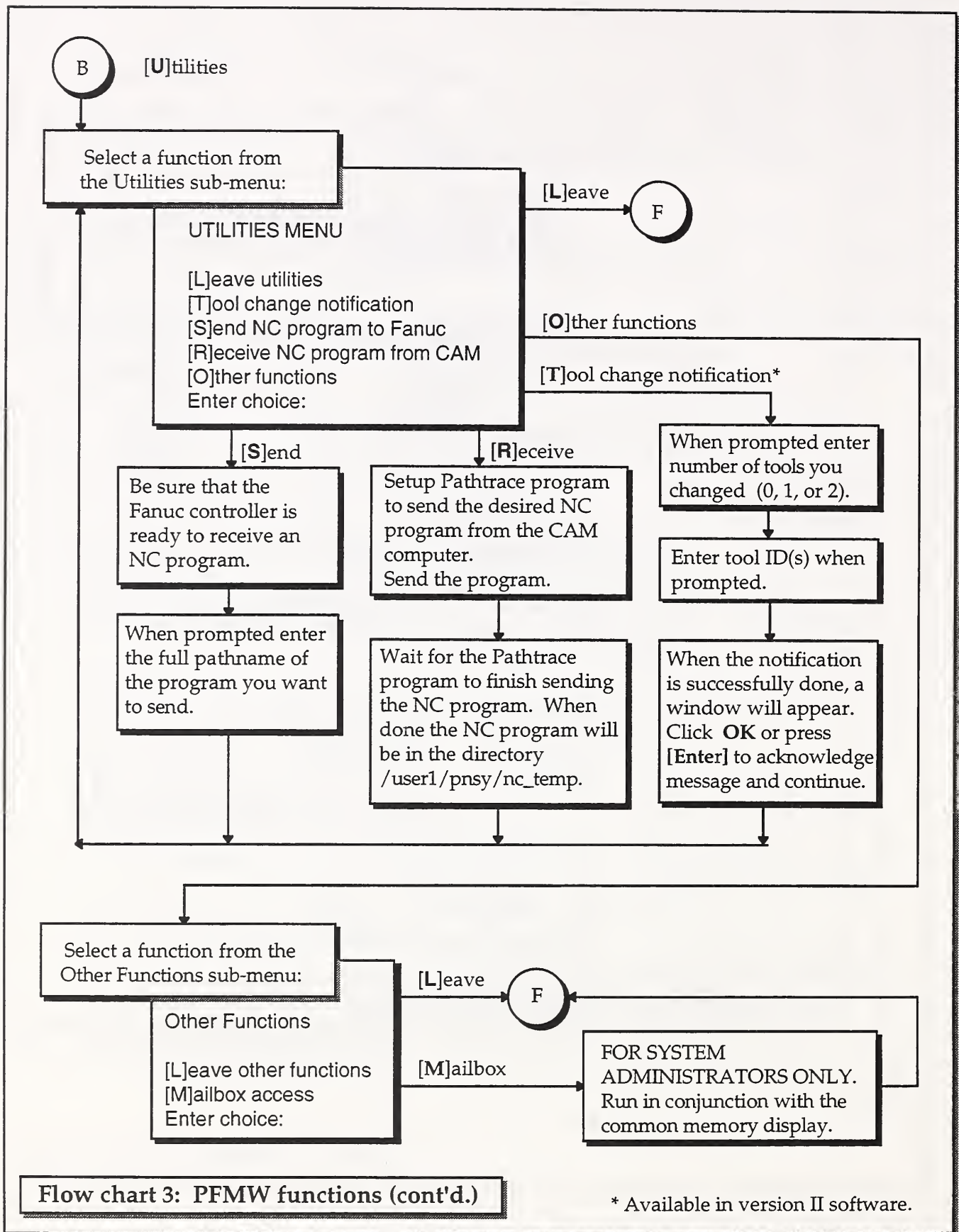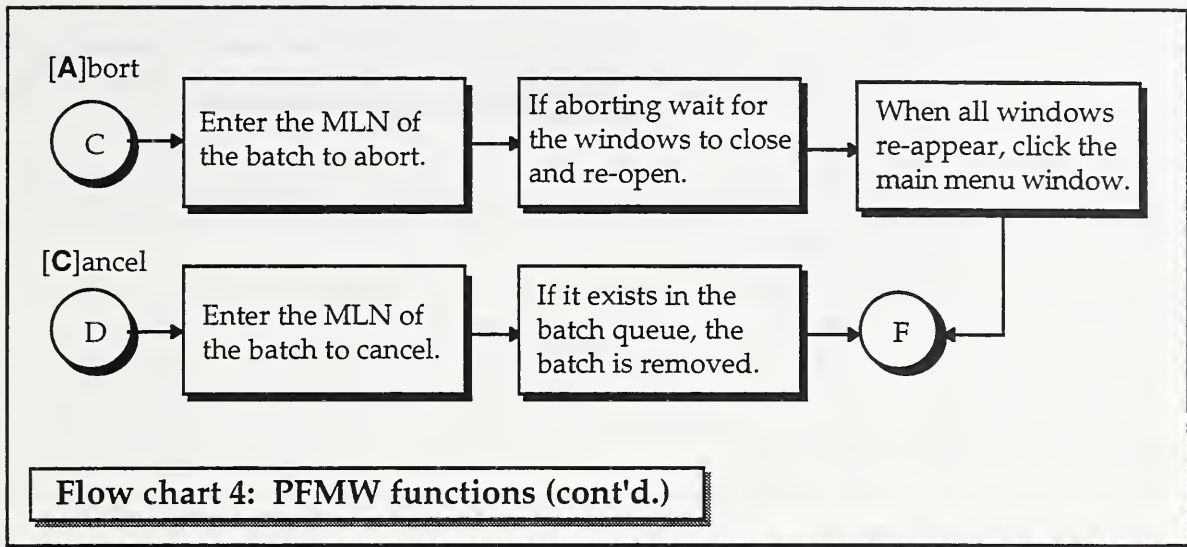
START

Login & wait for software to start - OR - double click icon to start software.

Select a function from the main menu:

MAIN MENU

[Q]uit session
[O]rder a batch
[L]ist batches
[S]tart a batch
[C]ancel a batch in queue
[A]bort a running batch
[P]rint batch setup forms/gaging reports
[U]tilities

Enter your choice:

[P]rint → A

[U]tilities → B

[A]bort → C

[C]ancel → D

[Q]uit

Sure? — no

yes

END

[O]rder

[L]ist

Batch queue is displayed.

Press [Enter] when done reading.

[S]tart

Enter the MLN of the batch to start.

Batch exists.

Batch is not in the queue.

Set up workstation equipment.

Use the mouse to activate the data base window. Wait for the order form to appear.

Fill in the order form with batch information.

Save information ? — no

Press function key F5.

yes

Press function key F4 to save the form.

Press [Enter] or click on OK at the pop-up window that says the batch was not saved.

Click the main menu window.

If you want a print-out of the order form & tool list, enter Y at the main menu prompt.

Click the main menu window

When done setting up, click on the OPERATOR_TASK window .

Click the OK button or press [Enter].

Re-activate the main menu window, and start machining the parts. See flow chart #5.

F

Flow chart 1: PFMW Functions.

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[P]rint

(A) Select a function from
the Print sub-menu:

Print:
[S]etup forms,
[P]arts listing for inspection purposes,
[T]hread gaging history for ALL parts made in a batch,
[L]eave print function

Enter your choice:

[S]etup
[P]arts
[T]hread

[L]eave

(F)

Make sure the printer is
on and ready for printing.
Choose font style and
point size on printer's
control panel.

Enter MLN for the batch when prompted.

Batch
doesn't
exist.

Batch exists.

Wait for printer to finish printing.

Press [Enter] when
prompted.

Flow chart 2: PFMW functions (cont'd.)

B → [**U**]tilities

Select a function from
the Utilities sub-menu:

UTILITIES MENU

[L]eave utilities
[T]ool change notification
[S]end NC program to Fanuc
[R]eceive NC program from CAM
[O]ther functions
Enter choice:

[**L**]eave → **F**

[**O**]ther functions

[**T**]ool change notification*

[S]end

Be sure that the
Fanuc controller is
ready to receive an
NC program.

When prompted enter
the full pathname of
the program you want
to send.

[R]eceive

Setup Pathtrace program
to send the desired NC
program from the CAM
computer.
Send the program.

Wait for the Pathtrace
program to finish sending
the NC program. When
done the NC program will
be in the directory
/user1/pnsy/nc_temp.

When prompted enter
number of tools you
changed (0, 1, or 2).

Enter tool ID(s) when
prompted.

When the notification
is successfully done, a
window will appear.
Click **OK** or press
[**Enter**] to acknowledge
message and continue.

Select a function from the
Other Functions sub-menu:

Other Functions

[L]eave other functions
[M]ailbox access
Enter choice:

[**L**]eave → **F**

[**M**]ailbox

FOR SYSTEM
ADMINISTRATORS ONLY.
Run in conjunction with the
common memory display.

Flow chart 3: PFMW functions (cont'd.)

* Available in version II software.

[**A**]bort

(C) → Enter the MLN of the batch to abort. → If aborting wait for the windows to close and re-open. → When all windows re-appear, click the main menu window.

[**C**]ancel

(D) → Enter the MLN of the batch to cancel. → If it exists in the batch queue, the batch is removed. → (F)

Flow chart 4: PFMW functions (cont'd.)

For flow charts 5 and 6:

```
#558 = 20    (ROUGH TURN)
#560 = 30    (CENTER DRILL END)
#562 = 10    (FINISH TURN)
#564 = 20    (THREAD RELIEF - SPUDS)
#566 = 10    (ROUGH THREAD)
#568 = 10    (FINISH THREAD)
#570 = 12    (CENTER DRILL - NYLOC EX. STUD)
#572 = 12    (DRILL- NYLOC EX. STUD)
#574 = 20    (DRILL- REMOVE STUD)
#576 = 50    (ROUGH MILL HEX)
#578 = 50    (FINISH MILL HEX)
#580 =  5    (CUTOFF)
#582 = 25    (FACE AND CHAMFER)
#584 = 20    (CENTER DRILL - CAPSCREW)
#586 = 20    (PILOT DRILL - CAPSCREW)
#587 = 0     (COUNTER OF PARTS COMPLETED)
#588 = 10    (PARTS TO BE MFG.)
#590 = 20    (DRILL FOR SOCKET - CAPSCREW)
#592 = 20    (COUNTERSINK - CAPSCREW)
#593 = 0-9   (THREAD GAGING METHOD)
#594 = 0/1   (NC STOP/RUN)
```

Even-numbered variables are estimated life (in terms of number of parts) of a tool.

