

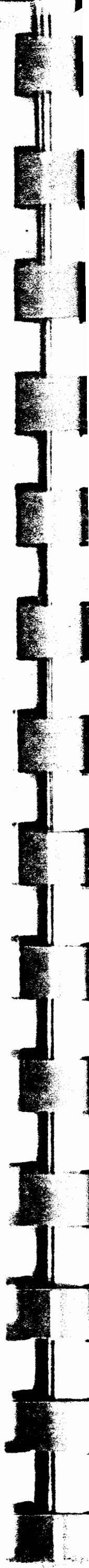
MILESTONE[®]

A Project Management and Time Scheduling Program

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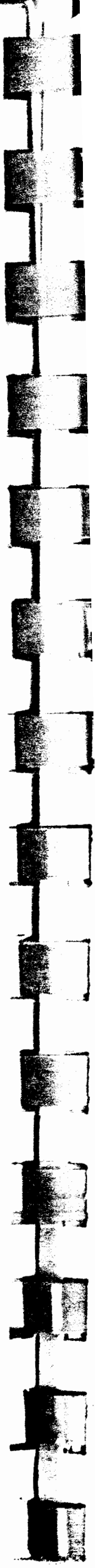
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Introduction

You may remember the terms "critical path" and "PERT/CPM" from your days as a student. Well, those terms are no longer restricted to the realm of the space program and large defense projects. Now you can use "critical path network analysis" on your projects. All you need is a desktop microcomputer and MILESTONE.

With today's concerns about increasing costs and declining productivity it is true more than ever that any project worth doing deserves careful planning. Whether you're planning a construction project or the opening of a new retail store, you must carefully schedule your manpower, dollars and time in order to maximize productivity.

This is a chance to increase your productivity by using the latest developments in computer technology. Today, most PERT/CPM programs cost thousands of dollars and run only on large expensive computers. Now MILESTONE provides the fundamental features of critical path analysis at a minimum cost and runs on inexpensive microcomputers.

What is a Critical Path?

Critical-path-network-analysis is a technique devised in the late '50s to aid in the planning and development of the Polaris missile system. The basic technique is to divide a complex project into a series of shorter independent tasks and then to analyze their timing to see which ones are critical to the overall completion of the project—critical in the sense that any delay in a job on the critical path results in a delay of the entire project.

There are basically two methods of critical path analysis: PERT and CPM.

PERT

The acronym PERT stands for Performance Evaluation and Review Technique. It treats a *project* as a *series of events occurring in a time sequence* and is considered to be a good tool for reporting the progress of a large project. PERT was designed for large research and development projects consisting of numerous activities whose completion times are uncertain. It is based upon probabilistic techniques in order to estimate the expected time required to complete an event.

CPM

CPM stands for Critical Path Method (not to be confused with the microcomputer operating system known as CP/M—Control Program for Microcomputers). In contrast to PERT, CPM treats a *project* as a *series of activities* and is generally considered to be useful for planning a project. CPM was developed for the construction industry where activity durations can be confidently estimated and trade-offs of cost versus completion date are important.

Implementations of PERT and CPM are typically very expensive and difficult to use. They cost from \$9000 to \$20000, require a large mainframe or minicomputer, and operate in a non-interactive batch mode.

Why MILESTONE?

MILESTONE brings the power of critical path analysis to areas where, because computers were so expensive, it would never before have been considered. By combining the fundamentals of critical path analysis into an easy-to-use package that is inexpensive and runs on a desktop computer, MILESTONE makes sophisticated project management techniques available to nearly everyone who has to delicately balance cost, manpower and time.

MILESTONE's design is a product of many years of experience in the "real world" of small-project management. In such an environment the primary purpose of planning is to help the project leader clarify the task at hand and to communicate those ideas to subordinates and superiors. For these two reasons the designers of MILESTONE stressed its interactivity and comprehensive reporting.

Instead of replacing PERT/CPM programs, MILESTONE is designed to complement them. It is designed to be used for the planning and tracking of relatively small projects. Two kinds of managers will find MILESTONE useful: ones who are not currently using planning tools and ones who are disenchanted with their powerful PERT/CPM packages.

Most projects are small and most small-project project managers are not using formal planning tools. They probably have been exposed to the CPM method in school or in a management course, but are not using CPM because they don't have a computer and/or they are tired of pencil and paper CPM calculations. These managers need answers to a few fundamental questions:

When will my project be completed?

How much will it cost?

Is the project ahead of, or behind, schedule?

How does delaying an activity affect project completion?

MILESTONE is designed to provide answers to these questions quickly and easily.

Some users of mainframe PERT/CPM programs convert to MILESTONE because they are spending more effort and money than is justified for a small project. They find that the batch mode routine of running a mainframe program is too cumbersome to be worthwhile for a small project. As one project leader said after preparing a MILESTONE report, "At that point I had six project engineers beating a path to my door. Although our project has a CPM/PERT system available to us on the central time share system, it is much too difficult to add sufficient detail to be useful in real time."

Other managers use MILESTONE in conjunction with PERT/CPM packages. On a large project like the Space Shuttle, with thousands of activity arrows, every activity is a project in its own right and a candidate for MILESTONE.

What's Special About MILESTONE?

INTERACTIVE

MILESTONE's screen interaction is much like an electronic spreadsheet in that you view the project through a moveable screen window. Every time you add a new activity or make a change to an existing one, the entire schedule is recomputed and the new critical path is immediately redisplayed, permitting you to ask "what if" questions about the schedule. Manpower and cost summaries are optionally displayed at the bottom of the screen, so that you are constantly aware of how schedule changes affect your budget and resources. This immediate feedback permits you to do cost-time tradeoffs, interactively.

POWERFUL

Internally, MILESTONE treats your project as a series of activities, each with a name, duration, capital cost, mix of manpower, and prerequisite list (finish/start precedence notation). The list of associated activities provides a thread that MILESTONE uses to link all jobs together into an overall project schedule. A project of one hundred or more activities can be entered without having to draw an arrow diagram or create dummy nodes.

EASY TO USE

Much of the design effort was put into eliminating unnecessary or redundant operator input and checking all entries for validity. You run MILESTONE by moving through a series of menus, selecting options or changing data with single keystrokes.

FAST

You have to run MILESTONE to appreciate its speed of response. Because interactivity demands speed, all project data is kept in memory to eliminate disk I/O and all computations use fast integer arithmetic. As you might expect, having all data in memory limits the total number of activities that can be handled. Even so, with MILESTONE it is possible to plan a project with nearly two hundred activities on a 64K byte microcomputer. MILESTONE is an excellent solution to the challenge of providing interactive critical-path fundamentals within the memory and speed limitations of a small computer.

What Can MILESTONE Do?

MILESTONE can help plan, schedule, and control any small project. Specifically, it can help you:

- Find out which activities are time critical and can't be delayed.
- Discover which activities have slack time and can be delayed if necessary without delaying the entire project.
- Prepare a detailed cost estimate based upon a summation of each activity's individual equipment and manpower expenses.
- Change an activity and instantly see the impact on the overall project schedule.
- Investigate the tradeoffs between manpower, dollars and time.
- Keep track of your project's progress by periodically updating the schedule to reflect changes in the plan and completed activities.
- Communicate your plan to your project team by giving them a clear picture of what is expected of them, and when.
- Help you convince management that your plan is sound through detailed printed reports.

System Requirements

If you are not sure whether MILESTONE will run on your computer system, the following information may help you. If your computer is not listed here, please contact your computer dealer or Digital Marketing Corporation.

Computers

A Z80, 8080, or 8085 computer and CP/M 2.x

An 8086 computer and CP/M-86

An APPLE II computer with a language card (or RAM card), Z80 soft card and a 24x80 video board

Any computer running UCSD PASCAL 4.0 or higher

Terminals

Any 24 line by 80 column CRT terminal or video display that has a home-and-clear function and absolute-cursor-positioning

Memory

At least 56K RAM with CP/M, 128K with CP/M-86

Disk Drives

One or two floppy or hard disk drives

Milestone Specifications

To save you the trouble of wading through this long manual in search of a few key numbers, the most important ones are listed here.

Speed

Virtually instantaneous - the critical path is recomputed and redisplayed immediately whenever you make a change to the schedule.

Capacity

The number of jobs (activities) per project depends upon the amount of RAM (Random Access Memory) available to a user program. This number is strongly dependent on the operating system overhead.

A few examples are shown below:

System	#Jobs
Digital Research 64K CP/M 2.x	190
CompuPro 64K CP/M 2.2	169
Morrow Discus 2D 60K CP/M Cbios 3.0	128
Microsoft Apple II CP/M 2.0 56K (64K RAM)	102
Lifeboat North Star 56K CP/M	83

To compute the capacity for other CP/M systems, substitute into the following equation the size of your computer's TPA (Transient Program Area), which should be listed in the reference manual:

$$\text{Capacity} = (\text{TPA} - 38376) / 92$$

Skills

Nine manpower categories may be entered with different costs per time-unit.

Time Units

Time can be measured in hours, days, weeks, months, quarters or federal fiscal quarters. You define your normal working hours, working days and holidays.

Duration

Up to 9999 time units may be entered.

Reports

Four reports are available, including a large time schedule chart and a user defined tabular report.

Limitations

It is only fair to list a couple of limitations. MILESTONE does not do resource leveling, resource allocation or probabilistic scheduling. Although these techniques are necessary for the management of large complex projects, we don't believe they are necessary for most small projects.

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Getting Started

For CP/M Systems

Step One: Making a Working Copy

First, make a copy of the MILESTONE diskette and put the original in a safe place. **USE THE ORIGINAL DISKETTE ONLY FOR MAKING A WORKING COPY.** Then load the copy into your second disk drive, log onto drive B, and list the directory. If you have a CP/M 2.x operating system your directory will look like this:

A>b:

B>dir

```
B:PRUN          COM : PASLIB      PCO : CONFIG      PCO : ORGANIC     DAT
B:LEARNHOW     PCO : MILESTON   PCO : EXAMPLE1   DES : EXAMPLE1   JOB
B:EXAMPLE2     DES : EXAMPLE2  JOB : EXAMPLE3   DES : EXAMPLE3   JOB
```

The file named PRUN.COM is the PASCAL/M interpreter by SORCIM Corporation. Your copy of 'prun' will be either for CP/M 2.x (with a .COM suffix) or for CP/M-86 (with a .CMD suffix) depending on the type of computer system you specified on your order.

The file named PASLIB.PCO is the run-time library. PRUN.COM and PASLIB.PCO comprise the PASCAL/M 'run-time package'. Although MILESTONE was written in PASCAL and compiled with PASCAL/M, you still need the run-time package.

Organic Software has entered into an agreement with SORCIM to allow the distribution of the PASCAL/M interpreter and run-time library along with each copy of MILESTONE. If you like MILE-

STONE and would like to write similar programs of your own, we suggest that you purchase a complete SORCIM PASCAL/M package that includes the PASCAL compiler.

Step Two: Customizing MILESTONE to your Terminal

Configure the terminal, printer and data disk by running the program named "CONFIG"

```
B>prun config
```

While running "CONFIG" you will see three different screens and menus. Pick the proper terminal, set your printer width in columns and make sure the data drive is set to "B". Section II-B gives you detailed information on how to do this.

Step Three: Learning how to enter data

Run LEARNHOW and practice entering different types of data. See Section III for a complete tutorial.

```
B>prun learnhow
```

Step Four: Running MILESTONE

To run MILESTONE, log onto drive B and type

```
B>prun milestone
```

Typing the "e" at the end of MILESTONE is optional because the CP/M system only uses eight character filenames.

You are now ready to learn how to use MILESTONE. Please turn to SECTION IV and complete the activities in the Tutorial.

For UCSD PASCAL Systems

On Disk Drives With Less Than 400 Blocks

Several computers have drives with such low storage capacity that all program and system files cannot fit on one disk. This is not a major problem, however, because the files are not all needed at the same time.

The solution is to install MILESTONE in steps by transferring files to your working disk and then removing them after they have been used.

Follow the steps shown below. They are designed to work on an IBM PC with 320 blocks/disk (i.e. single-sided single-density with 8 sectors per track).

Step 1

Format two blank diskettes by using your operating system utility program.

Step 2

Run the FILER and use the ZAP option to name the two disks as follows:

Name	Description
MS	The program disk
MSCOPY	A copy of the product disk

Step 3

Transfer the following files onto the disk named MS

FILE NAME	SIZE
SYSTEM.INTERP	27
SYSTEM.PASCAL	123
SYSTEM.MISCINFO	1
SYSTEM.LIBRARY	8

165 blocks used, 155 unused

Be sure that SYSTEM.LIBRARY is no larger than 32 blocks! If it is, there will not be enough room to run MILESTONE.

If SYSTEM.LIBRARY is too big, you can use LIBRARY.CODE to remove all the units except LONGOPS which is only about 8 blocks long.

Step 4

Transfer all files from the MILESTONE product disk onto the disk named MSCOPY and then transfer SYSTEM.FILER onto it also.

Step 5

Load the MS disk in the first drive and MSCOPY into the second drive and boot your system.

Step 6

Execute the FILER, and list the contents of the second drive. You should have the following files.

<u>NAME</u>	<u>SIZE</u>	<u>DESCRIPTION</u>
USERLIB.TEXT	4	Tells the system to use ORGANIC.CODE library
ORGANIC.CODE	29	A library used by other .CODE files
CONFIG.CODE	26	Used to configure your terminal and printer
ORGANIC.DAT	18	Control-code data for a variety of terminals
LEARNHOW.CODE	8	Sample program showing option and data entry
MILESTON.CODE	121	The MILESTONE program
EXAMPLE1.DES	1	First part of example #1
EXAMPLE.JOB	2	Second part of example #2
SYSTEM.FILER	32	The filer, you just copied it onto here

Step 7

Using the FILER, transfer the first five files onto the MS disk and then list its directory.

FILE NAME	SIZE
SYSTEM.INTERP	27
SYSTEM.PASCAL	123
SYSTEM.MISCINFO	1
SYSTEM.LIBRARY	8
USERLIB.TEXT	4
ORGANIC.CODE	29
CONFIG.CODE	26
ORGANIC.DAT	18
LEARNHOW.CODE	8

250 blocks used, 70 unused

Step 8

Run CONFIG and select your terminal from the list. There are two choices, the IBM PC with a BIOS supplied by Network Consulting Inc. (NCI), or the IBM PC with a BIOS supplied by SofTech Microsystems and marketed by IBM. Pick the proper one and test your selection.

Step 9

Run LEARNHOW and practice entering different types of data.

Step 10

Run the FILER and list the directory of #4 again.

FILE NAME	SIZE
SYSTEM.INTERP	27
SYSTEM.PASCAL	123
SYSTEM.MISCINFO	1
SYSTEM.LIBRARY	8
USERLIB.TEXT	4
ORGANIC.CODE	29
CONFIG.CODE	26
ORGANIC.DAT	18
LEARNHOW.CODE	8
TERMINAL.DAT	1

251 blocks used, 69 unused

The file **TERMINAL.DAT** was created by **CONFIG** and must remain.

Step 11

Remove the files **USERLIB.TEXT**, **ORGANIC.CODE**, **CONFIG.CODE**, **ORGANIC.DAT** and **LEARNHOW.CODE** since they are no longer needed.

Step 12

"Crunch" volume #4 to make as much disk space available as possible.

<u>FILE NAME</u>	<u>SIZE</u>
SYSTEM.INTERP	27
SYSTEM.PASCAL	123
SYSTEM.MISCINFO	1
SYSTEM.LIBRARY	8
TERMINAL.DAT	1
166 blocks used,	154 unused

Step 13

Transfer **MILESTONE.CODE**, **EXAMPLE1.DES** and **EXAMPLE1.JOB** from **MSCOPY** in the second drive to **MS** in the first drive. Then, list its directory.

<u>FILE NAME</u>	<u>SIZE</u>
SYSTEM.INTERP	27
SYSTEM.PASCAL	123
SYSTEM.MISCINFO	1
SYSTEM.LIBRARY	8
TERMINAL.DAT	1
MILESTON.CODE	121
EXAMPLE1.DES	1
EXAMPLE1.JOB	2
290 blocks used,	30 unused

You are now ready to use **MILESTONE**.

On Disk Drives With More Than 400 Blocks

If your disk drives have 400 or more blocks/disk, you should be able to have all files on one drive. If you have 494 or more blocks, it won't be necessary to erase the files listed in STEP 10.

The MILESTONE product disk is distributed in standard IBM single-density format (i.e. interleave=2, skew=6, and first pascal track = 1).

Step 1

Using your operating system utility, format a blank disk.

Step 2

Execute the FILER and use the ZAP option to name the disk as "MS".

Step 3

Transfer the following files onto the disk named "MS".

<u>FILE NAME</u>	<u>SIZE</u>
SYSTEM.INTERP	27
SYSTEM.PASCAL	123
SYSTEM.MISCINFO	1
SYSTEM.LIBRARY	8
SYSTEM.FILER	32

197 blocks used,

203 unused

Be sure that SYSTEM.LIBRARY is no larger than about 20 blocks! If it is, there will not be enough room to run MILESTONE.

If SYSTEM.LIBRARY is too big, you can use LIBRARY.CODE to remove units not needed by MILESTONE. The only one needed is LONGOPS which is only about 8 blocks long.

Step 4

Load the MS disk in the first drive and boot your system.

Step 5

Execute the FILER, load the MILESTONE product disk into the second drive and list its contents. You should have the following files.

NAME	SIZE	DESCRIPTION
USERLIB.TEXT	4	Tells the system to use ORGANIC.CODE library
ORGANIC.CODE	29	A library used by other .CODE files
CONFIG.CODE	26	Used to configure your terminal and printer
ORGANIC.DAT	18	Control-code data for a variety of terminals
LEARNHOW.CODE	8	Sample program showing option and data entry
MILESTON.CODE	121	The MILESTONE program
EXAMPLE1.DES	1	First part of example #1
EXAMPLE1.JOB	2	Second part of example #1
ORGDATA.CODE	14	Builds the file ORGANIC.DAT

Step 6

Using the FILER, transfer the first five files onto the MS disk and then list its directory.

FILE NAME	SIZE
SYSTEM.INTERP	27
SYSTEM.PASCAL	123
SYSTEM.MISCINFO	1
SYSTEM.LIBRARY	8
SYSTEM.FILER	32
USERLIB.TEXT	4
ORGANIC.CODE	29
CONFIG.CODE	26
ORGANIC.DAT	18
LEARNHOW.CODE	8

282 blocks used,

118 unused

Step 7

Execute CONFIG and select your terminal from the list.

If you get a "version error" message when running CONFIG, you must be using a 68000 or other cpu with the opposite byte sex from the INTEL family of microprocessors (for example, the SAGE II

or the Corvus Concept). If this happens to you, exit from CONFIG, and execute #5:ORGDATA.CODE. It will rebuild the file ORGANIC.DAT in a format your computer can understand.

Step 8

Execute LEARNHOW and practice entering different types of data.

Step 9

Run the FILER and list the directory of #4 again.

<u>FILE NAME</u>	<u>SIZE</u>
SYSTEM.INTERP	27
SYSTEM.PASCAL	123
SYSTEM.MISCINFO	1
SYSTEM.LIBRARY	8
SYSTEM.FILER	32
USERLIB.TEXT	4
ORGANIC.CODE	29
CONFIG.CODE	26
ORGANIC.DAT	18
LEARNHOW.CODE	8
TERMINAL.DAT	1

283 blocks used,

117 unused

The file TERMINAL.DAT was created by CONFIG and must remain.

Step 10

If there aren't at least 126 unused blocks on the disk, remove the file ORGANIC.DAT (it is no longer needed) to make room for MILESTONE.CODE.

Step 11

"Crunch" volume #4 to make as much disk space available as possible.

<u>FILE NAME</u>	<u>SIZE</u>
SYSTEM.INTERP	27
SYSTEM.PASCAL	123
SYSTEM.MISCINFO	1
SYSTEM.LIBRARY	8
SYSTEM.FILER	32
USERLIB.TEXT	4
ORGANIC.CODE	29
CONFIG.CODE	26
LEARNHOW.CODE	8
TERMINAL.DAT	1

265 blocks used,

135 unused

Step 12

Insert the MILESTONE distribution disk in the second drive and transfer MILESTONE.CODE, EXAMPLE1.DES and EXAMPLE1.JOB to the first drive.

<u>FILE NAME</u>	<u>SIZE</u>
SYSTEM.INTERP	27
SYSTEM.PASCAL	123
SYSTEM.MISCINFO	1
SYSTEM.LIBRARY	8
SYSTEM.FILER	32
USERLIB.TEXT	4
ORGANIC.CODE	29
INSTALL.CODE	60
TERMINAL.DAT	1
MILESTONE.CODE	121
EXAMPLE1.DES	1
EXAMPLE1.JOB	2

387 blocks used,

13 unused

If you are using a 68000 or other cpu with opposite byte sex, you will be unable to load the example data file.

You are now ready to run MILESTONE.

Customizing Your Terminal & Printer to Milestone

Before you run MILESTONE you must first run the program named CONFIG. It creates a special data file named "terminal.dat" that contains all the information you need to control your particular terminal and printer. If, at a later date, you have changed your terminal or printer, you can then rerun CONFIG to change the data file.

Whenever you run MILESTONE you must be sure that the file named "TERMINAL.DAT" is present on the currently logged disk drive.

Step One: Terminal Selection

After you run CONFIG, the first screen you see is the terminal selection menu:

CONFIGURE Revision 1.03

Copyright 1980-1981 by Organic Software, Inc.

This program is now configured for a

It can be changed to one of the following terminals

A) ANSI Standard terminal	M) Heath H19 & H89	Y) Televideo 900
B) ADDS Regent 20 & 25	N) IBM 3101	Z) TRS 80 MOD II FMG CF M
C) ADDS Regent 40 & 40	O) Matica 100	0) TRS 80 MOD II LARload
D) ADDS Viewpoint	P) Interdec Superbrain	1) TRS 80 MOD II P&T CF M
E) Apple II M&R Superterm	Q) Lear Siegler ADM 3A	2) Vector M2 Video Driver
F) Apple II SmartTerm	R) Lear Siegler ADM 42	3) VIC C Video Driver
G) Apple II Videx Video	S) MicroTerm ACT IV & V	4) Volker-Craig VC404
H) Apple II E-80 Softcard	T) NorthStar Advantage	5) Xerox 800
I) Beebiv Micro B 2	U) Otrona Attache	6)
J) Hazeltine 1410	V) Sanyo 16, 120 & 140	7)
K) Hazeltine 1410 & 1410	W) TAE 102.5	8)
L) Heath H19 & H89	X) Televideo 910 & 910	9) Terminal Not Shown

To change the terminal, press the corresponding letter.

To quit, press ESC; to leave as shown, press RETURN.

The screen lists some of the most popular terminals used with CP/M 2.x and small computers. CP/M-86 and UCSD versions will list terminals typically used by those systems. If yours is listed, then press its letter.

If it is NOT listed, press "9" and follow the instructions in Appendix B.

Step Two: Printer Selection

The printout options govern how output reports are to be printed. Some of them depend upon the physical characteristics of your printer, others depend upon how you want reports to be formatted.

PRINTOUT OPTIONS

D(evice name = printer
W(idth in columns = 80
H(eight in lines = 66
T(op margin = 3
B(ottom margin = 3
L(eft margin = 1
R(ight margin = 80
U(se form-feeds = Yes
P(ause at page end = No

To change a variable, press its letter D W H etc
To quit with no changes, press ESC
To leave as shown, press RETURN

D(evice name

Normally you will direct the printout to your printer (it's called "printer:", not "lst:" on CP/M systems), however, by changing the device name you can redirect the output to a disk file or any other device. Although legal device names on CP/M systems are limited to "printer:", "punch:" and "null:", you can direct the output to a different device by using the STAT command.

If the output is to a disk file, you can insert it directly into a report using a text formatting program such as TEXTWRITER by Organic Software.

W(idth in columns

You can use a printer of any width. Most printers print ten characters per inch on paper either 80 or 132 columns wide. Others can print at twelve or sixteen and a half characters per inch. Although most MILESTONE reports use only 80 columns, some, such as the MILESTONE Time Schedule Report, can use up to 255.

After running MILESTONE for a while, you may wish to rerun this program and change the printer width. For example, some printers automatically perform a linefeed whenever an 80 column line is printed, causing the output to be double-spaced. If this is true for yours, change the printer width to 75 columns.

H(eight in lines

The most common page height is 66 lines, corresponding to six lines per inch and a paper length of 11 inches. However, some printers can print at eight or more lines per inch producing 88 or more lines per page.

You must specify the page height so that the program can keep track of where it is on the page. If you are using fan-fold paper and a printer that responds to form-feeds, then this number may be less than the actual number of lines per page. If your printer does not do form-feeds, then this number must be exactly equal to the actual number of lines per page.

T(op margin

Any number of lines may be skipped at the top of each page. Normally this should be set at three to leave one-half inch at the top of the page, however, you may make it any value you wish.

B(ottom margin

Any number of lines may also be skipped at the bottom of each page. Normally this should be set at three to leave one-half inch at the bottom of the page, however, you may make it any value you wish.

L(eft and R(ight margin

You can also specify the position of the left margin and right margin for some reports and printouts. The margin value along with the three previous values mentioned above gives you complete control over the position of the printing on your printer paper. (**NOTE:** These two parameters are intended for word processing applications and are not used by MILESTONE.)

U(se form-feeds

Set this value to "YES" if your printer is capable of responding to an ASCII form-feed character. It causes the paper to be advanced as fast as possible to the beginning of the next sheet. **NOTE:** It will have an effect only if the bottom margin setting is not zero.

P(ause at page end

If you intend to use single sheets of paper in your printer, then you must have this option set to "YES", so that the program will stop at the end of each page ready for you to insert another single sheet.

There are two ways to load single sheets into your printer: so that the print element is ready to print on the very first line of the sheet, or rolled up one inch (and held against the platen by the pressure bail) so that the element is ready to print on the seventh line of the sheet. If you intend to roll the paper up one inch, then you must change the top margin to 0 and the paper length to 60 lines.

Step Three: Disk Drive Selection

DISK DRIVE OPTIONS

Data drive name = A

To change a variable or select an option press its letter
To quit with no changes press ESC
To leave as shown press RETURN

Data drive name

This is the name of the disk drive normally holding data files. The drive you select is used as a default drive only and can be overridden at any time. If you have a dual disk system, you should probably keep programs on the first drive and data on the second.



Learning How to Enter Data

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Learning How to Enter Data

To help you learn how to run programs provided by Organic Software, we have created a special program called "LEARNHOW" which is provided on your MILESTONE diskette. Our method of entering data may be a little different from what you have learned running other computer programs, but we think you will find it to be much better.

To get started, first run CONFIG, then run LEARNHOW.

For CP/M systems type:

B>prun learnhow

For UCSD or Apple PASCAL Systems type

```
Command: E)dit, R)un, F)ile, C)omp, L)ink, X)ecute, A)ssem,  
D)ebug? X  
Execute what file?   learnhow
```

You will see the Startup Menu:

LEARNHOW, Revision 1 03
Copyright © 1981 by Organic Software, Inc.
Learn how to enter data and to select options

DATA FIELDS

I(nteger variable = 101
S(tring variable = Hello
C(lock time = 12:00
D(ay of the year = 1/1/80

OPTIONS

A(dd one day to the date shown above
Q(uit this program

To change a variable or select an option, press its letter

The screen displays of all Organic Software programs are in this same general format.

At the top left-hand corner is the title of the display, or "menu". Menu titles are always listed in the index for quick reference.

Next is a list of data fields. You can tell they are data fields because each phrase is followed by an equals-sign and a value. The value is highlighted if this is possible on your terminal. To change the value of a data field, press the first letter of the field. It is capitalized and followed by a left parenthesis.

Following the data fields is a list of options. In the example above, "A(dd one day" means to increment the date shown in the data

field. Whenever you press an option letter, the option is performed immediately—you need not press RETURN.

At the very bottom of the screen, you usually will find a prompt message. It is typically a series of sentences listing actions you might want to take followed by a reminder of how to proceed. Sometimes when you change a data field, this prompt message will change and give you specific instructions about the data field you selected.

When the program you are running displays a special screen of data, the data fields and options are packed into a few lines at the bottom of the screen to save space. You still should be able to recognize your choices by looking for capital letters followed by left parenthesis.

Special Keys

Although the American National Standards Institute (ANSI) has published a standard for computer terminals, very few manufacturers follow it. As a result, most computer keyboards are slightly different.

Below are listed several actions you will wish to perform along with the keys you will need to press. Each action has several possible keys; use the one that you can find on your keyboard.

To backup the cursor one position:

BACKSPACE
DELETE
DEL
RUBOUT
RUB
CTRL-H (ASCII BS or DEL)
— (IBM-PC)

Don't use the back-arrow unless you are sure it generates an ASCII backspace.

To quit entering data and ignore changes that have been made:

ESCAPE or ESC (ASCII ESC)

To quit entering data and leave all values as shown on the screen:

RETURN or ENTER (ASCII CR)
— (IBM-PC)

To skip forward to the next data field:

TAB or CTRL-I (ASCII HT)
— (IBM-PC)

To skip backward to the previous data field:

BACKSPACE
DELETE
DEL
RUBOUT
RUB
CTRL-H (ASCII BS or DEL)
— (IBM-PC)

Skip-back only works from the first position in a data field.

Practice Changing Data

The values you see after each data item, or field, are called "default values". Unless you change them they will be used in the program. Changing data fields is easy:

To change the I(nteger variable value from 101 to 99 press:

I

to move the cursor to that field, press:

9

You will notice that the number 9 is displayed next to the = sign followed by three dots. These dots tell you how many more digits may be entered. This keeps you from entering more digits than a program will allow. Since you want the new value to be "99", once again press:

9

Now the integer value appears the way you want it to, so press:

RETURN

Entering words or letters is just as easy. To change the S(tring Variable value from "hello" to "Hi!" press these keys:

S HI! RETURN

And you have substituted your string of characters for the default value.