The odd-numbered variables are the counters. In the NC programs the odd-numbered variables compare with values in the even-numbered variables to determine tooling change.

Odd-numbered variables are used to track tool wear and part completed, they will be incremented automatically under NC program control.

For every part :

SPC calculates tool offset adjustment, then sends it to Mach6 through mailboxes.

Mach6 gets offset value from the CNC, adds it to the SPC's recommendation and then downloads the sum to the offset table in the CNC controller.

```
C S    =   Cycle Start, when the NC program stops on a M00, CS is required to continue.
G C    =   Gage Controller
MACH6  =   Machine Controller
P D    =   Pitch Diameter
F D    =   Functional Diameter
```

Start

MACH6 downloads NC programs, variables & offsets, and sets variables #587 = 0, #588 = # of parts ordered.

If #587 = 0, operator CS NC program to cut part to major diameter and later gages thread inside machine.

If #587 > 0, CS is not needed. The NC program runs continuously and Mach6 tells the operator to gage PD & FD outside the machine and set #593 = 9. After Mach6 obtains PD & FD values from GC, it sets X-offset of threading tool of tool position 5 on head 2 and then sets #593 = 6.

NC program increments tooling variable when the corresponding operation is completed.

Part probe measures part diameter.

Is the diameter within tolerance? — NO / YES

Finishing tool cut diameter with correction.

NC program STOPPED. Operator installs new threading insert(s) and move back X-offset by +.005 of threading tool position 5 on head 2.

Operator gages PD & FD, cuts screw thread until the thread meets specs (.00075" larger than minimum PD).

Operator can
set #593 = 1, for recut;
= 2, for cutoff;
= 6, for good thread.

NC program checks variable #593

5 | 0 - 2 | 6 | 9

See flow chart #6

Second or greater part in the batch

Wait until gaging is completed. After gaging on outside of the machine, Mach6 sets #593 = 6.

E

Cut screw thread

If #587 = 0 or #593 = 5, operator CS NC program to cut the rest of the part, else CS not needed

Part completed and unloaded. NC program increments #587.

next part

SPC writes data in a file
1. X–offset of threading tool 5 on head 2
2. PD, FD, Bad part

If Mach6 recommends tool change, it sets #593 = 5, and if operators change a broken tool on their own, they have to set #593 = 5.

Flow chart 5: Machining fasteners

```
                    ┌─────────┐
                    │  0 - 2  │
                    └─────────┘
                         │
                         ▼
              ┌────────────────────────┐
              │  First part of the batch│
              │ (insert with known offset)│
              └────────────────────────┘
                         │
                         ▼
              ┌────────────────────────┐
              │     Cut Screw thread    │
              └────────────────────────┘
                         │
                         ▼
              ┌────────────────────────────┐
              │  M code M00 stops NC program│
              └────────────────────────────┘
                         │
                         ▼
              ┌────────────────────────────┐
              │ Operator gages PD & FD in the machine│
              └────────────────────────────┘
                         │
                         ▼
              ┌────────────────────────────┐
              │ Using the information from GC, Mach6 │
              │ determines which procedure for NC to │
              │ execute by setting variable #593 =   │
              └────────────────────────────┘
                 0          1          2
```

PD & FD are within specs

PD is oversize. Mach6 adjusts x-offset of tool 5 on head 2. Operator CS NC prog

After CS

PD is undersize or PD is within tolerance, but FD is out of tolerance, therefore cutoff bad part.

E

Flow chart 6: Machining fasteners (cont'd.)

P.N.S.

APPENDIX B

List of generic NC programs for fasteners.

Listed here are the current NC program pathnames and manufacturing specification names used for the parts made by the workstation. The pathnames indicate where the programs are stored in the computer.

When filling in the order form to order a batch, be sure to type in the manufacturing specification exactly as shown in this list (including spaces and punctuation).

FASTENER TYPE: BOLT
NC PROG - HD1:   /user1/pnsy/fanuc_nc/nc_5921
NC PROG - HD2:   /user1/pnsy/fanuc_nc/nc_5922
MANUFACTURE SPECIFICATION: ANSI B18.2.1 TABLE 2

FASTENER TYPE: BOLT
NC PROG - HD1:   /user1/pnsy/fanuc_nc/nc_5921
NC PROG - HD2:   /user1/pnsy/fanuc_nc/nc_5922
MANUFACTURE SPECIFICATION: ANSI B18.2.1 TABLE 4

FASTENER TYPE: BOLT
NC PROG - HD1:   /user1/pnsy/fanuc_nc/nc_5931
NC PROG - HD2:   /user1/pnsy/fanuc_nc/nc_5932
MANUFACTURE SPECIFICATION: PL 2104657

FASTENER TYPE: BOLT
NC PROG - HD1:   /user1/pnsy/fanuc_nc/nc_5921
NC PROG - HD2:   /user1/pnsy/fanuc_nc/nc_5922
MANUFACTURE SPECIFICATION: MIL-B-857A TABLE VI

FASTENER TYPE: BOLT
NC PROG - HD1:   /user1/pnsy/fanuc_nc/nc_5921
NC PROG - HD2:   /user1/pnsy/fanuc_nc/nc_5922
MANUFACTURE SPECIFICATION: MIL-B-857A TABLE VII

FASTENER TYPE: BOLT
NC PROG - HD1:   /user1/pnsy/fanuc_nc/nc_5921
NC PROG - HD2:   /user1/pnsy/fanuc_nc/nc_5922
MANUFACTURE SPECIFICATION: MIL-B-857A TABLE VIII

FASTENER TYPE: CAPSCREW
NC PROG - HD1:   /user1/pnsy/fanuc_nc/nc_5901
NC PROG - HD2:   /user1/pnsy/fanuc_nc/nc_5902
MANUFACTURE SPECIFICATION: ANSI B18.3 TABLE 1

FASTENER TYPE: STUD
NC PROG - HD1:   /user1/pnsy/fanuc_nc/nc_5911
NC PROG - HD2:   /user1/pnsy/fanuc_nc/nc_5912
MANUFACTURE SPECIFICATION: NEW CONST. PL 2104656

FASTENER TYPE: STUD
NC PROG - HD1:   /user1/pnsy/fanuc_nc/nc_5911
NC PROG - HD2:   /user1/pnsy/fanuc_nc/nc_5912
MANUFACTURE SPECIFICATION: REWORK PL 2104655

FASTENER TYPE: STUD
NC PROG - HD1:   /user1/pnsy/fanuc_nc/nc_5911
NC PROG - HD2:   /user1/pnsy/fanuc_nc/nc_5912
MANUFACTURE SPECIFICATION: MIL-S-1222H

APPENDIX C

Sample order form information.

This appendix contains sample order form information for each type of fastener made in the workstation. Use this as a guide for ordering a batch.

Sample bolt order form:

```
┌─────────────────────────────────────────────────────────────────────────┐
│ ┌───────────────────────────────────────────────────────────────────┐   │
│ │ ▭          DATA_BASE                                      ▫  │ □ │   │
│ ├───────────────────────────────────────────────────────────────────┤   │
│ │                      ORDER INFORMATION                            │   │
│ │                                                                    │   │
│ │          SWI: 00AZ                 DATE: 17-mar-1992 18:34:14      │   │
│ │    JOB ORDER: 6091248581                                          │   │
│ │       KEY OP: 001           OPERATOR ID: 29516                    │   │
│ │    KEY EVENT: UNDK                                                 │   │
│ │ NUMBER OF PIECES?: 10                MLN: Z444                     │   │
│ │      LEVEL 1 #: KMAD9104-201A                                      │   │
│ │                                                                    │   │
│ │               FASTENER TYPE:  BOLT                                 │   │
│ │                                                                    │   │
│ │  NOMINAL DIAMETER: 0.8750      TPI: 9   THREAD SERIES: UNC         │   │
│ │     THREAD CLASS: 2                           LENGTH: 4.0000       │   │
│ │    MATERIAL TYPE: KMONEL            STOCK DIAMETER: 1.5000         │   │
│ │                                            NYLOCK?: N              │   │
│ │                                                                    │   │
│ │  GAGE SAMPLING PERIOD: 1                                           │   │
│ │  MANUFACTURE SPECIFICATION:  PL 2104657                           │   │
│ │                                                                    │   │
│ │  COMMENTS:                                                         │   │
│ │                                                                    │   │
│ │  SAVE_ORDER(F4)        QUIT(F5)                                    │   │
│ └───────────────────────────────────────────────────────────────────┘   │
└─────────────────────────────────────────────────────────────────────────┘
```

Sample capscrew order form:

```
┌─────────────────────────────────────────────────────────────────┐
│ ┌───────────────────────────────────────────────────────┬──┬──┐ │
│ │ ▭               DATA_BASE                              │ ▫│ ☐│ │
│ ├───────────────────────────────────────────────────────┴──┴──┤ │
│ │                  ORDER INFORMATION                           │ │
│ │                                                              │ │
│ │          SWI: 00ZZ                 DATE: 17-mar-1992 18:34:14 │ │
│ │    JOB ORDER: 6091248581                                     │ │
│ │       KEY OP: 001          OPERATOR ID: 29516                │ │
│ │    KEY EVENT: UNDK                                           │ │
│ │ NUMBER OF PIECES?: 10              MLN: Z222                  │ │
│ │      LEVEL 1 #: KMAD9104-201A                                │ │
│ │                                                              │ │
│ │                                                              │ │
│ │            FASTENER TYPE:  CAPSCREW                          │ │
│ │                                                              │ │
│ │                                                              │ │
│ │ NOMINAL DIAMETER: 0.7500    TPI: 10   THREAD SERIES: UNC     │ │
│ │    THREAD CLASS: 3                          LENGTH: 4.0000   │ │
│ │   MATERIAL TYPE: KMONEL             STOCK DIAMETER: 1.2500   │ │
│ │                                            NYLOCK?: N        │ │
│ │                                                              │ │
│ │ GAGE SAMPLING PERIOD: 1                                      │ │
│ │ MANUFACTURE SPECIFICATION:  ANSI  B18.3 TABLE 1              │ │
│ │                                                              │ │
│ │ COMMENTS:                                                    │ │
│ │                                                              │ │
│ │                                                              │ │
│ │ SAVE_ORDER(F4)        QUIT(F5)                               │ │
│ └──────────────────────────────────────────────────────────────┘ │
└─────────────────────────────────────────────────────────────────┘
```