Time-of-day is always entered in this format: hh:mm where hh stands for hour and mm stands for minutes. To change the "Clock Time" field from 12:00 to 1:45 type:

C 1:45 RETURN

To change it from 1:45 to 11:00 type:

C 11 RETURN

Dates are entered in this format: mm/dd/yy as in 10/3/49 for October third, 1949. To change 1/1/80 to July 1, 1980 press:

D 7 RETURN

And notice that the rest of the date (which is the same as the default value) is supplied for you. 7/1/80 can be changed to 12/6/83 by typing:

D 12/6/83 RETURN

12/6/83 can then easily be changed to 12/9/83:

D /9/ RETURN

There is a quick way to compute a new date. Suppose you want to change the date shown to a new date 45 days later. Just type:

D +45d

If the value of the date field was 1/1/80 when you entered this command, the new date would appear: 2/15/80.

You can go forward or backward in time by entering either + or - followed by up to three digits. You can move by days, weeks, months or years by following the number you enter with either "d", "w", "m" or "y".

The Options section of this menu is similar to ones you will encounter in MILESTONE. Pressing:

A

will automatically add one day to the date shown in the D(ay) field. Pressing:

Q

will return you to your operating system. From there you can run MILESTONE or another program.

Entering Data Is Easy Because ...

- You can read the prompt message at the bottom of the screen for special instructions.
- You don't need to press RETURN (or ENTER on some computers) when you select a data field or option, because the key is accepted as soon as you press it.
- To quit and return to the previous menu, or end the program, you simply press "Q".
- Once you have selected a data field, you may press ESC if you have changed your mind. Regardless of what data you may have entered, it will be ignored and the data field will be restored to its previous value.
- After you have entered a new data field, you may press:

RETURN

if the data is correct and you want to stop entering data.

TAB (or CTRL-I on some keyboards)

to skip to the next data field. The order is from left to right across the screen and then from top to bottom.

BACKSPACE

to backup one character position. If the cursor is at the very beginning of a data field, it will skip to the beginning of the previous data field. If your terminal does not have a BACKSPACE key, then try RUBOUT, DELETE, or CTRL-H (i.e. hold down the key labeled CTRL and simultaneously press H). One of these combinations will back up the cursor.

ESC

to erase the data you have entered and quit data entry.

- If you type an illegal character, it will be ignored and you will hear the terminal bell ring. You might also see an error message displayed at the bottom of the screen.
- To stop entering data, you just press RETURN, TAB, or ESC; if you don't, a bell will remind you.



IV

Milestone Tutorial

SECTION IV



Milestone Tutorial

This section will take you step-by-step through the loading and modifying of an example MILESTONE project. Completing the activities should take about ten minutes and will familiarize you with most of the features of MILESTONE. Section V will show you how to create a new project.

NOTE: The keys you should press will be shown in **boldface**.

RET means "press the RETURN or ENTER key"

TAB means "press the TAB key"

1. RUN MILESTONE:

prun mileston **RET** (for CP/M systems)

EX(ecute milestone **RET** (for PASCAL systems)

2. START-UP MENU:

Y(our name (enter your name) **RET**

C(ontinue (wait for new screen)

3. LOAD a project into memory:

L(oad **F**(ile **EXAMPLE1** **RET**

D(epress the letter of the drive Example1 is in **RET**

L(oad **Y**(es **M**(odify

N(ames, descriptions, options

4. From NAME, DESCRIPTIONS, AND OPTIONS menu:

a) change the project leader to your name:

L(eader (your name) **RET**

b) change start date to current date:

S(start (new date)

c) Q(uit making changes

5. Select **M**(ANPOWER menu:

a) change operating engineer cost to \$1000:

1 1000

b) change 'laborer' to 'ditchdigger':

2 ditchdigger

c) add category #5, 'painter', to cost \$500:

5 painter 500

d) Q(uit making changes

6. Select **W**(ORKING DAYS menu:

a) change finish lunch to '13' (on 24-hr. clock):

F 13

b) add 7/5/83 to holidays:

H 7/5/83 Q

7. Select **T**(IME SCHEDULE DISPLAY:

a) Insert job #12 'paint sidewalk' BEFORE job 11, cost \$800:

I J 11 B

b) Specify new job:

paint sidewalk 2 800 10 1

c) Modify job #5, "dig 2nd part of trench" to three weeks duration (instead of one week) and note how entire schedule is affected:

M 5 D 3

d) Practice cursor moves and jumps with number coordinates:

press **L** or **R** several times

press **4L** to move display 4 weeks to left

press **3U** to move display UP 3 lines

press **6D** to move display DOWN 6 lines

e) Press **O**(ther Options and then view results of:

R(enumber **E**(ffort Summary **C**(ost Summary

8. Return to Main Options menu: **Q Q** and select **P**(rint
View project report options on screen:

P(roject Description: One page summary listing all general information and manpower cost totals. Provides summary of all resources a project will require.

J(ob Description: A detailed summary of the factors involved in each job. User may select which portions of the report to print by specifying first and last job numbers under the "Modify Printout Parameters" option.

C(olumnar Job Report: A compact table showing all the information that appears in the Job Description Report. This report can be customized by selecting the data that will be contained in the tables.

T(ime Schedule Graph: A printed image of the screen Time Schedule display. Strips may be taped together for jobs which cover a long span of time. The Time Schedule is the only report which cannot be previewed on the screen.



Creating a Milestone Project

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Creating a Milestone Project

This section shows you how to develop a simple project with MILESTONE. If you have worked through the tutorial, you are familiar with how to enter and modify project data. Now you will learn how to create a new project.

This simple construction project exhibits most of the characteristics of a project management plan. The project is to install a new water main in a small town.

Assume for a moment that your name is J. K. Henderson and you are the city engineer in charge of installing a new water main. Before the project can begin you must come up with a plan and a cost estimate—a perfect job for MILESTONE.

Planning a Project

Before you run MILESTONE you think about the project and divide it into several steps.

- **Purchase the pipe:** Although this doesn't require any manpower, it will take two weeks for the pipe to be delivered and cost \$50,000.
- **Purchase the pipe fittings:** It will take three weeks for the pipe fittings to be delivered and cost \$25,000.

- **Dig the trench:** Since this will take one operating engineer and three laborers three weeks, the digging should be started immediately. Other costs will be \$5,000.
- **Lay the pipe:** As soon as the pipe and fittings are delivered and the trench is dug, laying pipe can begin. Two welders and four laborers will take four weeks to complete this job. Other costs will be \$13,000.
- **Fill the trench:** Two operating engineers and two laborers can fill the trench in two weeks. Rental of equipment is expected to be \$10,000.
- **Repave the street:** Three operating engineers, \$30,000, and 2 weeks.
- **Repair the sidewalk:** This job will be subcontracted for \$5,000 and take one week.

There are two types of costs in this project: direct outlays for material and indirect manpower costs. Manpower is expected to cost \$1000 per man-week for an operating engineer, \$500 per man-week for a laborer, \$750 per man-week for a welder, and \$1500 per man-week for a civil engineer.

Step One: Beginning the Project

With this information in mind, the first step is to create a new MILESTONE project and enter the project description. From the MAIN OPTION menu, select the C(reate option.

CREATE A NEW PROJECT

Name of project = First Street Water Main
 Leader of project = J K Henderson
 Time scale = Weeks (Hours, Days, Weeks, Months, Quarters, Fiscal)
 Start date = 1/5/81 (Tue Jan 1)
 Direct cost units = K\$ (Either \$, K\$, or M\$)
 Manpower cost units = \$ (Either \$, K\$, or M\$)
 Find critical path = yes

To change a project description data field, press its letter
 To quit making alterations, press "Q"

Above is how the screen appears after the name, leader and start date have been entered. The direct cost units and manpower cost units need not be changed because the default values are valid for our example.

To enter the project name on your screen as it is shown above type:

N First Street Water Main

and then press:

TAB

to move to the next data field (Leader of Project). Enter:

J.K. Henderson TAB TAB



We skipped the cursor over the time scale field because this project will use the default value, weeks. The cursor is now placed at the Start Date field, so type:

1/5/81

All the changes we have to make are complete. Press:

RET

to leave the data fields and then press:

Q

to return to the Main Options Menu.

Step Two: Setting Up the Skill Categories

The next step is to enter the names of each skill and their corresponding costs. Press:

M

To Modify or Display the Current (First Street Water Main) Project. Then press:

M

to go to the Manpower Skills and Costs Menu. After you enter your data the display will look like this:

MANPOWER SKILLS & COSTS

	Description	Cost in \$ Man-Week
1(st)	skill category = Operating engineer	1000
2(nd)	skill category = Laborer	500
3(rd)	skill category = Welder	750
4(th)	skill category = Civil Engineer	1500
5(th)	skill category =	
6(th)	skill category =	
7(th)	skill category =	
8(th)	skill category =	
9(th)	skill category =	

To change a skill description, press its number

To change a skill cost, press its number and then press TAB

To quit editing the skill categories, press Q

To enter the first category, operating engineer, and its cost per week type:

1 Operating Engineer **TAB** **1000**

Pressing **TAB** moves you to the next category. Use the above method to enter the next three categories. When you are finished entering data press:

RET

and then press:

Q

to go back to the Main Options Menu.

Step Three: Developing the Time Schedule

Now that all of the preliminary data has been entered, it is time to begin entering each job. It is not necessary to draw up a network diagram if you have a good idea of what steps are involved in the project. Instead, you can add and insert jobs as you think of them.

To select the Time Schedule option from the Main Options Menu, press:

T

and you are ready to begin entering the jobs.

First, select Other Options and turn on the Effort and Cost Summaries by typing:

O E C

Your screen should now look like this:

PROJECT SCHEDULE

	Jan				Feb				Mar			
Revision 1.1 (81)	5	12	19	26	2	9	16	23	2	9	16	
Job (Room for 128 more)	0	1	2	3	4	5	6	7	8	9	10	

Manpower level = 0 0 0 0 0 0 0 0 0 0 0

Manpower cost in K\$ = 0 0 0 0 0 0 0 0 0 0 0

Direct cost in K\$ = 0 0 0 0 0 0 0 0 0 0 0

Name = Duration = 0 Cost = 0

R(enumerate all jobs) don't show Effort Summary O(ther Options

S(ort jobs into time order) don't show Cost summary Q(uit

To select an option, press its letter to see other options press C

Press **O** again to return the first prompts to the screen.

Now you are ready to begin adding jobs, Press:

A

to add a job. The screen will display this message each time you add a new job:

Job number 1 will be added before or after the job shown below
J(job number = 0 B(efore = No A(fter = Yes
To change its position press "J" to change before or after press "B" or
"A"
To quit press ESC to continue press RETURN

This menu allows you to choose the position of each new job in your project.

Since we will be adding our jobs in the correct time order, this information can be left as shown. To continue press:

RET

To enter the first job, purchasing the pipe, type:

purchase the pipe TAB

Then enter the time duration (two weeks):

2 TAB

Enter the direct cost (\$50,000) and then quit adding data:

50

The screen should now look like this:

PROJECT SCHEDULE												
	Jan				Feb				Mar			
Revision 1 1181	5	12	19	26	2	9	16	23	2	9	16	
Job (Room for 127 more)	0	1	2	3	4	5	6	7	8	9	10	
1 Purchase the pipe	0		X									
Manpower level =	0	0	0	0	0	0	0	0	0	0	0	
Manpower cost in K\$ =	0	0	0	0	0	0	0	0	0	0	0	
Direct cost in K\$ =	50	0	0	0	0	0	0	0	0	0	0	
A(dd E(rase or I(nsert a job	move U(p D(own L(efl R(ight or H(ome											
M(odify or C(omplete a job	O(ther options				Q(uit							
To select an option press its letter; numbers can prefix a move												

At the bottom of the screen you can see the data fields as entered for "Purchasing the pipe". Since this job has no prerequisites, the early start date is set to zero, corresponding to January 5th. Purchasing the pipe will take two weeks and the Direct cost is \$50,000. No manpower is required for this job.

Notice that now there is room for 127 more jobs in memory. As you add more jobs, you will see this number decrease.



The arrow tail "O" shows that purchasing the pipe has no prerequisites, and the "X" shows that it has no successors. The equals signs "===" tell you that the job is on the critical path. Of course this job is critical; it is the first job in the project.

You can enter the next two jobs, purchasing the fittings and digging the trench, in a similar manner:

A(dd a job Purchase the Fitting 3 25

A(dd a job Dig the trench 3 5 1 3

The screen will now reflect these changes:

PROJECT SCHEDULE

	Jan				Feb				Mar			
Revision 1, 1/1/81	5	12	19	26	2	9	16	23	2	9	16	
Job (Room for 125 more)	0	1	2	3	4	5	6	7	8	9	10	
1 Purchase the pipe	O		X									
2 Purchase the fitting	O			X								
3 Dig the trench	O			X								

Manpower level = 4 4 4 0 0 0 0 0 0 0 0

Manpower cost in K\$ = 2 2 2 0 0 0 0 0 0 0 0

Direct cost in K\$ = 80 0 0 0 0 0 0 0 0 0 0

A(dd E(rase or I(nsert a job move U(p D(own L(ett R(ight or H(ome

M(odify or C(omplete a job O(ther options Quit

To select an option, press its letter; numbers can prefix a move

All three jobs are shown as critical because they occur in parallel and are totally independent of each other. Later, after adding other jobs, the slack times will appear.

The manpower level shows that four people are working during the first three weeks. The manpower cost is only approximate because it is rounded down to the next lowest level in K\$. Approximations are used in the cost summary to make the computations fast and to conserve memory. Totals that appear on the printed reports, however, are accurate to four significant digits.

The direct cost total shows that \$80,000 must be committed to the project in the first week.

The next screen shows the time schedule after "Laying the pipe" has been added:

PROJECT SCHEDULE

	Jan				Feb				Mar			
	5	12	19	26	2	9	16	23	2	9	16	
Revision 1 1 1 81												
Job (Room for 124 more)												
1 Purchase the pipe												
2 Purchase the fitting												
3 Dig the trench												
4 Lay the pipe								X				

Manpower level = 4 4 4 4 4 4 4 0 0 0 0

Manpower cost in K\$ = 2 2 2 2 2 2 2 0 0 0 0

Direct cost in K\$ = 80 0 0 13 0 0 0 0 0 0 0

A(dd E(rase or I(nsert a job move U(p D(own L(efl R(ight or H(ome

M(odify or C(omplete a job O(ther options Q(uit

To select an option, press its letter; numbers can prefix a move



The arrow ending with "X" shows that this phase of the project will be completed by February 23. Note that Job 1, purchasing the pipe, has one week of slack time. This means that a week's delay in pipe delivery will not delay the project.

A Few Words About Slack Time

New users of Milestone often wonder how they can make slack time appear.

Slack time appears only when a job's successor has a starting date that is later than the job's earliest finish date. In the example given, purchasing the pipe is scheduled to be completed by the end of week two, but laying the pipe does not start until the beginning of the fourth week.

Jobs 2 and 3 are both critical. Even though they are parallel, the fact that their durations are equal makes them both critical.

Entering Jobs With Prerequisites

Job 4, "Laying the pipe," depends upon the completion of the first three jobs. To enter this job you must specify the prerequisites 1,2,3 and then specify the manpower required (4 laborers and 2 welders):

Add Lay the pipe 4 13 1,2,3
 4 2

Notice that the early start field disappears when you enter prerequisites.

The next screen shows the time schedule after all eight jobs have been added.