Sample stud order form:

```
┌─────────────────────────────────────────────────────────────────┐
│┌────────────────────────────────────────────────────────────────┤
││ ▭            DATA_BASE                            ▫  □           │
│├────────────────────────────────────────────────────────────────┤
││                  ORDER INFORMATION                              │
││                                                                 │
││        SWI: 00AI                 DATE: 17-mar-1992 18:34:14      │
││  JOB ORDER: 6091248581                                          │
││     KEY OP: 001           OPERATOR ID: 29516                    │
││  KEY EVENT: UNDK                                                │
││ NUMBER OF PIECES?: 23               MLN: P567                   │
││    LEVEL 1 #: KMH6335-211A                                      │
││                                                                 │
││             FASTENER TYPE:  STUD                                │
││                                                                 │
││ NOMINAL DIAMETER: 0.6250     TPI: 11   THREAD SERIES: *         │
││     THREAD CLASS: *                         LENGTH: 3.5000      │
││    MATERIAL TYPE: KMONEL           STOCK DIAMETER: 0.7500       │
││                                         NYLOCK?: N              │
││                                                                 │
││ GAGE SAMPLING PERIOD: 1                                         │
││ MANUFACTURE SPECIFICATION:  MIL-S-1222H                         │
││ COMMENTS:                                                       │
││                                                                 │
││                                                                 │
││ SAVE_ORDER(F4)        QUIT(F5)                                  │
│└────────────────────────────────────────────────────────────────┤
└─────────────────────────────────────────────────────────────────┘
```

Sample stud order form (cont'd.):

```
┌─────────────────────────────────────────────────────────────┐
│┌──────────────────────────────────────────────────────────┐ │
││ □              DATA_BASE                          □  □    │ │
│├──────────────────────────────────────────────────────────┤ │
││                                                          │ │
││              ORDER INFORMATION                           │ │
││                                                          │ │
││        SWI: 00AI              DATE: 17-mar-1992 18:34:14  │ │
││   JOB ORDER: 6091248581                                  │ │
││     KEY OP: 001          OPERATOR ID: 29516              │ │
││   KEY EVENT: UNDK                                        │ │
││ NUMBER OF PIECES?: 23            MLN: P567               │ │
││     LEVEL 1 #: KMH6335-211A                              │ │
││                                                          │ │
││            FASTENER TYPE:  STUD                          │ │
││                                                          │ │
││  NOMINAL ┌────────────────────────────────────────────┐ │ │
││    THRE  │            STUD INFORMATION                 │ │ │
││    MATE  │ TYPE: IV                                    │ │ │
││         │ HARDNESS: HF                                │ │ │
││ GAGE SAMPL│ STYLE: C                                   │ │ │
││ MANUFACTU│ NUT THREAD CLASS: 2  NUT THREAD SERIES: UNC│ │ │
││ COMMENTS: │ SET THREAD CLASS: 2  SET THREAD SERIES: UNC│ │ │
││         └────────────────────────────────────────────┘ │ │
││                                                          │ │
││                                                          │ │
││  SAVE_ORDER(F4)      QUIT(F5)                            │ │
││                                                          │ │
│└──────────────────────────────────────────────────────────┘ │
└─────────────────────────────────────────────────────────────┘
```

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APPENDIX D

Computer shutdown procedure

FOR SYSTEM ADMINISTRATORS ONLY!

When the operator has completed his shift, he should first log out. Logging out will bring the computer down to the "login:" prompt. Then the following shutdown procedures are performed when the computer must be turned off.

1. Be sure that all users have logged out.

2. Login as the super user (root) on multiscreen **F1** of the console.

3. Type in: **shutdown -g0 -y**

4. The computer will proceed to shutdown its services.

5. When it is done, a message will appear that it is safe to power down.

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APPENDIX E

Diagnostics mode enabler instructions

FOR SYSTEM ADMINISTRATORS ONLY! The diagnostic mode option of the help program allows the system administrator to observe the TCC and MACH6 processes' activities. It allows debugging of the processes' state tables. This mode is used mainly during the development stage and is not needed during debugging of normal workstation operations.

To use the diagnostics mode, press **D** at the first-aid kit menu prompt (this menu is brought up by double clicking on the PFMW-HELP icon). You will get the following menu:

> Choose a process:
>
> [1] tcc
> [2] mach
> [Q]uit
>
> Enter choice:

If you want to turn on the diagnostics mode for the TCC process, type **1**. If you want to turn on the diagnostics mode for the MACH6 process, type **2**. Type **Q** if you want to return to the first aid kit menu.

If you choose the diagnostics for the TCC process, you will be prompted with the following:

> Which type of diagnostics
> do you want?
> [1]   Turn on the interactive
>   diagnostics mode
> [2] Toggle on/off the
>   non-interactive
>   diagnostics display
> [Q]uit
> Enter your choice:

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The first option will cause TCC to display all diagnostic information - i.e., the mailgram numbers, message numbers, echo command numbers, and the accompanying messages that are sent to and received by the TCC process. This option also allows you to see what is in the state table that the process is running, where in the state table the process is running, and what step the program is currently performing. This diagnostic mode was useful in the development stage of the program and is not needed in normal debugging situations. It allows you to have complete control over the execution of TCC's algorithm. To use this option, press **1** at the prompt.

The second option allows you to turn on or off the non-interactive display. Having the non-interactive display on allows you to see the commands and statuses sent to the TCC and what commands/statuses the TCC sends out. It does not allow you to control the execution of the program. This is the default diagnostic mode. Normally, the TCC program is iconified and is not displayed on the monitor screen. To see the display, click on the TCC icon to bring the window out to the screen.

If you choose the diagnostics mode for the MACH6 process you will have turned on the interactive diagnostics mode. This is the same as for the TCC process. You will have complete control over MACH6's execution and be able to see where in the state table MACH6 is running, where in the program MACH6 is, etc.

Under normal operations the diagnostics mode is not needed. It remains in the first-aid kit as a development tool and should be used for that purpose.
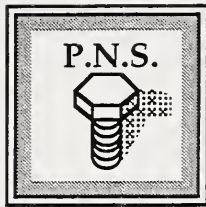
APPENDIX F

Mailbox names and identification numbers

FOR SYSTEM ADMINISTRATORS ONLY! This appendix lists the mailbox names
and their corresponding ID numbers. This list is used in conjunction with the
Mailbox Access program in the Utilities program for diagnostic purposes.

MAILBOX NAME	MAILBOX ID NUMBER
TCC_WSC_COM	0
TCC_WSC_STAT	1
TCC_MACH_COM	2
TCC_MACH_STAT	3
TCC_DB_COM	4
TCC_DB_STAT	5
TCC_OP_COM	6
TCC_OP_STAT	7
TCC_SPC_COM	8
TCC_SPC_STAT	9
MC_OP_COM	10
MC_OP_STAT	11
MC_DB_COM	12
MC_DB_STAT	13
SPC_DB_COM	14
SPC_DB_STAT	15
WSC_DB_COM	16
WSC_DB_STAT	17
*WSC_SPC_COM	18
*WSC_SPC_STAT	19

* Not currently used in the software version dated June 1992. Implemented in version II.

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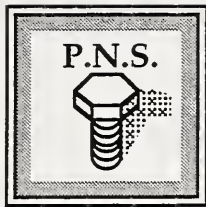
APPENDIX G

Process commands and statuses

FOR SYSTEM ADMINISTRATORS ONLY! This appendix contains the commands and corresponding statuses used by the processes to communicate with each other. They all use the same format. Use the Mailbox Access option of the utilities program to send or read mailbox messages. When you use the Mailbox Access option, the formatting is done automatically - just enter the message information as the program asks for them. Refer to "The Utilities Program" section for instructions on using this option.

COMMANDS

In TCC_WSC_COM:
"make_parts"   Begin making the parts in the batch specified. Include the number of parts to make as a parameter.
"abort"   Abort the (currently running) batch specified.

In WSC_DB_COM:
"coll_info"   Collect order information to order a batch. No MLN is specified - there is none. The MLN and other information is returned in the status message.
"print_rpt"   Print out the order form and setup data.
"cancel"   Remove the specified, not started batch from the queue.
"stop_db"   Tell the database to stop running.
"abort"   Mark the currently running batch as aborted.

In TCC_DB_COM:
"put_data"   Update the database with the current batch data - after a part is made, TCC indicates that one part was made and whether or not it is a good one.

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In TCC_OP_COM:

"measure"   Tell the operator to measure the part threads.
"setup"   Tell the operator to setup the equipment.
"change"   Tell the operator to change the finish threading tool.

In TCC_SPC_COM:

"spc_gage"   Tell Johnson Gage software to do thread measurement.
"setup"   Tell SPC to start up Johnson Gage software.
"quit"   Notify SPC of the end of batch.
"tool_chg"   Notify SPC that a tool was changed. Include number of tools
                   changed (1), and the tool ID of the finish threading tool. (To be
                   implemented in version II software.)

In TCC_MACH_COM:

"setup"   Tell machine controller to get batch information.
"mk_blnk1"   Tell machine controller to make first part.
"make_blank"   Tell machine controller to start next part.
"fin_blank"   Tell machine controller to finish current part.
"change"   Tell machine controller to change the finish thread tool and
                   finish machining the current part.
"data"   Give machine controller the offset for the last part made in the
                   batch.

In MC_DB_COM:

"get_data1"   Retrieve batch execution information.
"get_data2"   Retrieve batch execution information.

In MC_OP_COM:

"execute"   Tell operator to press the cycle start button.

In WSC_SPC_COM:

"tool_chg"   Notify the SPC of a finish threading or turning tool change (or
                   both). Number of tools changed and tool IDs are included as
                   parameters. (To be implemented in version II.)

STATUSES

In TCC_WSC_STAT:

"make_parts" command:
      "busy"   Acknowledge command & currently running the batch.
      "done"   Finished running the batch.
      "error"   Error occurred when running the batch.

"abort" command:
      "busy"   Acknowledge batch abort command & aborting.
      "done"   Finished aborting batch.
      "error"   Error occurred when aborting the batch.

In WSC_DB_STAT:

"coll_info" command:
      "busy"   Acknowledge command & collecting order information.
      "done"   Finished collecting order information. Information returned.
      "error"   Error occurred in order form.

"print_rpt" command:
      "busy"   Acknowledge command & working on printing.
      "done"   Finished printing.
      "error"   Error condition.

"cancel" command:
      "busy"   Acknowledge command & cancelling.
      "done"   Finished cancelling batch.
      "error"   Error condition.

"stop_db" command:
      "busy"   Acknowledge command.
      "done"   Stopped running the database - terminated.
      "error"   Error condition.

"abort" command:
      "busy"   Acknowledge abort command.
      "done"   Finished marking batch aborted in database.
      "error"   Error condition.

In WSC_SPC_STAT:

"tool_chg" command: (To be implemented in version II software.)
        "done"   Tool change notification acknowledged.
        "error"   Command not understood.

In MC_DB_STAT:

"get_data1" command:
        "busy"   Acknowledge command & getting data.
        "done"   Data retrieved.
        "error"   Error condition.

"get_data2" command:
        "busy"   Acknowledge command & getting data.
        "done"   Data retrieved.
        "error"   Error condition.

In MC_OP_STAT:

"execute" command:
        "done"   Command acknowledged.
        "error"   Command not understood.

In TCC_OP_STAT:

"measure" command:
        "done"   Measure command acknowledged & done measuring.
        "error"   Error condition.

"setup" command:
        "done"   Setup command acknowledged & done setting up.
        "error"   Error condition.

"change" command:
        "done"   Change tool command acknowledged & done changing tool.
        "error"   Error condition.

In TCC_SPC_STAT:

"spc_gage" command:
      "in"   The threads were measured and were found to be within specifications. Includes offset data.
      "change"   The threads were measured and were found to be within specifications but change the finish threading tool before machining the next part. Includes offset data.
      "chg_bad"   The threads were measured and were found to be out of specifications. Also change the finish threading tool before machining the next part.
      "bad"   The threads were measured and were found to be out of specifications.
      "data"   Only offset data returned. No judgment on thread quality.
      "error"   Error condition. Specify which type.

"setup" command:
      "done"   Finished setting up.
      "error"   Error condition.

"quit" command:
      "done"   Finished quitting.
      "error"   Error condition.

"tool_chg" command: (To be implemented in version II software.)
      "done"   Tool change acknowledged.
      "error"   Error condition.

In TCC_MACH_STAT:

"setup" command:
      "busy"   Started setting up machine tool.
      "done"   Finished setting up machine tool.
      "error"   Error condition.

"change" command:
      "busy"   Started changing tool and machining second half of part.
      "done"   Done changing tool and machining.
      "error"   Error condition.

"fin_blank" command:
      "busy"   Started machining second half of part.
      "done"   Done machining second half of part.

"error"   Error condition.

"make_blank" command:
         "busy"   Started machining first half of part.
         "done"   Done machining first half of part.
         "error"   Error condition.

"mk_blnk1" command:
         "busy"   Started machining first part.
         "done"   Done machining first part.
         "error"   Error condition.

"data" command:
         "done"   Command and data accepted.
         "more"   Expecting more data.
         "error"   Error condition.

In TCC_DB_STAT:

"put_data" command:
         "busy"   Acknowledge command & storing data.
         "done"   Data stored.
         "error"   Error condition.

P.N.S.

APPENDIX H

Thread gaging device instructions

The thread characteristics of the fasteners are measured by a variable gaging system which meets the requirements of System 22 as outlined in ANSI/ASME Standard B1.3M and MIL-S-1222H. Two of the attributes, pitch diameter and functional size (functional diameter) of the UNC threads on the fasteners, are measured by digital gaging devices from the Johnson Gage Company. Pitch diameter is measured using the model CHF roll-type comparator, while the functional size is measured by model BHF ring-snap thread comparators. These comparators (from now on referred to as gages) must be carefully handled during usage and periodically maintained and calibrated in order for them to achieve a long life and high degree of repeatability.

The hand-held gaging devices used in the workstation, either pitch diameter or functional size, consist of a gaging frame and handle, an electronic indicator, segment elements, and a corresponding master setting plug. The particular thread attribute measured by the gaging device is displayed on a digital indicator. The reading can also be transmitted electronically to the workstation control computer via an RS-232 serial link through an interface adapter by the actuation of the foot switch. The workstation control computer reads the gaging data only when the PFMW workstation controller software is running.

Adjustments and Calibration of the Gaging Devices

The gaging device must be calibrated periodically by an approved laboratory, based on the gage manufacturer's procedures and recommendations. Refer to the "Johnson External Thread Gaging Element Calibration System" manual, under "Procedure for the Inspection and Calibration of All Johnson Roll-type Thread Contact Units" for details in Appendix I. The master thread-setting plug contact force is set between 2.5 to 3 pounds, according to the manufacturer's recommendation. Refer to the setting instructions, item XIII, for gaging pressure adjustment information in Appendix I.

Gaging Device Use

Before performing thread measurements on a group of parts, use the corresponding master thread-setting plug to set or check the gages. To set the gage indicator, place the segment portion of the gage over the threaded portion of the master plug and rotate the master plug back and forth to be sure that the gaging segments seat firmly on the threads. Then press the button on the electronic indicator to "zero" the reading. Open the segments and remove the master plug.

The gage is ready to be used for measurement. The segments on the gaging device must be cleaned with a cylindrical brush before use. Any debris on the segments will cause faulty readings. Refer to the Johnson Gage manuals for information on cleaning the segments.

Electronic Indicator

The electronic indicator has a digital read-out unit with a resolution of 2.5 micrometers (one ten-thousandth of an inch). The indicator is powered either by the interface adaptor or one 3.4 volt lithium battery (model EBY-01011) in the indicator. If the electronic indicator's output to the interface adaptor is disconnected, it is automatically switched to battery power. The hand-held gages can be used in the turning center with its cable detached from the interface adaptor for local manual operation. Operating in this manner, the gage reading can not be transmitted to the PFMW workstation control computer.

Under normal use, the battery should last about six to eight months. The battery can be accessed by removing the four screws that secure the back cover of the indicator.
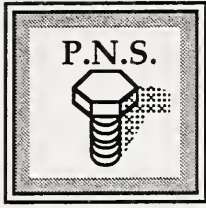
APPENDIX I

Johnson Gage instruction manuals

The contents of this appendix was supplied by the manufacturer and is reprinted with their written consent.

COMPONENTS FOR:

GROUP "B" - EXTERNAL/PORTABLE/FIXED SIZE
JOHNSON RING-SNAP THREAD COMPARATOR

SEGMENT-INTERCHANGEABLE
FOR DIFFERENT THREAD SIZES WITHIN RANGE SHOWN

BHF/1B — #10   to .500"
BHF/2B — .501" to .750"

BHF/3B — .751" to 1.000"
BHF/4B — 1.001" to 1.250"

BHF/5B — 1.251" to 1.500"
BHF/6B — 1.501" to 1.750"

BHF/7B — 1.751" to 2.000"
BHF/8B — 2.001" to 2.375"

BHF/9B — 2.376" to 2.750"
BHF/10B — 2.751" to 3.000"

1.   Pressure Adjusting Screw
2.   Dial Indicator
3.   Dial Indicator Guard
4.   Pivot Arm Stop Screw
5.   Setting Master
6.   Segments
7.   Retaining Screws (Locking Type)
8.   Indicator Guard Screws
9.   Gage Frame
10. Pivot Arm
11. Indicator Locking Screw
12. Segment Anti-Pivoting Cams

Reference: Drawing No. SA-80

SETTING INSTRUCTIONS FOR:

GROUP "B" - EXTERNAL/PORTABLE/FIXED SIZE
JOHNSON RING-SNAP SEGMENT THREAD COMPARATOR
(SERIES "BHF")

I.   Install appropriate Segments (6) as follows:

   A.   Be sure both Segments (6) have identical three letter coding

   NOTE: Segments having Flat Side Identification Marking should be facing toward front of gage.

   B.   Install Segments (6) on to stud with ledge toward frame.

   C.   Install Locking-Type Retaining Screws (7): Segments should be able to rotate on Studs with slight resistance.

II.   On a flat surface, rest the comparator horizontally on its ground qualification pads with the Segments in an "up" position. Maintain Comparator in this position throughout Steps 4A (a-h) and 4B (a-j).

III.   Place GO full-form portion of Setting Master (5) in Segments, oscillating to seat plug in Segments. Front surfaces of Segments should be approximately in line. Be sure gage is not cross-threaded on master.

   NOTE: Check Pressure Adjusting Screw (1). Pressure should be just enough to seat plug firmly in Segments (6).

IV.   Preliminary setting of segments with different configurations/shapes:

   A.   For Segments (6) having flat sides:

      1.   Align front surfaces of segments (6) utilizing a scale or other suitable flat piece.

      2.   While maintaining alignment and with GO full-form portion of Setting Master still engaged, tighten Locking-Type Retaining Screws (7) against top face of Segment.

      3.   Rotate Lock Cams (12) to touch Segment Ledge. Lock Cams (12) in place with Cam Lock Screw.

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4.   Tighten Locking-Type Retaining Screws (7) to final tension.

5.   Tighten screw in Pivot Arm Segment against its mounting stud.

6.   Oscillate GO full-form Set Master in Segments to assure proper seating. Tighten screw in frame against its mounting stud.

7.   Assemble Dial Indicator (2) into hole provided in gage frame (9). Move Dial Indicator (2) in until contact is made with Pivot Arm (10) and a zero/zero position is achieved on the Indicator Hand and the Revolution Counter.

8.   Tighten Indicator Locking Screw (11).

B.   For Segments with a Crescent Shape

1.   Assemble Dial Indicator (2) into hole provided in Gage Frame (9). Move Dial Indicator (2) in until contact is made with pivot arm (10) and a zero/zero position is achieved on the Indicator Face and the Revolution Counter.

2.   Tighten Indicator Locking Screw (11).

3.   Loosen Locking-Type Retaining Screws (7) and pivot Setting Master and Segments to high point in Dial Indicator (2).

4.   While maintaining high point and with GO full-form portion of setting plug still engaged, tighten Locking-Type Retaining Screws (7) against top face of Segments.

5.   Rotate Lock Cams to touch Segment Ledge. Lock Cams (12) in place with Cam Lock Screw.

6.   Tighten Locking-Type Retaining Screws (7) to final tension.

7.   Tighten screw in Pivot Arm Segment against its mounting stud.

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8. Oscillate GO full-form Set Master in Segments to assure proper seating. Tighten Screw in Frame Segment against its Mounting Stud.

9. Move Dial Indicator (2) until a zero/zero position is achieved on the Indicator Hand and the Revolution Counter.

10. Tighten Indicator-Locking Screw (11).

V.   With Setting Master (5) engaged in Segments (6), move Pivot Arm Stop Screw (4) in until contact is made with Pivot Arm (10) and Dial Indicator Hand moves one dial graduation.