PROJECT SCHEDULE

	Jan				Feb				Mar		
Revision 1 1 1/81	5	12	19	26	2	9	16	23	2	9	16
Job (Room for 120 more)	0	1	2	3	4	5	6	7	8	9	10
1 Purchase the pipe	○										
2 Dig trench	○										
3 Purchase fittings	○										
4 Lay pipe											
5 Fill trench											
6 Repave street											
7 Repair sidewalk											
8 Project completed											

Manpower level =	4	4	4	6	6	6	6	4	4	3	3
Manpower cost in K\$ =	2	2	2	3	3	3	3	3	3	3	3
Direct cost in K\$ =	80	0	0	13	0	0	0	10	0	35	0

A(dd E(rase or I(nsert a job move U(p D(own L(eft R(ight or H(ome
M(odify or C(omplete a job Other options Q(uit
To select an option press its letter. numbers can prefix a move

Completion of the project is off the screen to the right. To see the end of the project, you can type "4L" and move the display four time units to the left.

At this point the project leader can refine the schedule by splitting jobs into parts or by adding other jobs as necessary.



What would happen to the schedule if we modified the job sequence in an attempt to complete the project in a shorter time?

PROJECT SCHEDULE

	Jan				Feb				Mar			
Revision 1 1/1/81	5	12	19	26	2	9	16	23	2	9	16	
Job (Room for 117 more)	0	1	2	3	4	5	6	7	8	9	10	
1 Purchase the pipe	O											
2 Dig 1st part of trench	O	-----										
3 Purchase fittings	O											
4 Lay 1st part of pipe												
5 Dig 2nd part of trench												
6 Fill 1st part of trench												
7 Lay 2nd part of pipe												
8 Fill 2nd part of trench												
9 Repair sidewalk												
10 Repave street												
11 Project completed											X	

Manpower level = 4 4 4 6 6 6 6 4 4 3 3

Manpower cost in K\$ = 2 2 2 3 3 3 3 3 3 3 3

Direct cost in K\$ = 80 0 0 13 0 0 0 10 0 35 0

A(dd E(rase or I(nsert a job move U(p D(own L(eft R(ight or H(ome

M(odify or C(omplete a job O(ther options Q(uit

To select an option, press its letter, numbers can prefix a move

The original steps of digging the trench, laying the pipe and filling the trench were each broken down into two parts so that some of the work could be overlapped. For example, you can lay the first part of the pipe after the first part of the trench is dug but before the second part has been dug.

The steps were broken into parts by using the modify and insert options. First, the existing job was modified to have a new name and a shorter duration. Then, a new job was inserted into the schedule after the original one. This new job was the second half of the original step.

It is this type of user interaction that makes MILESTONE unique among project planning programs. You can ask "What If?" questions and immediately see the impact on your project.



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Milestone Menus

The StartUp Menu

When MILESTONE is started, the terminal screen is cleared and the startup menu is displayed. It gives you the chance to enter new values for two data fields: the date and your name.

At the top of the Startup Display is the title of the program, the revision number, a copyright notice and a serial number. To receive verbal or written help from your software distributor or from Organic Software, you must always state your serial number and revision level so that we can check it against our file of signed Registration Cards.

As clearly stated in the Purchaser-Licensee Agreement in the beginning of this manual, use of this program is restricted to one computer system. To guard against copyright infringement each copy of the program is serialized and registered to the purchaser. If the copyright notice and serial number are altered in any way, the program will cease to function.

MILESTONE Revision 1.12, Room for 128 jobs in memory
Copyright © 1981 by Organic Software. Serial Number 000001

STARTUP DATA.

T(oday's date = 1/1/80
Y(our name =

STARTUP OPTIONS.

C(ontinue MILESTONE
Q(uit MILESTONE

To change T(oday's date press T
To change Y(our name press Y
To quit MILESTONE press Q to continue press C

MILESTONE keeps a small work file (named MILESTON.WRK) on disk. This file contains some information about your last MILESTONE session to make it easy to pick up where you left off. This file keeps the date, your name and the name and disk drive of the last project you worked on.

If the date and name are correct as shown, then press

C

and MILESTONE will continue. If you have changed your mind and want to quit, press

Q

But, if you want to change either of the two data fields, follow the instructions below.

T(oday's date

When MILESTONE is first started, it reads the file named "MILESTON.WRK" to find the date when it was last run. If the date is no longer correct, press the letter "T" and enter a new date (see Section III to find out how to enter dates).

Y(our name

The second item of startup data is your name. Even though you are preparing this project plan, you may not be the project leader. If this is true, you should enter your name here so that it will appear on all printed reports, giving you proper credit for your work.

Main Option Menu After Startup

After the startup data has been entered, MILESTONE's Main Options Menu is displayed. Upon completion, all other menu options will return you to this menu.



MILESTONE MAIN OPTIONS

There is no project in memory at this time

C(reate a new project

L(oad a different project into memory

Q(uit MILESTONE and return to the operating system.

To begin work, press "C" or "L" to create or load a project

To end MILESTONE, press "Q"

Look on the third line of the display to see a message indicating that there is no project in memory. Before you can do anything else, you must first either create a new project or load one in from disk.

C(reate a New Project

Select this option if you want to start from scratch and completely describe a new project. All of the project data is initialized to the default values, and then the project description is displayed, ready for changes.

Load a Different Project into Memory

As mentioned earlier, all project data is stored in two work files. The Load option reads these disk files into memory so that you can display your project on the screen, make changes to it, or print one or more reports on the printer.

Main Option Menu After Loading

After a project has been loaded into memory, the MAIN OPTIONS look different. First, you will notice that the name of the project is listed on the third line of the display. You will also notice that there are three other options available: Modify, Print and Save.

MILESTONE MAIN OPTIONS

The current project in memory is First Street Water Main

Create a new project

Load a different project into memory

Modify or display the current project

Print one of the project summary reports

Save the current project on disk

Quit MILESTONE and return to the operating system

To select a different project, press either C or L

To modify the current project, press M

To print a project summary report, press P

To end MILESTONE, first save your work with S and then press Q



C(reate new project

Select this option if you are finished working on the project in memory and wish to start from scratch with another. After first checking to make sure you have saved your work, all of the project data in memory is erased and re-initialized to a standard set of default values. Then the project description is displayed, ready for changes. Don't worry. If you load a project and then change it, you will be warned before the data is erased.

L(oad a different project into memory

First a reminder about disk files. As mentioned earlier, all project data is stored in two associated disk files. The "L(oad" option reads these two files into memory so that you can work with them.

The load option and the save option give you explicit control over your project files. However, along with this control comes the responsibility to manage the files intelligently. Although MILESTONE always gives you fair warning before erasing any information, it is up to you to save your own work and to periodically make backup copies of your important project files.

M(odify or display the current project

This is the most frequently selected option because you must use it to change any of the data that make up a project. When it is selected, it causes the Modify Options to appear on the screen. You may then modify any of the four data groups that define a project.

P(rint summary reports

Choose this option whenever you want to make a printout of the project schedule or any other project report on your printer. The printout is a permanent record of your work which you can hang on your office wall, show to others, or include in your project documentation.

A complete discussion of the "P(rintout reports" is provided under the Print Summary Reports menu at the end of this section.

S(ave the project on disk

As mentioned above, all project data is stored in two associated disk files. The "S(ave" option writes from memory into the disk file so that you can save your work.

Be careful! The old project file is destroyed in the process of saving the new one if the new one has the same name as the old. If you want to keep a record of a version of the project either make print-outs of the old file before you change it or copy the old version to a separate disk before altering it.

Q(uit MILESTONE

To end a MILESTONE session, press the letter "Q". If you have not saved your work, you will be warned.

Create a New Project Menu

The project description is made up of six data fields which normally are the first data that you enter when you create a new project. The most important one is the "T(ime scale" and you should consider it carefully.

CREATE A NEW PROJECT

N(ame of project =
 L(eader of project =
 T(ime scale = Weeks (Hours Days Weeks
 Months Quarters Fiscal)
 S tart date = 1/1 80 (Tue Jan 1)
 D(irect cost units = K\$ (Either \$ K\$ or M\$)
 M(anpower cost units = \$ (Either \$ K\$ or M\$)
 F(ind critical path = yes

To change a project description data-field, press its letter
 To quit making alterations, press Q

Create a new project

Select this option if you want to start from scratch and completely describe a new project. All of the project data is initialized to a standard set of default values, and then the project description is displayed, ready for changes.

N(ame of project

The project name appears on all printouts generated by MILESTONE and is the primary means of identifying a project. You may enter any string of up to 40 characters.



L(leader of project

Every project has a leader and, as you know, they tend to be rather conceited types and never miss an opportunity to see their name in print. So here it is: you can use up to twenty-four characters; make sure you spell his/her name correctly. If you are preparing the plan for someone else, don't worry, your name will still appear on all of the reports so that you get credit for your work.

T(ime scale

As shown to the right of the display, the time scale may take on several different values: hours, days, weeks, months, quarters, or fiscal quarters.

All job durations are an integral number of time units, so pick the time scale that corresponds to the shortest job in your project. If some of the jobs are only one or two days in duration, then you should probably choose days as the time unit. However, if most jobs are many weeks long, you may choose weeks as the time scale and enter 'day-long' jobs as zero weeks. Before you choose a time scale, think carefully about how "closely" you are going to manage the project. If you plan to check its progress every week, then weeks is the proper time scale. Don't select a shorter time scale unless you really need it.

Your choice also determines how the time line is displayed across the time schedule graph. The table below illustrates each of the options.



TIME SCALE	TIME SCHEDULE EXAMPLE
HOURS	Thu Jan 1 Fri Jan 8 9 10 11 12 1 2 3 4 8 9 0 1 2 3 4 5 6 7 8 9 10
DAYS	Jan 1 2 3 4 5 6 7 8 9 10 11 0 1 2 3 4 5 6 7 8 9 10
WEEKS	Jan Feb Mar 6 13 20 27 3 10 17 24 2 9 16 0 1 2 3 4 5 6 7 8 9 10
MONTHS	1980 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov 0 1 2 3 4 5 6 7 8 9 10
QUARTERS	1980 1981 1982 Jan Apr Jul Oct Jan Apr Jul Oct Jan Apr Jul 0 1 2 3 4 5 6 7 8 9 10
FISCAL QUARTERS	FY80 FY81 FY82 Oct Jan Apr Jul Oct Jan Apr Jul Oct Jan Apr 0 1 2 3 4 5 6 7 8 9 10

Although the screen display is limited to eleven units of time, the entire duration of the project appears on the printed time schedule graph. This is done by printing the schedule in several vertical strips which you can attach to form a complete chart. See the section titled "Print summary reports".

The time scale is the most crucial data item - choose it carefully. If you change the time scale, the individual job durations are not converted automatically and you will have to use the MODIFY option to change the durations of each job accordingly. MILESTONE does not automatically change the durations because there is no unambiguous transformation between all possible time scales.

Start date

The start date is the date when you expect the project to begin. It becomes the 0th time unit in the project. All dates are relative to

the start date, not absolute. After entering all the jobs, a project can be shifted in time by simply changing the start date.

Direct cost units

Each job may have an associated direct cost. This is a one time capital or expense outlay that is independent of the duration of the job. For example, in the "First Street Water Main" project, "purchase the pipe" has a direct cost of 50K\$. As is common practice when dealing with cost estimates, figures are expressed in units of thousands or millions with only a few significant digits. This data field specifies which units will be used.

Only four significant digits are printed by MILESTONE. This saves space in memory allowing room for a large number of jobs. If you select K\$, then direct costs can have values from \$1000 to \$9,999,000. This means that direct cost of less than \$1000 must be either ignored or rounded up to \$1000. Likewise, direct costs of more than \$9,999,000 must be spread over more than one job.

Use the table shown below to choose the cost units depending on the range of job costs you foresee.

COST RANGE	COST UNITS
Dollars	\$
Thousands	K\$
Millions	M\$

Don't worry about cost totals exceeding the range of the units you have selected; MILESTONE automatically adjusts the cost units when totals are printed.

If you change the cost units, you will have to change the job costs that you have already entered.

Manpower cost units

Each skill category has an associated manpower cost expressed as "cost units/work unit" where the work unit is determined from the time scale. So, choose the manpower cost units based upon the time

10

scale that you have already chosen. For example, a time scale of weeks results in a work unit of man-weeks. The work units are summarized in the table below.

Time scale	Work units
Hours	Man-Hours
Days	Man-Days
Weeks	Man-Weeks
Months	Man-Months
Quarters	Man-Months
Fiscal	Man-Months

Later, when you enter the details for each skill category, you will be asked to specify the corresponding manpower costs.

If you change the cost units, you will have to change the skill category costs that you have already entered.

Find critical path

Although MILESTONE is based upon critical path analysis, it is sometimes useful to disable this feature and just consider direct scheduling of jobs. If that's what you want, then set this data field to "no".

Load a Different Project Menu

This menu appears when you choose the Load a Different Project option from the main menu. Use this menu to retrieve a project you have previously saved. If you can't remember the file name and the disk drive for a project, you must return to the operating system and read the disk directory to find out the exact information. Therefore, it is a good idea to keep a list of project filenames or check the directory before running MILESTONE.

LOAD A DIFFERENT PROJECT**DISK FILE DATA**

F(ile name = example1

D(isk drive = B

DISK FILE OPTIONS

L(oad the project into memory

Q(uit and return to the MAIN OPTIONS

To change the file name or disk drive press 'F' or 'D'

To quit and return to the MAIN OPTIONS press 'Q'

To load the project press 'L'

F(ile name

To work on a different project, change the file name by pressing:

F

and entering a new file name. After the file is loaded, its name and a short summary is displayed for you to verify.

D(isk drive

To change the disk drive, press:

D

Besides choosing a file name, you must keep track of the disk drive where the file is stored. As shown in the screen above, the file named "example1" contains data for the water main project and

resides on the "B" disk drive. (On UCSD PASCAL system, disk drives are named with numbers like #4 and #5 or with seven character names.)

Modify or Display The Project Menu

Project information is entered in four parts:

- Project name and description
- Skill categories
- Working hours
- Time schedule

The last three parts contain data items that apply to the entire project. The job description contains details that describe each step of the project.

Since the four sets of data are distinct, you are given access to them through different menus.

MODIFY OR DISPLAY THE PROJECT

PROJECT DATA GROUPS

N(ame description & options

M(anpower skills & costs

W(orking days, hours & holidays

T(ime schedule

To modify or display the project press N M W or T

To quit and return to the MAIN OPTIONS press Q

N(ame, description & options

This data group includes the project name, the name of the project leader, the start date, time scale, and cost units.

M(anpower skills & costs

If you want to keep track of manpower for your project, you should make use of the skill categories. MILESTONE allows up to nine different manpower classifications and their corresponding rates of pay.

W(orking days, hours & holidays

If your project uses a time scale of HOURS or DAYS you should make use of this option. It gives you the opportunity to define your



normal working hours, working days and holidays. Don't bother to set up this data if your project's time scale is weeks, months or quarters.

Time schedule

This is the heart of MILESTONE. Under this option you enter job data and view the time schedule on the screen.

Name, Description and Options Menu

These are the first items you should enter when defining a new project.

NAME DESCRIPTION & OPTIONS

N(ame of project =	First Street Water Main
L(eader of project =	J. K. Henderson
T(ime scale =	Weeks
	(Hours, Days, Weeks Months, Quarters Fiscal)
S tart date =	1/1/81
	(Thu Jan 1)
D(irect cost units =	K\$
	(Either \$, K\$, or M\$)
M(anpower cost units =	\$
	(Either \$, K\$, or M\$)
F(ind critical path =	yes

To change a project description data-field, press its letter
To quit making alterations, press "Q"

A complete description of each of these categories is provided above under the "Create a New Project" menu.

Working Hours, Days and Holidays Menu

WORKING HOURS, DAYS AND HOLIDAYS

WORKING HOURS

B(egin work = 8
 S(tart lunch = 12
 F(inish lunch = 12
 E(nd work = 17

WORKING DAYS

D(ays of the week = MTuWThF

HOLIDAYS

Holiday list = 1 1 81 5 25 81 7 4 81 9 7 81 11 26 81
 12 25 81

To change the working hours, press B S F, or E
 To change the working days, press D
 To add or remove a holiday, press H
 To quit and return to the MAIN OPTIONS, press Q

B(egin and E(nd work

These two values define when the normal working day begins and ends. They must be whole hours as defined on a 24-hour clock. Follow the rules for entering integers rather than times. You can setup a 24-hour day with "B(egin work = 0" and "E(nd work = 23".

S(start and F(inish lunch

These two values define when the lunch time begins and ends. If you don't want to consider time off for lunch, then set them both equal. As with normal working hours, they must be even hours as defined on a 24-hour clock.

D(ays of the week

Not everyone is fortunate enough to work only five days a week. If you are one of the unlucky ones, you can use this option to redefine your working days.

To change these days, press "D" and follow the new instructions that are displayed at the bottom of the screen.

H(oliday list

You can define up to twelve holidays. When the project is first created, six of the most commonly observed holidays are listed: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day. You can customize this list by pressing the letter "H" and following the instructions on the screen.

Time Schedule Display Menu

The Project Time Schedule display is the most important part of MILESTONE because it graphically illustrates the progress of your project as a function of time. The screen display shown below is for the First Street Water Main example on your disk.

PROJECT SCHEDULE

Keys are critical --- normal
slack done

	Jan				Feb				Mar		
Revision: 1 6 1 83	5	12	19	26	2	9	16	23	2	9	16
Job: (Room for 117 more)	0	1	2	3	4	5	6	7	8	9	10
1 Purchase the pipe	O	---	---	---	---	---	---	---	---	---	---
2 Dig 1st part of trench	O	---	---	---	---	---	---	---	---	---	---
3 Purchase fittings	O	---	---	---	---	---	---	---	---	---	---
4 Lay 1st part of pipe											
5 Dig 2nd part of trench											
6 Fill 1st part of trench											
7 Lay 2nd part of pipe											
8 Fill 2nd part of trench											
9 Repave street											
10 Repair sidewalk											
11 Project completed											X

Add Erase or Insert a job move U(p D(own L(eft R(ight or H(ome
M(odify or C(omplete a job O(ther options Q(uit
To select an option, press its letter, numbers can prefix a move

Interpreting the Time Schedule

The project name is at the top of the display, followed by the revision number and today's date.

Next comes the time line mentioned earlier in the discussion on "T(ime scales". It shows time progressing from left to right across the screen with specific dates marked in every fifth column. In the example the time line begins with the first week, January 5th, and extends to the end of the tenth week, March 16th.



There is room for sixteen jobs on the screen—eleven are shown in the example. Although many more jobs may be included in a project, the size of the terminal screen limits your view to only sixteen at a time. However, by choosing the “move” options, you can view all parts of the schedule.

Arrows and Other Symbols

The arrows are coded to convey as much information as possible about each job. The left end of an arrow is called its tail, and the right end is its head.

> ===== > A critical path job—It cannot be delayed without delaying the entire project.

> ----- > A non-critical or normal job—The tail of the arrow is aligned with the earliest start date and the head is aligned with the earliest finish date.

> > Slack time for a non-critical job—The slack time is the length of the arrow in time units. A job can be delayed up to its total slack time without delaying the project. The head of the slack arrow is aligned with a job’s latest finish date.

O ===== > A job with no prerequisites—The job has been scheduled to start on a specific date.

> ===== X A job with no successors—No other job names this one as a prerequisite. The last job in a project normally ends with an “X”, but other jobs may end with X’s if your project has multiple finishes.

* A zero length job—Sometimes it is convenient to define a job with zero duration just to mark an important event.

- O A zero length job with no prerequisites—Most often this corresponds to an outside event.
- X A zero length job with no successors—Typically the completion date of a project.

Determining Prerequisites from Arrows

The key to critical path analysis is the notion of a job's prerequisites. Prerequisites are the other jobs that must be finished before a job can start (this is sometimes called "finish/start" precedence notation).

An easy way to determine a job's prerequisites while viewing the time schedule on your terminal is to press "M" for modify and then enter the job number. All job data is displayed at the bottom of the screen and you can read the prerequisite list. After looking at the data, you can leave the job unmodified by pressing ESC.

Although the prerequisites are not shown explicitly on the time schedule, a lot of information can be determined by looking at the alignment of arrow heads and tails. For example,

The tail of a critical path job is always aligned with the heads of its prerequisites.

```

.....>
----->
      >

```

In the Time Schedule display shown immediately above, you can see that jobs 1, 2, and 3 are all prerequisites of job number 4.

Modifying the Time Schedule

A(dd a job

There are two ways to enter a new job into the time schedule: by A(dding or by I(nserting. They are identical except for the way in which prerequisites are handled.

The screen display lists the jobs in topological order, i.e. every job follows all of its prerequisites. By requiring jobs to be listed in this order MILESTONE makes it impossible to create an endless loop, at the expense of limiting your control over the appearance of the time schedule.

Whenever you are entering new jobs, remember this rule:

EVERY JOB MUST FOLLOW ITS PREREQUISITES

You can control where a new job is placed in the list by specifying its position to be before or after another job, as long as you don't violate the rule of ordering.

Example: Suppose you forgot to enter job #6: "fill 1st part of the trench". You can add this job at any time as long as you specify that the prerequisite for filling the trench is:

4—lay 1st part of pipe

Since job #4 has prerequisites of its own, you can be sure that job #6 will be correctly placed after job #4. If, however, you want job #6 to occur after another task that is not directly related to it, you must specify that task as a prerequisite also as we have done in the example schedule. The prerequisites for job #6 are both jobs 4 (laying 1st part of pipe) and 5 (digging 2nd part of trench).

When you specify the prerequisites, MILESTONE will automatically place the new job in its proper position in the schedule. Then you can use the "R(enumerate)" option to correct the numbering of the entire list.

Job Placement

When you select the "A(dd)" or "I(nsert)" options, a short menu appears at the bottom of the screen:

Job number x will be added before or after the job shown below.
J(ob number = y B(efore = No A(fter = Yes
To change its position, press "J"; to change before or after press
"B" or "A"
To quit, press "J"; to continue, press RETURN

The value "x" in the first line is the job number of the entry that will be added. MILESTONE assigns these numbers automatically to ensure that no number is inadvertently used for two different jobs.

The value "y" in the second line tells where the new job is to be added. MILESTONE initializes this to the number of the last job you entered, making it easy to add quickly a series of jobs. To change it to a new value, press "J" and enter a new number.

Also on the second line are two options, "B(efore" and "A(fter", telling where the new job is to be added relative to job number "y". Of course, these two options are mutually exclusive. To pick the option you want, press either "B" or "A".

After you have set these three fields, press RETURN to continue.

A(dd

Selecting "A(dd" initializes all job data fields and sets the prerequisite list in one of two ways:

Add x after y—The prerequisite list is set to y

Add x before y—The prerequisite list is set equal to y's list

To see how this works, consider adding a new job between Jobs 1 and 2 in the simple list shown below:

INITIAL JOB LIST

1	O-->....>	Job 1 has no prerequisites
2	O >	Job 2 has no prerequisites
3	> X	Job 3 has 1 & 2 as prerequisites

Adding after Job 2 initializes Job 4's prerequisites to Job 2.

LIST AFTER ADDING JOB 4 AFTER JOB 2

1	O-->....>	Job 1 has no prerequisites
2	O >	Job 2 has no prerequisites
4	>... X	Job 4 has 2 as a prerequisite
3	>... X	Job 3 has 1 & 2 as prerequisites

Adding before Job 3 initializes Job 4's prerequisites to 1 and 2.

LIST AFTER ADDING JOB 4 BEFORE JOB 3

1	O-->....>	Job 1 has no prerequisites
2	O >	Job 2 has no prerequisites
4	>... X	Job 4 has 1 & 2 as prerequisites
3	>... X	Job 3 has 1 & 2 as prerequisites

* For an explanation of all job data fields, read the part of this section called "Job Description".

I(nsert

The "I(nsert" option is just like "A(dd" except the new job is inserted into the job sequence, not just into a list position. Here's how it works:

Insert x after y— The prerequisite list is set to y, and all other jobs that name y as a prerequisite are changed to name x instead.

Insert x before y— The prerequisite list is set equal to y's list and y is changed so that x is its only prerequisite.

To see how this works, consider inserting a new job between Jobs 1 and 2:

INITIAL JOB LIST

1	O-->.....>	Job 1 has no prerequisites
2	O >	Job 2 has no prerequisites
3	> X	Job 3 has 1 & 2 as prerequisites

LIST AFTER INSERTING JOB 4 AFTER JOB 2

1	O-->.....>	Job 1 has no prerequisites
2	O >	Job 2 has no prerequisites
4	> >	Job 4 has 2 as a prerequisite
3	> X	Job 3 has 1 & 4 as prerequisites

LIST AFTER INSERTING JOB 4 BEFORE JOB 3

1	O-->.....>	Job 1 has no prerequisites
2	O >	Job 2 has no prerequisites
4	> >	Job 4 has 1 & 2 as prerequisites
3	> >	Job 3 has 4 as a prerequisite

E(rase a job

The "E(rase" option removes a job from the list and changes all other jobs prerequisites accordingly. First you are asked to enter the job number you wish to erase:

To erase a job, enter its number then press RETURN -->

If you change your mind at this point, press ESC and you will return to the modify options. If you enter a job number, you are asked to confirm your selection:

Is this the job you want to erase?
 Job number = 1 Job name = Purchase the pipe
 Enter "Y" or "N"

If you answer "Y" for yes, the job is removed and the project schedule is readjusted.

M(odify a Job

If you want to change any of a job's data fields, then you must select the "M(odify" option. First, you must specify which job you want to change:

To modify a job, enter its number then press RETURN -->

If the job exists, its data fields are displayed at the bottom of the screen:

```

Name = Purchase the pipe      Duration = 2      Cost = 50
Prerequisites = 0              Early start = 0
Skills  1(=0 2(=0 3(=0 4(=0 5(=0 6(=0 7(=0 8(=0 9(=0
To enter a field, press its key; to quit, press ESC; to use, press
RETURN
  
```

To modify a data field, press the first letter of its name. The cursor will jump up to the first character of the field you select and wait for you to enter the new data. For a detailed discussion of each field, read the part of this section titled "Job Description".

C(omplete a job

By marking jobs as completed, you can keep track of your project's progress. Periodically load your project file into MILESTONE and mark as complete those jobs which have been finished, then print out a new set of reports.

After picking the "C(omplete" option, enter the job number:

To complete a job, enter its number then press RETURN -->

If the job is found, you are asked to verify your choice:

Is this the job you want to complete?
Job number = 1 Job name = Purchase the pipe
Enter "Y" or "N"

The job's prerequisites are checked to make sure they have all been completed. If they are not completed, you will not be allowed to mark this job as complete. If you want to mark it as completed anyway, first use the modify option to change its prerequisites, then rerun the complete option.

If it is legal to complete the job, you are asked to enter its actual completion date:

A(ctual completion date = 2
To change the actual completion date, enter a new number
To quit with no change, press ESC; to leave as shown, press RETURN

The actual completion date is initialized to the value of the earliest finish date, but you can change it to anything you want.

To uncomplete a job, select the complete option. MILESTONE will detect that the job has already been completed and ask if you want to uncomplete it.

Moving the Screen Display: U(p, D(own, L(ef, R(ight or H(ome
As mentioned earlier in this chapter, a project may have many jobs, but only sixteen can be displayed on the screen at one time. These five options (up, down, left, right and home) permit you to move around on the project schedule and view any sixteen consecutive jobs.

The screen display is like a window. Imagine that there is a little man inside your terminal holding a large piece of paper for you to see. You can view any part of that imaginary paper by commanding that little man to move the paper in a specific direction. By moving it up, down, left or right you can see any part of the schedule.

To move the window up or down one job, press the letter "U" or "D". If you want to move more than one job, type a number before you press "U" or "D". For example, to move down five jobs, press "5D".

To move the window left or right one time unit (i.e. one week if the time scale is in weeks), press "L" or "R". If you want to move more than one time unit, press a number before you press "L" or "R". For example, to move right twelve weeks, press "12R".

To view a specific job, enter its number and then press "H" for home. For example, to redisplay the schedule with job number ten at the top, press "10H".

O(ther options

There are several other options that affect how the project schedule is displayed. Rather than listing them all at the bottom of the screen, they are displayed only if you press "O".

R(enumerate all jobs	show E(ffort summary	O(ther options
S(ort jobs into time order	show C(ost summary	Q(uit
To select an option, press its letter; to see other options, press "O"		

E(ffort summary

If the effort summary option is selected, then an extra line appears at the bottom of the screen showing the manpower effort level for each time period:

Manpower level = 4 4 4 6 6 9 6 4 3 3 0
--

If your project is short on manpower, you may wish to have the manpower level displayed along with the schedule while you are entering or modifying job data. By glancing at the summary you can see immediately if you have exceeded your project's manpower allocation. You can then readjust the job sequence or effort level so as not to exceed your allocation.

To see an individual skill level, press a number from 1 to 9. For example, if EXAMPLE1 is loaded in memory, pressing "1" (while viewing the "Other Options" with the effort summary displayed) shows the manpower level for the first skill category, Operating Engineer:

Operating Engineer = 1 1 1 0 0 1 0 2 3 3 0
--

You can also use this feature when you are entering jobs to remind you of which manpower titles are assigned to which number.

To see any other skill, press its number. To see the total for all skills, press "0". To erase the effort summary, press "E" again.

C(ost summary

Selection of the cost summary option adds two more lines to the bottom of the display: the manpower cost and the direct cost. Each column is the summation of all the jobs aligned above it.

Manpower cost in K\$ =	2	2	2	3	3	5	3	3	3	3	0
Direct cost in K\$ =	75	0	5	13	0	10	5	10	30	0	0

R(enumerate all jobs	show E(ffort summary	O(ther options
S(ort jobs into time order	show C(ost summary	Q(uit
To select an option, press its letter; to see other options, press "O"		

As mentioned under "Project Description", two types of cost are involved in any project: direct costs (i.e. capital/expense) and manpower costs. The cost summary displays the direct costs as they are incurred at the beginning of a each job.

Here's how the project schedule would look if both the effort and cost summaries were selected. Notice in the example below that the first digit of each amount is aligned with the first digit of a time number and date. This alignment shows the amount of money allocated to any given time period.