VI.   Remove Setting Master (5) and release Pivot Arm (10).

VII. Move Pivot Arm Stop Screw (4) out until Indicator Hand moves 1/2 revolution to a 6 o'clock position. This provides for gage "undertravel".

VIII. Lock Pivot Arm Stop Screw (4) with Locking Screw (11).

IX.   Place Setting Master (5) back into Segments (6). During this final stage of setting the Comparator, the Master Thread Setting Plug must be fixtured on a Mounting Stand or some other suitable device so that the entire weight of the gage rests on the Setting Plug.

X.   With GO Setting Master engaged in Segments (6), set Dial Indicator Tolerance Hands where ZERO equals MAXIMUM MATERIAL (GO). Set other Tolerance Hand at MINUS Tolerance according to Pitch Diameter tolerance for product part.

XI.   Remove Set Master from Comparator.

XII. Re-check Comparator setting by re-engaging Comparator and Set Plug. Re-Set as may be required. At this point, it may be helpful to hold the Setting Master Plug on a sturdy Mounting Stand, so that when setting, the entire weight of the gage is on the master, thereby duplicating the actual manner in which the gage will be used.

XIII. Gaging pressure is adjusted with Knurled Knob (1) - clockwise to increase, counter-clockwise to decrease. Re-check Comparator Setting after gaging pressure is changed.

OPERATING INSTRUCTIONS FOR:

GROUP "B" - EXTERNAL/PORTABLE/FIXED SIZE
JOHNSON RING-SNAP SEGMENT THREAD COMPARATOR

(SERIES "BH": MODELS "BH1F", "BH2F", AND "BH3F")

I   Place Segment portion of Gage over threaded part to be checked by compressing handle and Pivot Arm so as to open Segment portion of gage.

II   Rotate and Oscillate gage to:

    A)   Seat gaging elements firmly on part.

    B)   Check part for an OUT-OF-ROUND condition.

        Note: Observe reading to see if product part is within or outside of Indicator tolerance hands. Release pressure of handle and pivot arm gradually onto part.

III   Remove Gage from part by repeating Step #1.

MAINTENANCE

1.   Clean Segments occasionally with any cylindrical brush.2

2.   A light solvent, applied directly to the Segments will keep them clean.

3.   Check the Setting of the thread comparator occasionally with the setting plug to insure that the setting of the Dial Indicator has not changed.

4.   Visually check segments to be certain that no burrs, nicks, chips, etc..., are present in the Segments.

DETERMINING WEAR ALLOWANCES ON SEGMENTS

1.   Place truncated portion of GO Setting Plug into Thread Comparator. Set Dial Indicator to ZERO. Remove truncated portion and engage full form portion of GO Setting Plug. Observe reading. Note the difference of the two dial indicator readings. The difference should not exceed 1/2 of the total cumulative tolerance as found in appropriate columns, Table 6.9, Page 6.14 of Handbook H-28 (1969) Part 1, "Screw Thread Standards for Federal Services".

THE JOHNSON GAGE COMPANY

SERIES BHF-FIXED SIZE

SA-8.C
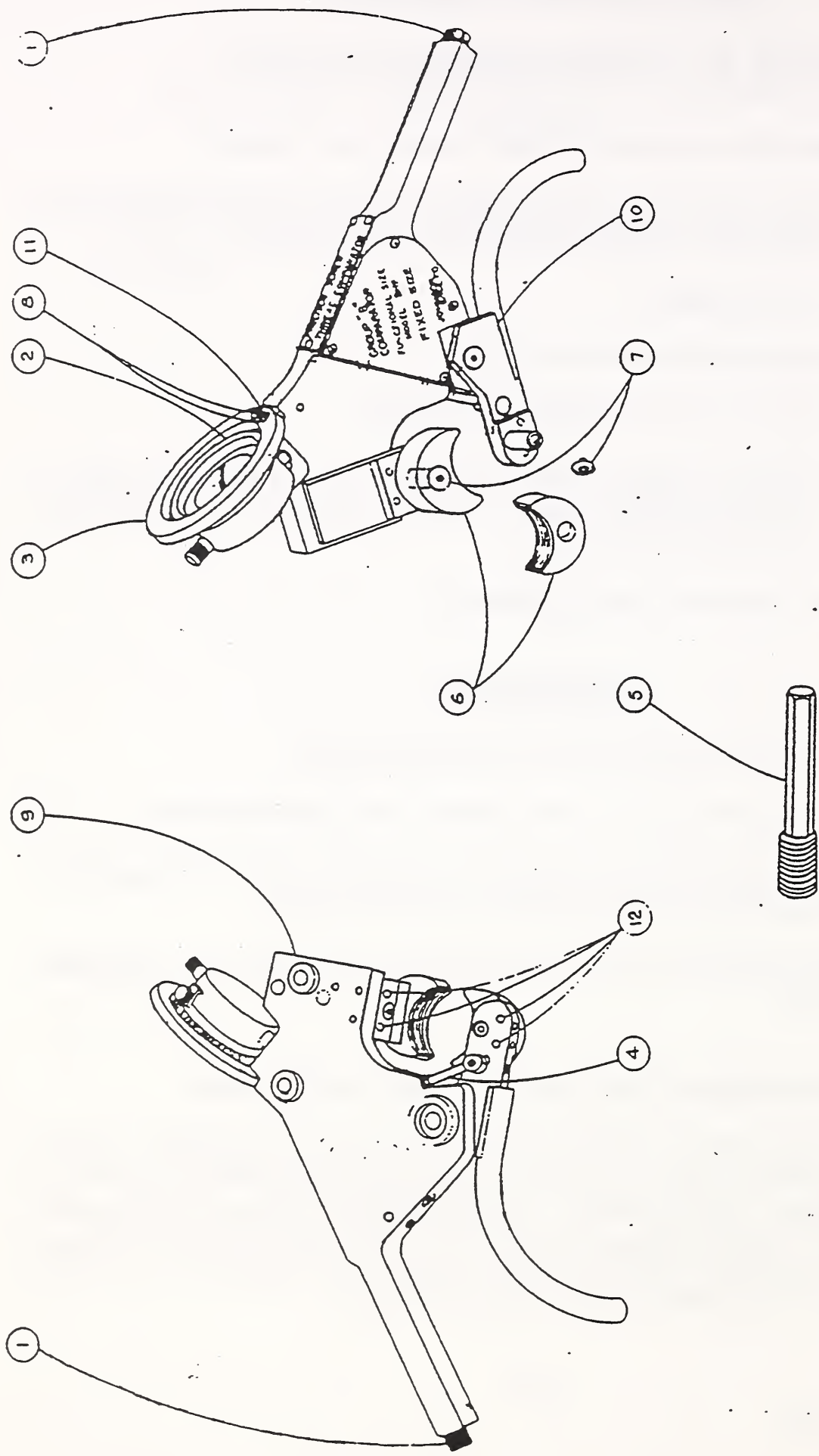
COMPONENTS

FOR

GROUP "CHF" - EXTERNAL/PORTABLE - FIXED SIZE

JOHNSON ROLL-TYPE THREAD COMPARATOR

MODEL "CHF" - SIZES: .190 THRU 3.000 INCH (5 THRU 75mm)

1. Stud (Roll Position #1)

2. Stud (Roll Position #2)

3. Stud (Roll Position #3)

4. Pivot Arm

5. Pivot Arm Stop Screw

6. Dial Indicator

7. Dial Indicator-Locking Screw

8. Gaging Pressure-Adjusting Knob

9. Frame

10. Pivot Arm Stop Lock Screw

11. Storage Bracket

REFERENCE: Drawing SA-108
            Drawing SA-106

1. Remove all three Roll-Retaining Screws and/or Rolls: Positions 1-2-3.

2. Inspect and clean all gage component assembly surfaces of all foreign matter.

3. Select Indicator as follows: (Normally furnished with Comparator.)

SIZE:	AGD GROUP #2
GRADUATION:	(a) x.00025" or .005mm (when product Pitch Diameter is .010" or less.
	(b) x.0005" or .01mm (when product Pitch Diameter Tolerance is greater than .010".)
BALANCED DIAL:	(a) 0-10-0 (Inches) or 0-25-0 (mm) with x.00025" or 25mm graduation.
	(b) 0-20-0 (Inches) or 0-50-0 (mm) with x.0005" or .01mm graduation.
RANGE:	.010" minimum
MOTION:	Standard Travel with Revolution Counter. (Dial Hand turns clockwise when Indicator Rack is actuated inward toward Dial from rest position.)
DIAL HAND:	Set @ 3 o'clock in free state.
CONTACT POINT:	Length

4. Verify type rolls for same pitch, form, type, and complete set of 3 (each roll is individually numbered 1, 2, 3.)

5. Facing the stud assembly surfaces of the CH-F frame (9), assemble rolls on Studs as follows: (RIB ENDS OUT on PD type rolls and Minor Diameter type rolls, marking ends out on FUNCTIONAL rolls.) Assemble clockwise for RIGHT HAND Threads as follows:

         #1 Vee Roll on Pivot Arm (4)
         #2 Cone Roll at 10 o'clock - (Position 2)
         #3 Cone Roll at 2 o'clock - (Position 3)

   (NOTE: For LEFT HAND THREAD, REVERSE position of Roll #2, and #3, counter-clockwise assembly.)

6. Install Roll-Retaining Screws. Rolls must freely rotate on Studs. FINGER TIGHT ONLY - DO NOT OVER TORQUE!

      NOTE: Steps 7 thru 14 when setting to a THREADED Setting Plug.

            Steps 15 thru 24 when setting to a Plain Cylindrical Setting Plug.

7. Place Comparator onto "GO" Master Threaded Setting Plug. (NOTE: Be sure Comparator is not cross-threaded on master. Horizontally position the Setting Master Plug on some type of mounting stand - so that when setting, the entire weight of the Comparator is on the master - thereby, duplicating the actual manner in which the Comparator will be used.)

8. With Comparator engaged on Setting Master, position the Dial Indicator (6) so that "ZERO" on Indicator Hand is at the 12 o'clock position approximately 3/4 turn on Dial Indicator. (Although Dial Indicator revolves counter-clockwise, the + and - on Dial are direct reading on size.)

      a) Tighten Dial Indicator Locking Screw (7).

      b) Advance (clockwise) Pivot Arm Stop Screw (5) until a movement of approximately .001" on the Dial Indicator Hand is observed.