<u>PROJECT SCHEDULE</u>		Keys are /critical,---/normal... slack,///done											
		Jan				Feb				Mar			
		1	8	15	22	29	5	12	19	26	5	12	
Revision 10, 6/26/83		0	1	2	3	4	5	6	7	8	9	10	
Job (Room for 117 more)		○	-----										
1 Purchase the pipe		○	-----										
2 Dig 1st part of trench		○	-----										
3 Purchase fittings		○											
4 Lay 1st part of pipe													
5 Dig 2nd part of trench													
6 Fill 1st part of trench													
7 Lay 2nd part of pipe													
8 Fill 2nd part of trench													
9 Repave street													
10 Repair sidewalk													
11 Project completed												X	
Manpower level = 4		4	4	4	6	6	9	6	4	3	3	0	
Manpower cost in K\$ = 2		2	2	2	3	3	5	3	3	3	3	0	
Direct cost in K\$ = 75		0	5	13	0	10	5	10	30	0	0		
Add E(rase or I(nsert a job		move U(p D(own L(eft R(ight or				H(ome							
M(odify or C(omplete a job		O(ther options				Q(uit							
To select an option, press its letter; numbers can prefix a move													

R(enumerate All Jobs

The job numbers appearing to the left of the job name are assigned by MILESTONE. After a long session of erasing, adding, and inserting jobs, these numbers may no longer be in ascending order. To make your schedule more readable, you may wish to renumber the list.

WARNING! Renumbering is an irreversible process. If you want to keep a set of numbers, don't select the renumber option.

S(ort jobs into time order

This is another option that may improve the appearance of the display. It results in a time schedule with arrow heads further to the right as you move down the list. The jobs are sorted into the following order:

Primary key = Increasing late finish time
Secondary key = Decreasing early start time
Tertiary key = Decreasing late start

WARNING! Sorting is an irreversible process. If you want to keep a specific ordering, don't select the sort option.

Job Description

MILESTONE treats a project as a collection of jobs (or activities) that must be completed in a specified sequence. This is the only rational way to plan a complex project; it's too difficult to grasp the intricacies of a complex project without breaking it down into smaller, easily tracked jobs.

A job should be a well-defined activity for which you can devise confident duration, cost and effort estimates. If you have a high level of confidence in each job estimate, then you can have confidence in the completed project schedule.

The project schedule is determined by linking jobs together in time according to how they depend upon each other. This dependence is determined by specifying which other jobs must be completed

As mentioned under "Project Description", two types of cost are involved in any project: direct costs (i.e. capital/expense) and manpower costs. The cost summary displays the direct costs as they are incurred at the beginning of a each job.

Here's how the project schedule would look if both the effort and cost summaries were selected. Notice in the example below that the first digit of each amount is aligned with the first digit of a time number and date. This alignment shows the amount of money allocated to any given time period.

PROJECT SCHEDULE

Keys are /critical,---/normal,.../
slack,:::/done

	Jan		Feb		Mar						
Revision 10, 6/26/83	1	8	15	22	29	5	12	19	26	5	12
Job (Room for 117 more)	0	1	2	3	4	5	6	7	8	9	10
1 Purchase the pipe	O	-----									
2 Dig 1st part of trench	O	-----									
3 Purchase fittings	O										
4 Lay 1st part of pipe											
5 Dig 2nd part of trench											
6 Fill 1st part of trench											
7 Lay 2nd part of pipe											
8 Fill 2nd part of trench											
9 Repave street											
10 Repair sidewalk											
11 Project completed											X

Manpower level = 4	4	4	6	6	9	6	4	3	3	0
Manpower cost in K\$ = 2	2	2	3	3	5	3	3	3	3	0
Direct cost in K\$ = 75	0	5	13	0	10	5	10	30	0	0

A(dd E(rase or I(nsert a job move U(p D(own L(eft R(ight or H(ome
M(odify or C(omplete a job O(ther options Q(uit
To select an option, press its letter; numbers can prefix a move

R(enumerate All Jobs

The job numbers appearing to the left of the job name are assigned by MILESTONE. After a long session of erasing, adding, and inserting jobs, these numbers may no longer be in ascending order. To make your schedule more readable, you may wish to renumber the list.

WARNING! Renumbering is an irreversible process. If you want to keep a set of numbers, don't select the renumber option.

S(ort jobs into time order

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A job should be a well-defined activity for which you can devise confident duration, cost and effort estimates. If you have a high level of confidence in each job estimate, then you can have confidence in the completed project schedule.

The project schedule is determined by linking jobs together in time according to how they depend upon each other. This dependence is determined by specifying which other jobs must be completed

before any one job may be started. These other jobs are called "prerequisites", otherwise known as finish/start precedence.

A prerequisite is another job that must be done first. In the water main example project, the trench shouldn't be filled until after the pipe has been tested for leaks; therefore testing for leaks is a prerequisite to filling the trench. On the other hand, purchasing the pipe has no prerequisites and can begin as soon as the project is given the go-ahead.

Whenever you select A(dd, I(nsert or M(odify a job, a Job Description menu is displayed at the bottom of the screen. This menu lists all of the data fields necessary to completely define a job.

Look below at the two sample menus to see the job descriptions for the two parts of "digging the trench" in the water main project. "Digging the first part" has no prerequisites and can begin immediately. However, "digging the last part" can only begin after digging the first part is completed.

N(ame = Dig 1st part of trench	D(uration = 2	C(ost = 0
P(rerequisites = 0		E(arly start = 0
Skills 1(=1 2(=3 3(=0 4(=0 5(=0 6(=0 7(=0 8(=0 9(=0		
To enter a field, press its key; to use as is, press RETURN		

Remember, the data fields are in order from left-to-right and top-to-bottom, i.e. N(ame, D(uration, C(ost, P(rerequisites, etc.

To move to the next field, press **TAB**

To move to the previous field, press **BACKSPACE**

To quit at any time with no changes, press **ESC**

To enter the job with all fields as shown, press **RETURN**

The menu above shows the data fields necessary to completely describe a job that has no prerequisites. Since the number of prerequisites is zero, the start date is shown as a data field. If the number

of prerequisites listed is not zero, then a slightly different display is shown:

```

N(ame = Dig 2nd part of trench      D(uration = 1          C(ost = 5
P(rerequisites = 2
Skills   1(=1 2(=3 3(=0 4(=0 5(=0 6(=0 7(=0 8(=0 9(=0
To enter a field, press its key; to use as is, press RETURN

```

N(ame

A job name can be up to thirty characters long and should accurately describe the activity. However, there is only room for twenty characters on the time schedule display. MILESTONE will display the first 20 characters (spaces or other punctuation included) of the job name.

D(uration

The duration is the number of time units necessary to complete the job.

For some jobs the duration may be related to the effort level, i.e. more workers can do the job in a shorter time. It is up to you to choose a combination of duration and effort best suited to your working conditions. At a later time you may change the combination and see the resulting effect on the overall project schedule.

Other jobs may have a duration that is completely independent of the effort level. For example, after pouring structural concrete twenty-eight days must elapse before it reaches full strength. Such a job could be shown as a four week duration and zero effort.

Fractional durations are not allowed. If you find it necessary to have a duration such as 1.5 weeks, perhaps you should use a time scale of days (instead of weeks for your project.)

P(rerequisites

A job "with no prerequisites" is defined by setting the number of prerequisites to zero and then specifying a time for the earliest

before any one job may be started. These other jobs are called "prerequisites", otherwise known as finish/start precedence.

A prerequisite is another job that must be done first. In the water main example project, the trench shouldn't be filled until after the pipe has been tested for leaks; therefore testing for leaks is a prerequisite to filling the trench. On the other hand, purchasing the pipe has no prerequisites and can begin as soon as the project is given the go-ahead.

Whenever you select A(dd, I(nsert or M(odify a job, a Job Description menu is displayed at the bottom of the screen. This menu lists all of the data fields necessary to completely define a job.

Look below at the two sample menus to see the job descriptions for the two parts of "digging the trench" in the water main project. "Digging the first part" has no prerequisites and can begin immediately. However, "digging the last part" can only begin after digging the first part is completed.

N(ame = Dig 1st part of trench	D(uration = 2	C(ost = 0
P(rerequisites = 0		E(arly start = 0
Skills 1(=1 2(=3 3(=0 4(=0 5(=0 6(=0 7(=0 8(=0 9(=0		
To enter a field, press its key; to use as is, press RETURN		

Remember, the data fields are in order from left-to-right and top-to-bottom, i.e. N(ame, D(uration, C(ost, P(rerequisites, etc.

To move to the next field, press **TAB**

To move to the previous field, press **BACKSPACE**

To quit at any time with no changes, press **ESC**

To enter the job with all fields as shown, press **RETURN**

The menu above shows the data fields necessary to completely describe a job that has no prerequisites. Since the number of prerequisites is zero, the start date is shown as a data field. If the number

of prerequisites listed is not zero, then a slightly different display is shown:

```

Name = Dig 2nd part of trench      Duration = 1          Cost = 5
Prerequisites = 2
Skills  1(=1) 2(=0) 3(=0) 4(=0) 5(=0) 6(=0) 7(=0) 8(=0) 9(=0)
To enter a field, press its key; to use as is, press RETURN

```

Name

A job name can be up to thirty characters long and should accurately describe the activity. However, there is only room for twenty characters on the time schedule display. MILLSTONE will display the first 20 characters (spaces or other punctuation included) of the job name.

Duration

The duration is the number of time units necessary to complete the job.

For some jobs the duration may be related to the effort level, i.e. more workers can do the job in a shorter time. It is up to you to choose a combination of duration and effort best suited to your working conditions. At a later time you may change the combination and see the resulting effect on the overall project schedule.

Other jobs may have a duration that is completely independent of the effort level. For example, after pouring structural concrete twenty-eight days must elapse before it reaches full strength. Such a job could be shown as a four week duration and zero effort.

Fractional durations are not allowed. If you find it necessary to have a duration such as 1.5 weeks, perhaps you should use a time scale of days (instead of weeks for your project.)

Prerequisites

A job "with no prerequisites" is defined by setting the number of prerequisites to zero and then specifying a time for the earliest

possible start. For example, "Dig 1st part of trench" has no prerequisites and can begin as soon as the project begins.

A job "with prerequisites" is defined by entering the number of the jobs which must be completed first. In the water main example, "Dig 2nd part of trench" cannot begin until after "Dig 1st part of trench" is completed.

A job cannot have more than nine prerequisites. If a job depends on more than nine others, consider creating two other fictitious jobs of zero duration. Each of these fictitious jobs could depend on up to nine others and one job depending on both of them could, in effect, depend on up to eighteen.

Early Start

This is the earliest date on which a job with no prerequisites can start. You only need to enter the Early Start date for jobs with no prerequisites. Jobs with prerequisites can start only after their prerequisites are completed.

When you add a new job, the start date is automatically set to the project start date (i.e. the 0th time unit). If you change the project start date, all jobs with no prerequisites are automatically rescheduled. See the discussion of time scales under the "Create a New Project Menu" earlier in this section.

Skills 1(to 9(

Each job can draw manpower from any combination of the nine different skills. In the "water main" example, three laborers (skill category number 2) and one operating engineer (skill category number 1) are needed to dig the trench.

Each skill is indicated by the skill number, "1(", and a manpower level. To change the manpower for a given skill, press the key for the corresponding skill number and then enter the manpower level.

To make MILESTONE fast and interactive, it was necessary to restrict manpower levels to whole integers. If your application requires fractional levels of manpower, consider inputting the levels as if they were tenths of a person. For example, use a level of "15" for one and a half people instead of "1.5". If you set up the costs for the skill categories accordingly, this method will work fine. Just remember to divide the totals by 10 when you interpret the manpower reports.

After you have entered the manpower level, press TAB to go to the next skill category or press RETURN to leave the remaining categories as they are shown.

Don't confuse the manpower level with the total effort. The manpower level is the number of people working on a job; the total effort is the product of the manpower level and duration. For example a manpower level of four men working for a duration of four weeks results in sixteen man-weeks of total effort.

Print a Summary Report Menu

MILESTONE provides several different report formats, each one designed to give you quick access to information about your project. Subsequent revisions of MILESTONE may have more reports than are listed here.

PRINT A SUMMARY REPORT

REPORTS THAT CAN BE PREVIEWED ON THE TERMINAL

- P(roject description report
- J(ob description report
- C(olumnar job report

REPORTS THAT ARE SENT DIRECTLY TO THE PRINTER

- T(ime schedule report
- A(ll of the above reports

OTHER OPTIONS:

- M(odify the printout parameters
- Q(uit and return to main options

To printout a report, press its letter, "P", "J" etc
To return to the main menu, press "Q"

All reports except the Time Schedule Report can be previewed by displaying it directly on the screen rather than sending it to the printer. If you select one of the "previewable" reports, you will be asked if you want to see it on the screen first.

Printouts of each of the following reports for the First Street Water Main Project are provided in Appendix A.

P(roject description report

This is a one page summary of the entire project. It lists all of the general information about the project along with pertinent manpower and cost totals. Its purpose is to provide a concise summary of the resources a project requires.

J(job description report

This is an exhaustive summary of the details for each job in a project. It is printed in a "paragraph" style format for easy reading. Because it is so lengthy, you probably will use the columnar report most of the time and generate this report at less frequent intervals.

The length of this report can be limited by setting the first and last job numbers under the "M(odify printout parameters" option. For example, you might review the details of jobs numbered 15-32 only.

C(olumnar Job Report

This columnar report prints the job description information as a table, rather than paragraphs, resulting in a compact report. You can customize it to suit your needs by including or excluding different data fields. See the sample reports in Appendix A for ways to use this report.

COLUMNAR JOB REPORT

COLUMN NAME	WIDTH
J(ob number = Yes	5
N(ame = No	
D(uration = Yes	20
E(arly times = Yes	20
L(ate times = Yes	20
S(lack = Yes	10
C(osts = No	
P(rerequisites = No	
M(anpower = No	
U(se page headings = Yes	75 columns 80 max

OPTIONS:

- B(egin printing
- Q(uit and return to the report options

To include or remove a column, press its letter
 To return to the report options, press "Q"
 To begin printing, press "B"

You can select up to nine report columns as long as the total width of the report does not exceed the width of your printer. You can change the printer width with the "M(odify printout" option. Each column is described in the following table:

NAME	WIDTH	EXPLANATION
Job number	5	The job number takes five columns
Name	30	Thirty columns are allowed for the project name
Duration	20	Number of time units and completed status
Early times	20	Early start and finish in integer time units
Late times	20	Late start and finish in integer time units
Slack	10	Number of time units
Costs	20	Total manpower and direct costs
Prerequisites	40	Job numbers in the prerequisite list
Manpower	40	Number in each of the nine skill categories
	205	Maximum possible report width

Although the times are shown as integer numbers, you can use this report in conjunction with the Time Schedule Graph to determine the actual dates.

To use this report as input to a program other than MILESTONE, set the "U(see page headings" option to "NO" and set the output device name to a disk file name. This will strip the column titles, blank lines and form feeds from the report so that it can be more easily input to another program. The resulting format is ASCII with fixed width columns as noted in the preceding table.

Time Schedule Graph

The time schedule graph is a printed image of the screen display of the entire time schedule.

As you know by now, a project may consist of one hundred or more jobs over a long time span. You may wonder how such a wide schedule could be printed on the narrow width of printer paper.

We think we have come up with a unique solution: the time schedule is printed in a series of strips. To make a large chart, you simply tape the strips together. For example, if you look at the schedule in Appendix A, you see that it is on two separate sheets of paper which can be aligned to form one wider sheet. When this report is several pages wide and job durations travel the entire width, you might find it helpful to use colored pens to highlight the paths of different jobs.

There is no practical limit to the size chart that can be produced by printing separate strips in this manner. If you have a wide printer, be sure to set the report width accordingly. Some printers can print 132 or more columns on one sheet of paper. You can change the report width under the "M(odify printout options" or permanently with the CONFIG program. By changing it under the printout option, you can use 132 column paper for the time schedule and 80 column paper for the other reports.

A(ll of the above reports)

This option is provided for those of you who don't like to sit around watching printers chatter away. Just press the letter "A" and go out for a cup of coffee. When you return, unless your printer has had problems in your absence, you will have a neat stack of paper with all of the pertinent reports.

M(odify the printout parameters)

The printout parameters govern how reports are to be printed. Some of them depend upon the physical characteristics of your printer, others depend upon how you want reports to be formatted.

PRINTOUT PARAMETERS

D(evice name = printer.
W(idth in columns = 80
F(irst job = 1
L(ast job = 11
S(ingle sheets = No

To change a variable, press its letter
To quit with no changes, press ESC
To return to the PRINTOUT options, press "Q"

D(evice name

Normally you will direct the printout to your printer (it's called "printer:" by PASCAL/M programs, not "lst:"); however, by changing the device name you can redirect the output to a disk file or any other device. Although legal device names on CP/M systems are limited to "printer:", "punch:" and "null:", you could direct the output to a different device by using the STAT command.

To send your output to a disk file, change the device name to a file name like "REPORT.TEX". At a later time, you can insert the report directly into another document using a word processing program.

If the disk file already exists, it will be left unchanged and the report will not be output. Therefore, if you want to send more than one MILESTONE report to a disk file, you must change the Device name each time. Likewise, if you select "A(ll of the reports", only the first one will appear in the disk file. (MILESTONE behaves this way because the PASCAL language does not allow a program to append text to a sequential file.)

W(idth in columns

You can use a printer of any width. Most printers print ten characters per inch on paper either eighty or one hundred thirty-two columns wide. Others can print twelve or sixteen and a half characters per inch. Although most reports use only eighty columns, the Columnar Job Report and the Time Schedule Graph can use up to 255 columns.

If the Time Schedule Graph comes out double spaced on your printer, you should change the width to 79 columns. Some printers perform an automatic linefeed when an eighty column line is printed, causing a double linefeed when MILESTONE subsequently sends the carriage return and linefeed.

F(irst & L(ast jobs

To shorten the length of the MILESTONE reports, you can set these two numbers. Only the jobs from the first number you specify

to the last one will be printed. This is especially useful for the Job Description Report and the Time Schedule Graph because it lets you print a subset of the entire project.

Reports list jobs in exactly the same sequence as they are shown on the Time Schedule. To list just a portion of the jobs, enter the first job number and the last job number. If the numbers are not sequential this may result in the first job number being greater than the last. Don't worry about this. It is supposed to work this way.

Single sheets

If you intend to use single sheets of paper in your printer, then you must have this option set to "YES", so that the program will stop at the end of each page and wait for you to insert another single sheet.

There are two ways to load single sheets into your printer. The first way is to load the paper so that the print element is ready to print on the very first line of the sheet. The second is to roll the paper up an inch so that it is held against the platen by the pressure ball and the element is ready to print on the seventh line of the sheet. If you intend to roll the paper up one inch, then you must rerun the CONFIG program and change the top margin to 0 and the paper length to 60 lines.

Save the Current Project Menu

After you have created a new project, or modified an existing one, use this option to save your work.

SAVE THE CURRENT PROJECT**DISK FILE DATA**

F(ile name = example1
D(isk drive = B

DISK FILE OPTIONS

S(ave the project on disk
Q(uit and return to the MAIN OPTIONS

To change the file name or disk drive, press "F" or "D"
To quit and return to the MAIN OPTIONS, press "Q"
To save the project, press "S"

F(ilename

All project data is kept in two disk files. It is up to you to choose a filename and to keep track of the disk drives the files are on.

When you enter the filename, two files are created both having the same filename you have chosen, but each having a unique suffix. For instance, the file EXAMPLE1.DES contains your project description data (such as time intervals, skill categories and manpower levels). The file EXAMPLE1.JOB contains the details of each individual job.

When you create a new project you must invent a unique filename for it before you can save it on disk. It is good practice to invent a name that has a meaning relevant to the project so that you can remember what the file contains.

WARNING! Be careful not to use duplicate filenames. If you choose a name that matches the name of a file already stored on diskette, the new file will replace the old. This may be what you want to do when you are saving updates of a project, but if you want to keep an older version, be sure to give a different name to the newer one. For example, version 1 might be called "water1", while subsequent versions could be called "water2", "water3", etc.

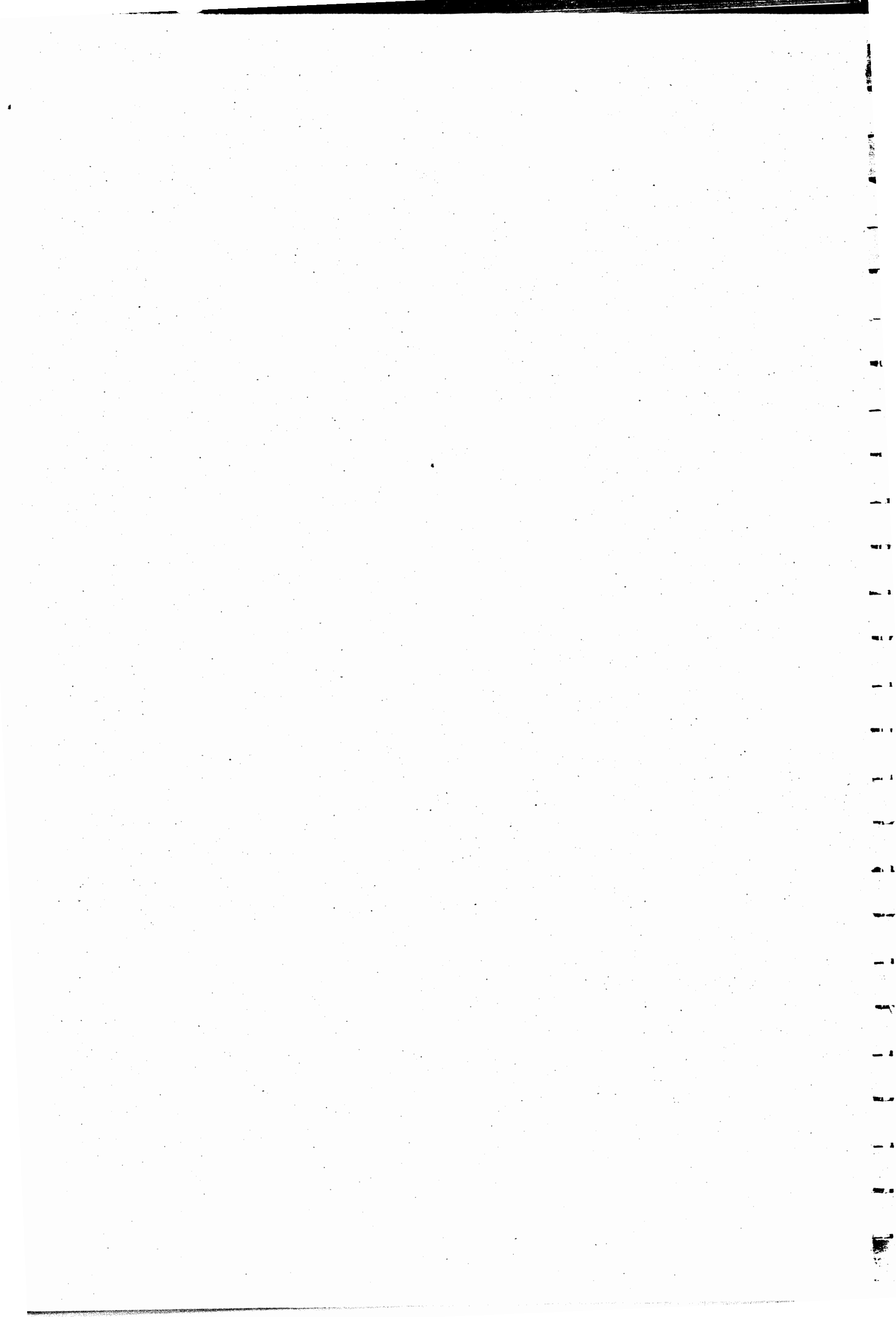
WARNING! Never change diskettes in the middle of a MILESTONE session. If you read or write on a disk drive, change diskettes, and then try to save a file on that drive, you will get the error message "BDOS ERROR ON x READ ONLY". Since there is no way to recover from this error, you may lose all of your work.

Disk drive

Besides choosing a filename, you must keep track of the disk drive where the file is stored. As shown in the screen above, the file named "example1" contains data for the water main project and resides on the "B" disk drive. (On the UCSD PASCAL system, files are named with numbers like #4 and #5, or with seven character names.)

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Milestone Error Messages

Error Messages

Although MILESTONE contains a comprehensive set of checks on each individual key that you press and warns you about invalid keys by ringing the terminal bell, some errors are impossible to detect until after you have made a complete data entry. These errors are listed below with some comments that may help you.

ERROR #1—The time scale is limited to: Hours, Days, Weeks, Months, Quarters and Fiscal Quarters. If you try to enter some other value, it will cause an error.

ERROR #2—The cost units are limited to one of the following values: \$, K\$ and M\$. Thousands are denoted by "K" and millions by "M".

ERROR #3—You must enter either "Yes" or "No". All other entries will cause an error.

ERROR #4—You have entered the number of a job that does not exist. Perhaps you have either renumbered the jobs or have erased one.

ERROR #5—A fundamental requirement is that a job's prerequisites must precede it. This also implies that a job cannot name itself as a prerequisite because in that case a job could not start until it was finished.

ERROR #6—As mentioned in number 5 above, a job's prerequisites must precede it. If this error is preventing you from modifying a job's prerequisites, first erase the job and then use the I(nsert option to put it back into the list where it belongs.

ERROR #7—You have attempted to display or modify a project before you loaded it into memory. Exit the menu, return to the Main Options menu, and load the project.

ERROR #8—Another fundamental requirement is that no job can have more than nine prerequisites. If you encounter this error, you have tried to erase a job and MILESTONE's attempt to correct all jobs that depend upon it would result in the named job having more than nine prerequisites. The solution to this dilemma is to modify manually the prerequisites of the named job.

ERROR #9—Before you run MILESTONE, you must first run the program named CONFIG in order to create the file named "TERMINAL.DAT". This file contains all information needed to control your terminal and printer. If you have already run CONFIG, then check to make sure that you are logged onto the disk drive which contains the file "TERMINAL.DAT". On CP/M systems you log onto a disk drive by entering its letter and then pressing RETURN. On UCSD Pascal Systems log onto a disk by executing the FILER and setting the PREFIX to the disk's name or number.

ERROR #10—This error occurs if you try to enter a time that is illogical. For example, the time that you end work must be after the time that you start work.

ERROR #11—When defining your normal working days, you must have at least one. Hey, if you don't work at least one day a week, why are you running this program?

ERROR #12—The working day must be at least one hour long. We have yet to find a place of business that works less than

one hour per working day. If you do, please send us a stack of job applications.

ERROR #13—The number of holidays is limited to twelve. This arbitrary limitation is necessary in order to conserve memory space. If you are fortunate enough to need more than twelve, you might define the twelve days that immediately follow the project start date as holidays. If you want to block off a period of time for vacation, simply define a job that has no prerequisites and begins when your vacation begins. Then you can have other jobs name your vacation as a prerequisite.

ERROR #14—There is not enough room in memory to hold another job. One solution would be to buy more memory for your computer. But if you only need to enter a few more jobs you might consider combining several jobs into one. If you need to enter many more, you can divide your project into phases and treat each one as a separate project.

ERROR #15—A prerequisite list must be made of up to nine numbers separated by commas. Each number can be up to three digits long.

ERROR #16—A job cannot be completed until all of its prerequisites are completed. Trying to complete a job before its prerequisites are finished contradicts the definition of a prerequisite. If the job is really completed, then correct its prerequisite list before marking it as complete.

ERROR #17—You can't UNcomplete a job if one of its successors is completed. This is the reverse of the situation in error #16. First, uncomplete the successor job, then uncomplete this one.

ERROR #18—You can't insert an uncompleted job into a sequence of completed jobs. This prevents you from ever creating a situation where a completed job's prerequisite is uncompleted.

Warning Messages

Warnings are not really errors, but rather messages to alert you that the action you are about to take may cause loss of data. A bell rings, the warning message is displayed, and you are asked to confirm your action.

WARNING #1—Since you have not yet saved the project that is in memory, the action you are about to take will cause it to be erased. If you want to save it first, answer “NO”. If you want to create a new project anyway, then answer “YES”.

WARNING #2—There is no need to save the project since it has not been changed. This warning might appear if you are confused about what you are doing.

WARNING #3—Since you have not yet saved the project that is in memory, the action you are about to take will cause it to be erased. If you want to save it first, answer “NO”. If you want to load a different new project anyway, then answer “YES”.

WARNING #4—Since you have not yet saved the project that is in memory, quitting MILESTONE will cause it to be erased. If you want to save it first, answer “NO”. If you want to quit anyway, then answer “YES”.

System Error Messages

The phrase “System Error Messages” refers to those errors that are outside of MILESTONE’s control. If you encounter one of these errors, it is probably due to an electronic hardware error, a problem with your disk media, or simply confusion on your part about disk drives and filenames. The following paragraphs may help you fix the problem.

SYSTEM ERROR #1—Hardware error when reading. Probably a bad disk.

SYSTEM ERROR #2—Unknown device specified. Probably an incorrect disk drive name when loading or saving a file.

SYSTEM ERROR #3—Illegal operation. You should not get this error.

SYSTEM ERROR #4—Undefined hardware error. Call your computer dealer, there is something wrong with your disk controller.

SYSTEM ERROR #5—Device referenced is not on line. Most likely an incorrect disk drive name when loading or saving a file. It could also be due to an incorrect name for the printer device—Try running CONFIG again.

SYSTEM ERROR #6—File is no longer in directory. You probably put a new diskette in a drive while running MILESTONE. That is a NO-NO.

SYSTEM ERROR #7—Illegal filename. Most likely an invalid character imbedded inside a filename. Consult your system manual for rules about file names.

SYSTEM ERROR #8—There is not enough room on your disk to store this project. Try saving your file on a different drive that may have some space left.

SYSTEM ERROR #9—No such volume on line. Most likely a bad disk name.

SYSTEM ERROR #10—File not found on the drive you have specified. Double check the filename and disk drive. The project description report, if you have printed one, has this information.

SYSTEM ERROR #11—Duplicate file. The named file already exists.

SYSTEM ERROR #12—File already open. You should not encounter this error.

SYSTEM ERROR #13—File is not open. You should not encounter this error.

SYSTEM ERROR #14—Error in reading real or integer. Most likely you are trying to read a file that was not created by MILESTONE.

SYSTEM ERROR #15—File position error. You should not get this error.

SYSTEM ERROR #16—End of file found when reading. Probably trying to read a file not created by MILESTONE or a file that has been copied incorrectly.