9. Remove Comparator from Master Setting Plug by squeezing Pivot Arm (4).

10. Turn Pivot Arm Stop Screw (5) until Dial Indicator Hand is at the 6 o'clock position.

11. Tighten Pivot Arm Lock Screw (10).

12. Re-check Comparator setting by re-engaging Comparator and Set Plug. Re-adjust as required.

13. Set Dial Indicator Tolerance Hands where ZERO equals MAX MATERIAL (GO). Set other hand to Minus Tolerance according to Pitch Diameter Tolerance for product part.

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14. Utilizing Storage Bracket (11), place Comparator on Storage Stand provided when not in use. This will prevent any damage that may be caused by lying the Comparator on the working area.

> NOTE: Gaging Pressure is adjusted with Knurled Knob (8) - clockwise to increase -- counter-clockwise to decrease. Re-check Comparator setting after gaging pressure is changed.

15. Holding the CH-F Comparator frame handle (9) in a roll DOWN position (and not actuating the pivot arm lever), unlock the pivot arm stop lock screw (10) and retract the pivot arm stop screw (5) until the stop screw does not contact the gage frame (9). See Step B, SA-106.

16. Holding the CH-F Comparator frame (9) horizontally by the handle such that the rolls are now in an UP position (vertical thread axis mode), actuate the pivot arm lever and engage the Plain Cylindrical Minor Diameter Setting Master with the alignment flange seated flush and square against the heads of each of the three roll retaining screws. After releasing the pivot arm lever and the Minor Diameter Rolls engage the Setting Master, oscillate the master to confirm the seating of the setting master. The flange must remain flush and square against the heads of each retaining screw. See Step C, SA-106.

(The following steps are completed with the CH-F Comparator held horizontally by the handle in the vertical thread axis mode: ROLLS UP and setting master engaged in a vertical/downward position; alignment flange seated flush and square against the heads of each of the three roll retaining screws.)

17. Loosen the Dial Indicator Locking Screw (7) and reposition the Dial Indicator (6) so that the "ZERO" on the indicator hand is at the 12 o'clock position approximately 3/4 turn on the Dial Indicator. Both the large dial hand and the small dial hand should be at "0". See Step D, SA-106.

18. Tighten the Dial Indicator Locking Screw (7). Advance (clockwise) the Pivot Arm Stop Screw (5) until movement of approximately +.001" on the Dial Indicator is observed.

19. Actuate the pivot arm lever and remove Master Setting Plug from Comparator, and allow pivot arm to return to +.001" stop position without Setting Plug engaged.

20. Turn pivot arm stop screw (5) until Dial Indicator moves in MINUS DIRECTION (counter-clockwise) .012".

21. Tighten Pivot Arm Stop Lock Screw (10).

22. Re-check Comparator "0" setting by re-engaging Comparator and set master in the USE/APPLICATION mode - reposition indicator or adjust bezel as may be required to achieve the 12 o'clock "ZERO" position. (When verifying the final setting of the Comparator, it is recommended that the actual USE/APPLICATION mode be duplicated; i.e., that the setting master is positioned in a manner identical to the product part to which the Comparator will be presented during the gaging process.

23. The Plain Cylindrical Minor Diameter Setting Master conforms to the MAX MINOR DIAMETER size. Set one of the tolerance hands at "0", where "0" equals the MAX MINOR DIAMETER SIZE and the other tolerance hand to the required minus tolerance setting according to the Minor Diameter Tolerance specified for that specific product part.

24. Return to storage stand or storage case when not in use.

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EXTERNAL

ROLL POSITIONS

PIVOT ARM LEVER

MASTER SETTING PLUG

STAND

EXTERNAL

STEP A

B RIB MINOR DIA. ROLL

ROLL RETAINING SCR.

STUD

FRAME OR PIVOT ARM

FRAME

2 O'CLOCK

PIVOT ARM

6 O'CLOCK

10 O'CLOCK

ROLL PORTRADE

① ③ ②

STEP B

⑤ PIVOT ARM STOP SCREW

PIVOT ARM

⑩ PIVOT ARM STOP LOCK SCREW

⑨ COMPARATOR FRAME

PIVOT ARM LEVER

FRAME HANDLE

STEP C

ROLL RETAINING SCR. (B)

ROLL (B)

PLAIN CYLINDRICAL MINOR DIAMETER SET MASTER W/ALIGNMENT FLANGE

FLUSH

COMPARATOR FRAME

VERTICAL THREAD AXIS MODE

STEP D

⑥ DIAL INDICATOR

⑦ DIAL INDICATOR LOCK SCREW

VERTICAL THREAD AXIS MODE

EXTERNAL

JOHNSON EXTERNAL THREAD GAGING ELEMENT

CALIBRATION SYSTEM

AUGUST 1, 1983

EXTERNAL MEASURING SYSTEM

ITEM NO. 1

Johnson External Measuring Thread Comparator System for the Calibration of Type BG External Segments.

   1.   Description of System

   The above system is designed to determine if a pair of Johnson BG Segments has exceeded the allowable wear tolerance of Class "X" (refer to H-28, 1969, Page 6.13, Table 6.8). Plain Cylindrical Plugs and Class "W" Master Set Thread Plugs are utilized in the calibration process. The following characteristics of the BG Segments are calibrated:

   a) Straightness

   b) Flank Angle Wear

   c) Lead Wear

   d) Size Relationship - Minor Diameter Size/Pitch Cylinder Size

ITEM NO. 2

Johnson Model CNPLT Thread Roll Optical Comparator Charts.

   1.   Description

   The above charts are used on an optical comparator to determine that the CNPLT and CNPLTI rolls are within and have not exceeded Class "X" Wear Tolerance. They are designed for 20x, 25x, and 50x magnification. Individual charts are supplied per pitch.

PROCEDURE FOR INSPECTING

ALL JOHNSON EXTERNAL THREAD SEGMENTS

(ITEM NO. 1)

1. Visual Inspection

   Remove segments from mounting studs, clean, and examine thread section closely for nicks, burrs, and foreign matter in the relief area of the Major Diameter of the Segments.

2. Inspection of the Threaded Section

   Assemble segments to appropriate Type B Johnson Comparator using standard setting method (Operating and Setting Instructions - Model B) and Class "W" GO AGD Truncated Set Thread Plug Gage.

   a) *Straightness*

      1. Engage the first three threads of the GO Truncated Set Thread Plug segments and read indicator.

      2. Engage the first three threads of the GO Truncated Set Thread Plug into the opposite end of segments.

      3. If the difference between the two end readings exceeds .0003, segments should be returned to the factory for rework.

   b) *Flank Angle Wear*

      1. Engage the Truncated portion of the GO AGD Truncated Set Thread Plug and set indicator to zero.

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2. Engage the Full Form portion of the GO AGD Truncated Set Thread Plug. Observe the reading.

3. If the difference between 1 and 2 exceeds plus 0.0003, this indicates excessive segment wear. Segments should be returned to factory for rework.

For Class "X" Tolerance, refer to H-28, 1969 (Page 6.13, Table 6.8)

c) *Lead Wear*

1. Using the last three threads of the Full Form portion of the Setting Plug (handle end on the taper lok blanks), engage the FIRST three threads on the end of the segments. Observe the reading.

2. With the three thread engagement above, rotate the Full Form portion of the Setting Plug thru the segments to full length engagement of the full form. Observe the increase in reading, if any.

3. An increase in reading exceeding plus 0.0003 between reading 1 and 2 reveals the segments have lead error.

d) *Size Relationship - Minor Diameter Size/Pitch Cylindrical Size*

1. Using the Full Form portion of the Class "W" Set Plug, engage the entire length fully into the segments and zero-out the indicator at the high point.

2. Using the Minor Diameter Plain Cylindrical Plug, engage that plug fully into the segments and observe the reading.

3. The indicated difference between 1 and 2 should not exceed plus or minus 0.0005 from the zero setting.

For Class "X" Tolerance, refer to H-28, 1969 (Page 6.13, Table 6.8)

PROCEDURE FOR THE INSPECTION AND CALIBRATION

OF

ALL JOHNSON ROLL-TYPE THREAD CONTACT UNITS

(ITEM NO. 2)

1. Visual inspection. Remove rolls from mounting studs to examine thread-contacting surface for nicks, burrs, and foreign matter.

2. Mount Thread Roll on approved roll arbor (0.375 nominal size).

3. Place arbor between centers on optical comparator.

4. Clean roll so that all foreign matter is completely removed.

5. Select applicable optical comparator chart (i.e., correct pitch chart for roll to be checked).

6. Inspect contacting surface for wear. Contacting surface must be within prescribed zonal limits of wear on chart. Observe Maximum and Minimum "New" Wear Limits and observe Maximum and Minimum Worn Limits.

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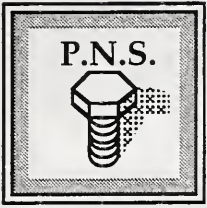
APPENDIX J

Thread gage electronic indicator specifications

The contents of this appendix was supplied by the manufacturer and is reprinted with their written consent.

The **MAXµM** Connection!

MAXµM Electronic Indicator with Digital Output

MAXµM®

ELECTRONIC INDICATOR with DIGITAL OUTPUT

Recessed Connector — 6-pin connector, protected by a captured dust cap, conveniently and quickly connects the Maxµm® Indicator with Output to a selected interface and computer.

Heavy-Duty Construction — die cast metal case, stainless steel stem, tough plastic crystal; fully gasketed to seal out contaminants, resist moisture.

Battery or Interface Powered; When output is connected, the Maxµm® Indicator is powered by the interface unit. When output is disconnected, the indicator is powered by its own internal battery.

Dual Display — features both digital and analog readouts, plus limit signals for positive, instantaneous identification of "over" and "under" readings.

Use also as a regular Maxµm® Indicator; just disconnect the output.

Digital Readout — shows exact deviation from zero; eliminates guesswork and hand position interpolation; smaller digit pinpoints reading between graduations.

Single Purpose Controls — convenient, easy to operate switches, the same as a regular Maxµm® Indicator, control all functions — auto-zero, upper and lower limit settings, count up and count down, and true spindle position.

ACTUAL SIZE
MADE IN U.S.A.
U.S. PATENT NO. 4,289,382
Foreign patents pending.

With just one easy connection, the Maxµm® Indicator with Digital Output provides direct communication of measurement readings to a variety of computers, from hand-held models to mainframes.

Via this connection, measurement data can be gathered, stored and quickly analyzed. With appropriate computer hardware and software, the user can manipulate the data and generate a variety of reports — such as statistical summaries and evaluations of manufacturing processes which can highlight trends and reduce the number of rejects. Or, short-term and long-term measurement data analyses. Or, print out the readings for a hard copy review.

The output signal from the Maxµm® Indicator is a 35 pulse data stream, which is available up to 4 readings per second. A variety of peripherals and interfaces, including a Maxµm® Statistical Analyzer, HP-IL and RS-232C convertors, and GageTalker™ and DätaMyte® systems, are available to decode and process the data stream. Contact Federal Products, Electronic Products Group, in Providence, for the application that will best meet your gaging requirements.

Maxµm® Indicating Unit with Digital Output and Remote Transducer

A Maxµm® Indicating Unit with Digital Output is also available with Remote Transducer, ideally suited for fixture gages. Simply mount the transducer in existing gaging fixtures in place of a regular dial indicator or other gage head. A full range of stem and cable lengths is available.

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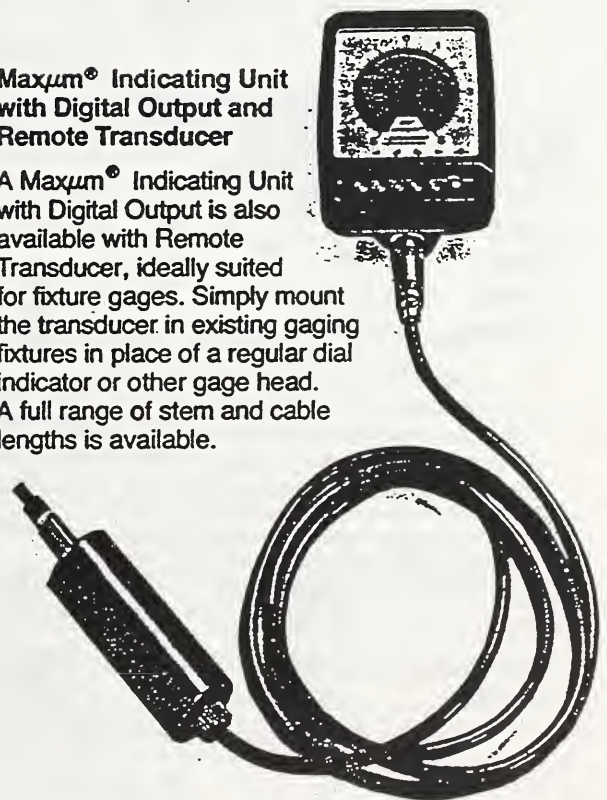
Specifications:

Choose from five Maxμm® Indicator models, three inch and two metric, plus options and accessories to satisfy every application. For added versatility, the ±.005" analog range model and both metric models have extended digital ranges.

Digital Range	Digital Min. Value	Analog Range	Analog Min. Grad.	Pretravel	Overtravel	Accuracy (% of digital range)
±.01000"	.00005"	±.005"	.0001"	.040"	.060"	0.5%
±.0200"	.0001"	±.020"	.0005"	.030"	.050"	0.5%
±.0400"	.0001"	±.040"	.001"	.010"	.030"	1.0%
±.199mm	.001mm	±0.050mm	0.001mm	1.1mm	1.6mm	0.5%
±1.000mm	.001mm	±0.50mm	0.01mm	0.3mm	0.8mm	1.0%

Temperature ranges:
  operation: 50° to 130°F/ 10° to 55°C
  storage: −4° to 149°F/−20° to 65°C

Total range of spindle travel: .120"/3,05mm (all models)

Gaging Force: 3 oz./85 grams, preloaded

Signals: Clock, Data, Sign

Connector: 6 pin, with captured Dust Cap.

Power Requirements (output disconnected): One 3.4 volt lithium battery, EBY-01011, normally furnished unless otherwise specified. A 4.5 volt alkaline battery, EBY-01007, can also be used, but lifetime will be shorter.
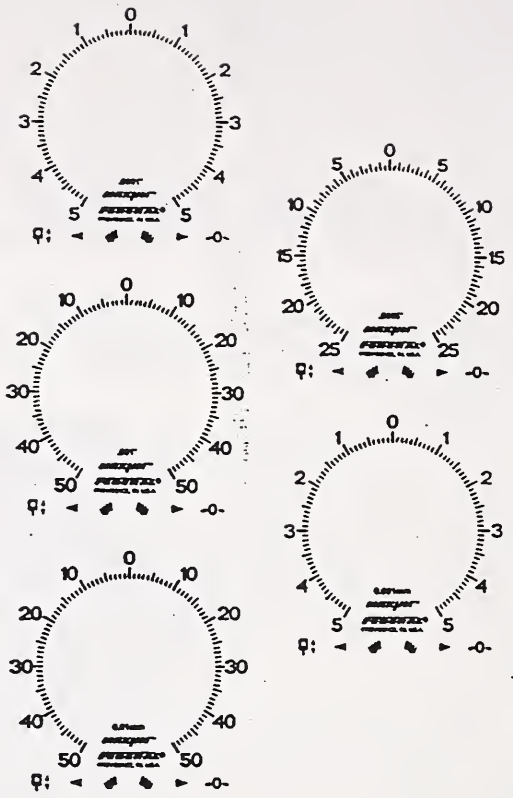
How to order the *MAXμM*° Indicator or Indicating Unit with Output:

From the Model Numbers table below, select the desired digital range, display direction and stem length, and note the corresponding code number for each feature. The resultant 5-digit number, beginning with the "DEI-" prefix and ending with the "D" suffix is the Maxμm® model number to order.

Interfaces, to decode the data stream from the Maxμm® Indicator with Output, are available and are recommended based on individual gaging requirements. To order, contact Federal Products in Providence or your local Federal representative.

Model Numbers:

Digital Range	Regular Indicator Code	or	Indicating Unit* Code	Code	Display Direction	Code	Stem Length	Regular Indicator Code	or	Indicating Unit* Code	Output Code
±.01000"	11		71		Clockwise (for O.D. Gaging)	1	.670"/17mm**	1			
±.0200"	12	or	72			or	1.5"/38mm	2	or	0	
±.0400"	13		73		Counter-clockwise (for I.D. gaging)	2	2"/51mm	3			
±.199mm	14 or 34†		74				3"/76mm	4			
±1.000mm	15 or 35†		75								
DEI –	___			1		___		___			D

*For use with Remote Transducers (see Table below).
**.670"/17mm normally furnished unless otherwise specified.
†Code "34" and "35" are 8mm/.315" dia. stem models.

Note: Indicators with "12 o'clock" stem orientation and Indicating Units with "12 o'clock" transducer connector orientation are not available with the digital output option.

Remote Transducers:

Stem Length	.375/9,5mm Dia. Stem	8mm/.315" Dia. Stem	Stem Length	.375/9,5mm Dia. Stem	8mm/.315" Dia. Stem
.670"/17mm	EAS-02104-W1	EAS-02105-W1	2"/51mm	EAS-02104-W3	EAS-02105-W3
1.5"/38mm	EAS-02104-W2	EAS-02105-W2	3"/76mm	EAS-02104-W4	EAS-02105-W4

Note: All Maxμm® Remote Transducers are normally furnished with a 4'/1,2m long cable. Other cable lengths optionally available.

Prices included in separate Price List; delivery information on request.

Shown 1/2 size.

2.69"
63,3mm

4'/1,2m
Cable
Length

1"
25,4mm
Dia.

.670"*
17mm

1.42"
36,1mm

.375"**
9,5mm

"At Rest"

Note: Mount Transducer
by Stem only.

2.77"
70,4mm

3.42"
86,9mm

.670"
17mm

1.42"
36,1mm

At Rest

4-48 Threaded
Contact Point

2.50"
63,5mm

1.60"
40,6mm

6-Pin
Output Connector

Optional Lug Back
shown in Horizontal
Position

.25" Dia.
6,4mm

.375" Dia.
9,5mm

.390"
9,9mm

.985"
25mm
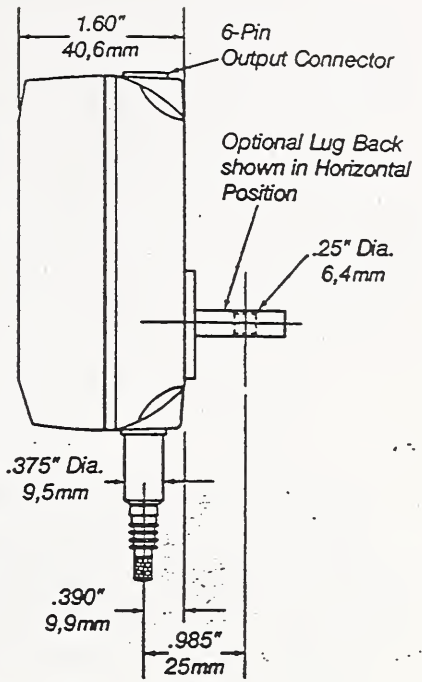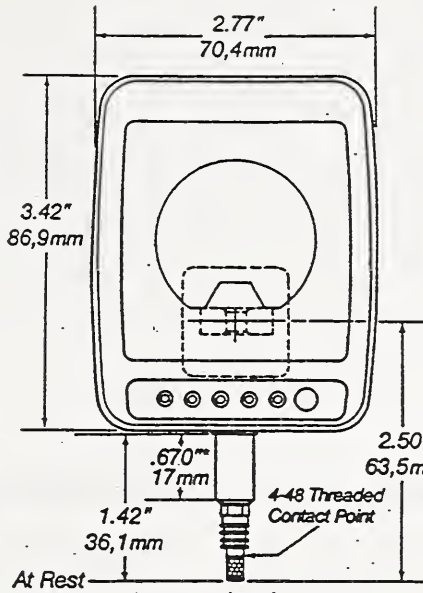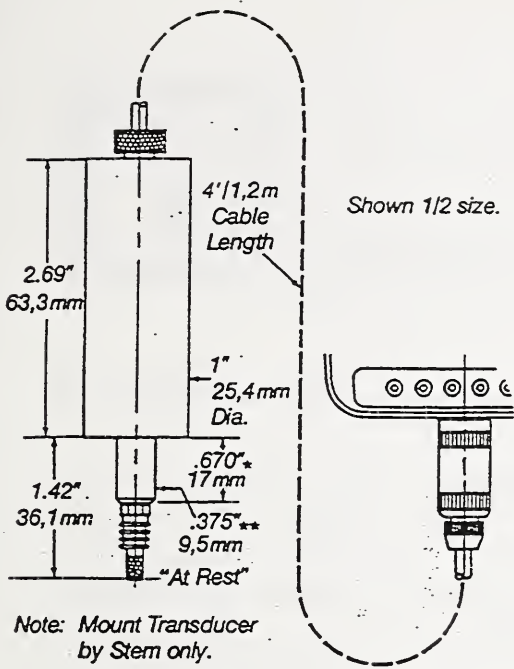
*Alternate Stem Lengths available: 1.5"/38mm, 2"/51mm, 3"/76mm.
**8mm/.315" dia. stem also available. Alternate Contact Points available.

Accessories:

Backs
(furnished with mounting screws)
Rack (fits SE-33 and SE-73 Adjustable
Mounting Brackets) EBK-01005
Lug (vertical and horizontal) EBK-01006
Adjustable Slide EBK-01007

Lifting Levers
(furnished with washer and
longer contact point)
Left-Hand (shown)
EAS-01903*

Right-Hand (not shown)
EAS-01904*
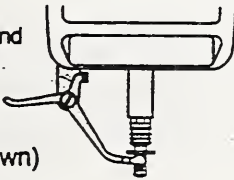
3"/75mm
Auxiliary Plunger
EAS-01912*
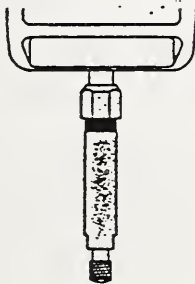
Hole Attachments
Short Straight Lever
(shown)
EAT-01032-W1*

Long Straight Lever
(not shown)
EAT-01033-W1*
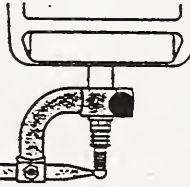
Right Angle Attachments

Lever Type (not shown)
EAT-01034-W1*

Spring Type (shown)
EAT-01035-W1*
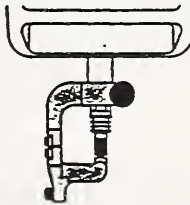
Contact Points
Maxμm® Indicators and Remote
Transducers having .375" dia.
stems use 4-48 threaded contact
points. Normally furnished contact is
PT-223 — ¼" long, 3/16" spherical radius.
Maxμm® Indicators and Remote
Transducers having 8mm dia. stems use
M2.5 threaded contact points. Normally
furnished contact point is EPT-01037-W1
— 6mm long, radiused tip. Refer to
Maxμm® Price List A-250 for complete
selection of alternate contact points.

Mounting Brackets
(for Remote Transducers)
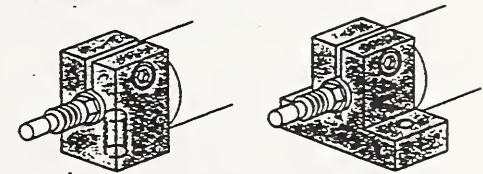
AAD-67*   AAD-91*
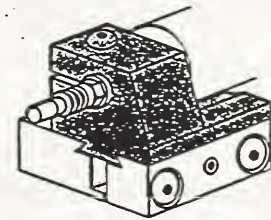
EAD-01007-W1*

Fits SE-33 (shown) and SE-73 Adjustable
Mounting Brackets (not included).

.88"/22mm Total Range of Adjustment.

*For .375"/9,5mm dia. stem. Most accessories
are available in equivalent models for
8mm/.315" dia. stem, or Adaptor Bushing
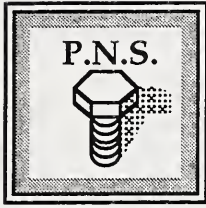CCG-8465P-13 (not shown) is required;
inquire when ordering.

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APPENDIX K

Troubleshooting

If you encounter any problem when using the workstation controller software, be sure to write a description of the situation in the workstation log book. Include the circumstances of the problem, i.e., what step in the manufacturing process were you in (ordering a batch, aborting a batch, measuring a part, machining a part). This will be helpful to you and the system administrator in analyzing a problem that might occur in the future.

PROBLEM: One or more of the PFMW windows are missing from the workstation controller computer.

SOLUTIONS: There should be four workstation windows in addition to a blue desktop window and an icon window.

• If all four of the workstation windows are missing, the workstation controller program may not be running. Check the Icons box to see what icons are there (there should be a total of seven icons - one for the Desktop, six for the workstation software). If only the Desktop window is there and none of the workstation icons, are, then the workstation controller program is not running. It will have to be started from its icon in the blue Desktop window.

• If some or all of the windows are missing, check the Icons window. If all the workstation controller program icons are there, then click on the one corresponding to the missing window to open it.

If the icon of the missing window is not there, then the process running in the window has "died". The workstation controller software will have to be restarted. It will not continue to run without the missing process.

To restart the software, double-click on the PFMW-HELP icon in the blue Desktop window. From the first-aid kit menu in the window that appears, press **R** to use the **[R]e-start all PFMW software** function. The software windows will disappear and reappear. Note that data may be lost by doing this (e.g., if a part had been made but not measured). See page 48 for more information on using the PFMW first-aid kit.

PROBLEM: The blue Desktop window is missing.

SOLUTION: The Desktop window may actually not be missing. It may be closed. Check around the computer screen to look for an icon with the label "Desktop". If you find it, double-click on it to reopen the window. Note that all the windows may be iconified. In the case of the Desktop, the icon will appear outside of the Icons window.

PROBLEM: The Icons window is missing.

SOLUTION: The window may not actually be missing. It may be closed. Check around the computer screen to look for an icon with the label "Icons". If you find it, double-click on it to reopen the window. Note that all the windows may be in iconified form. The Icons window's icon will appear directly on the screen.

PROBLEM: One or more of the icons is missing from the blue Desktop window.

SOLUTION: There should be four icons in this window. They are labelled PFMW, PFMW-UTIL, PFMW-HELP, and Home. If they are not here, notify the system administrator. He will need to edit the "xdtinitial.xde" hidden file to put the icons back on the desktop.

To the system administrator: Refer to the *Portsmouth Fastener Manufacturing Workstation Controller* document for the contents of this file.

PROBLEM: The windows look strange - the frames are missing or have lost their details. The keyboard may be locked up, the mouse may not work.

SOLUTION: Contact the system administrator immediately. Record the circumstances of the situation in the workstation log book.

To the system administrator: The motif window manager (MWM) may have died or is not working correctly. You may attempt to switch to another multi-screen if the keyboard is not locked up or attach a dumb terminal to the serial multi-port terminals to gain access to the computer. If possible, run the UNIX "crash" utility. Refer to the system administrator's guides for more information.

PROBLEM: The computer does not seem to be accepting any input from the keyboard when you are typing.

SOLUTIONS:
• The first thing to check is to make sure that the window you are prompted from is active. When a window is active its frame is colored cyan (blue-green) and not grey like the other windows.

Only one window is active at a time. If it isn't active, make it active by using the mouse to click on the window once. The frame should change to cyan. Input will then be accepted from the keyboard.

• If the window is active, check to see if the keyboard is connected to the computer. If it is not, plug it in. The port for the keyboard is labelled for the keyboard.

• If the window is active, check to see if the keyboard is still active. Press the [NUM LOCK] key on the keyboard to see if its pilot light toggles on and off. If pressing the key has no effect, the keyboard is locked up. Contact the system administrator.

To the system administrator: Attempt to access another multi-screen to login as "root". If this is not possible (if the keyboard is locked up) attempt to access the computer from a dumb terminal hooked up to an active port on the serial multi-port board. Login as "root" and kill **pnsy** processes to log the user out.

PROBLEM: The computer screen has completely blacked out - it was running fine a while ago.

SOLUTIONS:
• The screen saver may have started running. To help increase the life of the computer monitor, a screen saver comes up after five minutes of no input at the computer keyboard or from the mouse.

To de-activate the screen saver, press the [SPACE BAR] key on the keyboard or move the mouse. The screen will reappear.

• The monitor may have been powered off. Check to see if the green pilot light next to the power switch is off. If it is, the monitor is not powered on. Press the monitor's power switch on.

PROBLEM: A window with a yellow background and red lettering with the following message appears:

NOT ALL WORKSTATION PROCESSES EXIST!
Contact the system administrator for help.
Press [Enter] to continue...

SOLUTION: This means that one or more of the workstation controller processes has died. The batch execution cannot continue.

Contact the system administrator so that he can analyze the situation and determine what had happened.

The workstation controller software must be restarted. The following actions are to be performed to restart the software.

In the blue desktop, activate the PFMW-UTIL program by double-clicking its icon. A window will appear with the PFMW first-aid kit menu in it. Select the **[R]e-start all PFMW software** function by pressing **R**. This will cause all the workstation controller windows and icons to disappear and reappear. Note that data may be lost during this process. Reorder and start the batch.

PROBLEM: The computer seems to have frozen. It will not accept input from the keyboard, the mouse does not move the cursor, the controller does not proceed to the next production step.

SOLUTION: Contact the system administrator immediately. Record the circumstances of the situation in the workstation log book.

To the system administrator: Attempt to access the computer by connecting a dumb terminal to the computer at one of the serial multi-port terminals. If access to the computer is possible, attempt to login as "root" and run the "./configure" program to use the "strstat" command. Refer to the system administrator's documentation for more details on using this program. Afterwards, attempt to kill the **pnsy** process to log it out.

PROBLEM: Some of the text in the windows contain strange characters.

SOLUTION: In the current version of the operating system there is a bug that sometimes causes a couple of letters to change shape. Nothing can be done about this situation except to properly stop the batch, log out, and log in again. If it is not too irritating, nothing needs to be done - the batch can be executed as usual.

PROBLEM: The computer does not proceed to bring the gaging window up when it is supposed to. It seems to be hanging. The fastener you had just completed is waiting to be gaged. The computer accepts input from the keyboard, the mouse works.

SOLUTION: Contact the system administrator immediately. Record the circumstances of the situation in the workstation log book. There are two solutions to this problem. The first is easy (although loss of data may occur), the second needs the help of the system administrator and, if successful, will allow the workstation controller software to continue running without a loss of data.

• If possible, abort the batch. If successfully aborted, re-order the batch and start it. The workstation controller software must be fooled into thinking that the first part in the batch has been machined. You will have to force the turning/milling center to change its variables to indicate that a fastener had been made without actually machining a fastener. This will cause the workstation controller software to proceed to gage the fastener. When the gaging window comes up, gage the fastener and proceed with workstation operations as usual.

• To the system administrator: In an SCOterm or in another multi-screen, check in the "/user1/gage6" directory for the 0-byte file named "semaphor". If it exists (a message in the window says "cmd semaphor still exists"), delete it by using the command string "rm semaphor". After the file is removed, the gaging interface process should realize this and proceed to create the "command" file for the Johnson Gage software to read. The gaging window should then appear.