SYSTEM ERROR #17—No more room in memory. You are trying to load a project with too many jobs. This only happens if the project was created on a different computer with more memory, or if you have taken some memory out of your computer. If you continue, you will notice that memory was filled with as much of the project as possible.

SYSTEM ERROR #18—Project files have not been updated. The file formats changed between Milestone revision 1.07 and 1.08. To read old project files, you must first update them by running the program named UPDATE.

Other Error Messages

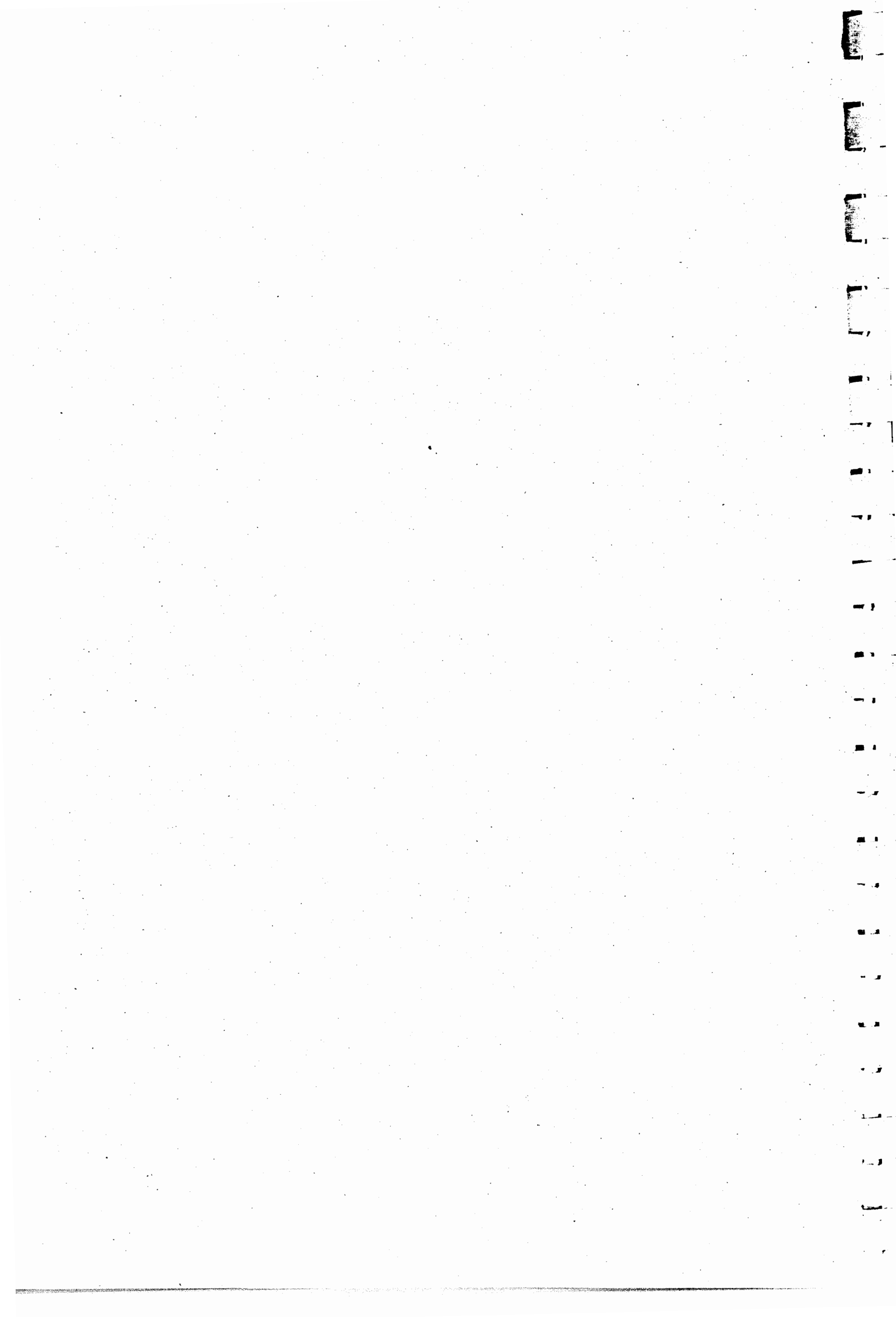
BDOS ERROR ON x SELECT—The disk drive has either been turned off or the disk has been removed. There is no recovery from this error.

BDOS ERROR ON x READ ONLY—You have changed disks while MILESTONE was running. There is no recovery from this error.

Pcode file not found. Pascal/M ABORT.—Either you typed the program name in wrong or you are logged onto the wrong disk drive.

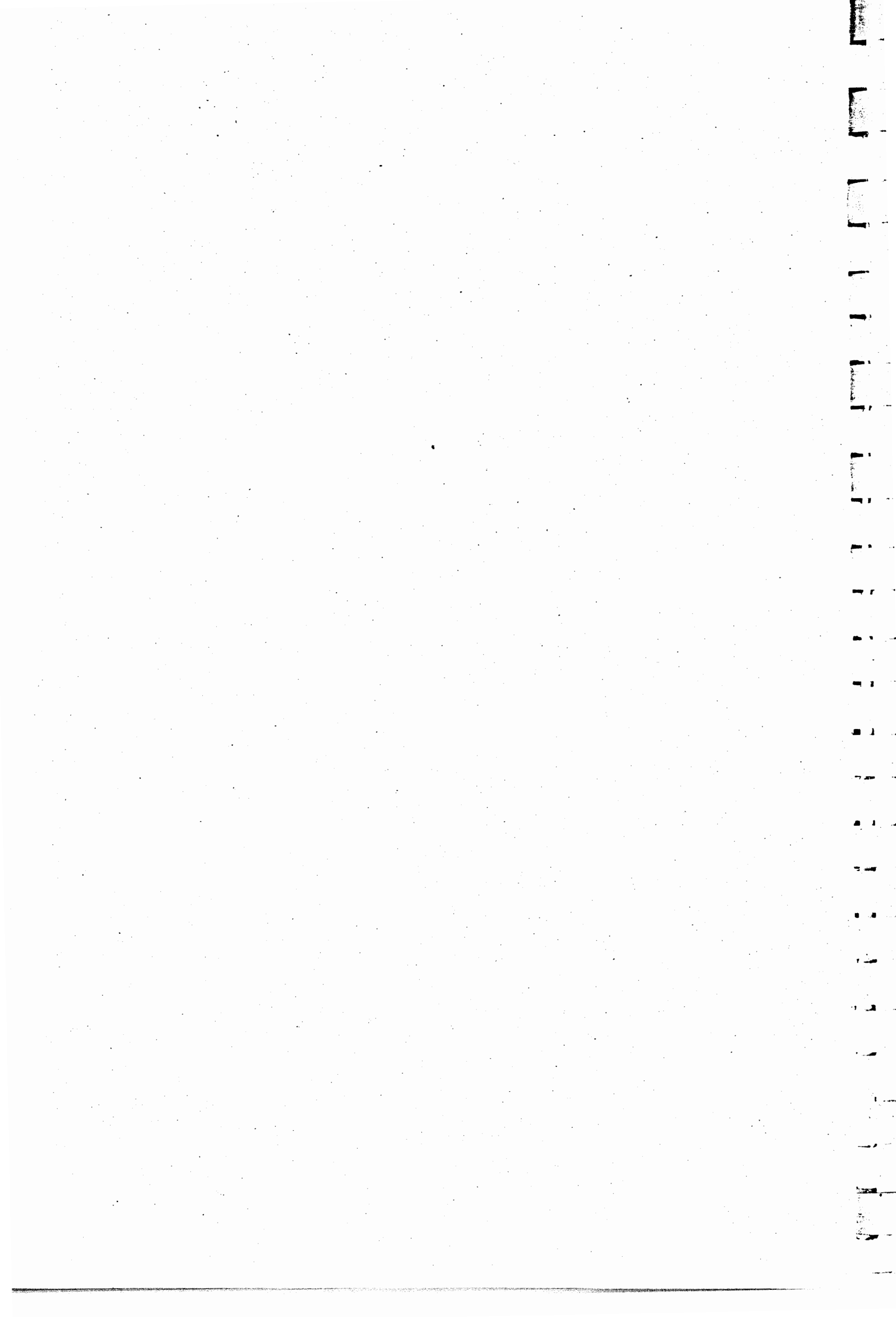
Pcode file ill-formed. Pascal/M ABORT.—Either you are trying to execute a file that is not a Pascal/M program or somehow you have clobbered the program file. If so, recopy the program from your master diskette.

String length exceeds declared limit.—Somehow one of the MILESTONE data files has been clobbered. Sometimes this happens when files are copied incorrectly (i.e. by reading into memory with DDT and then saving onto a different disk drive). To make sure you copy files correctly, always use PIP.



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Sample Reports

PROJECT DESCRIPTION REPORT

First Street Water Main
Revision 10, 1/1/83
Prepared by Mike Posehn

DESCRIPTION DATA FIELDS:

Name of project=First Street Water Main
Leader of project=J. K. Henderson
Time scale=Weeks
Start date=1/5/83
Direct cost units=K\$
Manpower cost units=\$
Find critical path=Yes
File drive and name=A:example1

SKILL CATEGORIES:

Description	\$/Man-Week	Man-Weeks	Total Cost
1st skill category=Operating Engineer	1000	12	\$12K
2rd skill category=Laborer	500	29	\$14K
3rd skill category=Welder	750	8	\$6K
4th skill category=Civil Engineer	1500	0	\$0
5th skill category=	0	0	\$0
6th skill category=	0	0	\$0
7th skill category=	0	0	\$0
8th skill category=	0	0	\$0
9th skill category=	0	0	\$0

WORKING HOURS:

Begin work=8
Start lunch=12
Finish lunch=12
End work=17

WORKING DAYS:

Days of the week=MTuWThF

HOLIDAYS:

Holiday list=1/1/83 5/25/83 7/4/83 9/7/83 11/24/83 12/25/83

SCHEDULE SUMMARY:

Completion date=3/16/83
Number of jobs=11
Total manpower=49 Man-Weeks
Manpower cost=\$32500
Direct cost=\$148000
Total cost=\$180500

JOB DESCRIPTION REPORT

First Street Water Main
Revision 10, 1/1/83
Prepared by Mike Posehn

Job #1, Purchase the pipe

Duration=2 Weeks
Completed=No
On critical path=No
Slack time=1 Week

Earliest Start=1/5/83
Earliest finish=1/19/83
Latest start=1/12/83
Latest finish=1/26/83

Prerequisites=none

Manpower skills=none

Total effort=none
Manpower cost=\$0
Direct cost=\$50000

Job #2, Dig 1st part of trench

Duration=2 Weeks
Completed=No
On critical path=No
Slack time=1 Week

Earliest start=1/5/83
Earliest finish=1/19/83
Latest start=1/12/83
Latest finish=1/26/83

Prerequisites=none

Manpower skills=Skill #1, Operating Engineer, 1 @ 1000\$ per Man-Week
Skill #2, Laborer, 3 @ 500\$ per Man-Week

Total effort=8 Man-Weeks
Manpower cost=\$5000
Direct cost=\$0

First Street Water Main
Revision 10, 1/1/83

Job #3, Purchase fittings

***** CRITICAL *****

Duration=3 Weeks
Completed=No
On critical path=Yes
Slack time=none

Earliest start=1/5/83
Earliest finish=1/26/83
Latest start=1/5/83
Latest finish=1/26/83

Prerequisites=none

Manpower skills=none

Total effort=none
Manpower cost=\$0
Direct cost=\$25000

Job #4, Lay 1st part of pipe

***** CRITICAL *****

Duration=2 Weeks
Completed=No
On critical path=Yes
Slack time=none

Earliest start=1/26/83
Earliest finish=2/9/83
Latest start=1/26/83
Latest finish=2/9/83

Prerequisites=Job #1, Purchase the pipe
Job #2, Dig 1st part of trench
Job #3, Purchase fittings

Manpower skills=Skill #2, Laborer, 4 @ 500\$ per Man-Week
Skill #3, Welder, 2 @ 750\$ per Man-Week

Total effort=12 Man-Weeks
Manpower cost=\$7000
Direct cost=\$13000

First Street Water Main
Revision 10, 1/1/83

Job #5, Dig 2nd part of trench

Duration=1 Week
Completed=No
On critical path=No
Slack time=2 Weeks

Earliest start=1/19/83
Earliest finish=1/26/83
Latest start=2/2/83
Latest finish=2/9/83

Prerequisites=Job #2, Dig 1st part of trench

Manpower skills=Skill #1, Operating Engineer, 1 @ 1000\$ per Man-Week
Skill #2, Laborer, 3 @ 500\$ per Man-Week

Total effort=4 Man-Weeks
Manpower cost=\$2500
Direct cost=\$5000

Job #6, Fill 1st part of trench

Duration=1 Week
Completed=No
On critical path=No
Slack time=1 Week

Earliest start=2/9/83
Earliest finish=2/16/83
Latest start=2/16/83
Latest finish=2/23/83

Prerequisites=Job #4, Lay 1st part of pipe

Manpower skills=Skill #1, Operating Engineer, 1 @ 1000\$ per Man-Week
Skill #2, Laborer, 2 @ 500\$ per Man-Week

Total effort=3 Man-Weeks
Manpower cost=\$2000
Direct cost=\$10000

First Street Water Main
Revision 10, 1/1/83

Job #7, Lay 2nd part of pipe

***** CRITICAL *****

Duration=2 Weeks
Completed=No
On critical path=Yes
Slack time=none

Earliest start=2/9/83
Earliest finish=2/23/83
Latest start=2/9/83
Latest finish=2/23/83

Prerequisites=Job #5, Dig 2nd part of trench
Job #4, Lay 1st part of pipe

Manpower skills=Skill #2, Laborer, 4 @ 500\$ per Man-Week
Skill #3, Welder, 2 @ 750\$ per Man-Week

Total effort=12 Man-Weeks
Manpower cost=\$7000
Direct cost=\$0

Job #8, Fill 2nd part of trench

***** CRITICAL *****

Duration=1 Week
Completed=No
On critical path=Yes
Slack time=none

Earliest start=2/23/83
Earliest finish=3/2/83
Latest start=2/23/83
Latest finish=3/2/83

Prerequisites=Job #7, Lay 2nd part of pipe
Job #6, Fill 1st part of trench

Manpower skills=Skill #1, Operating Engineer, 2 @ 1000\$ per Man-Week
Skill #2, Laborer, 2 @ 500\$ per Man-Week

Total effort=4 Man-Weeks
Manpower cost=\$3000
Direct cost=\$10000

First Street Water Main
Revision 10, 1/1/83

Job #9, Repave street

***** CRITICAL *****

Duration=2 Weeks
Completed=No
On critical path=Yes
Slack time=none

Earliest start=3/2/83
Earliest finish=3/16/83
Latest start=3/2/83
Latest finish=3/16/83

Prerequisites=Job #8, Fill 2nd part of trench

Manpower skills=Skill #1, Operating Engineer, 3 @ 1000\$ per Man-Week

Total effort=6 Man-Weeks
Manpower cost=\$6000
Direct cost=\$30000

Job #10, Repair sidewalk

Duration=1 Week
Completed=No
On critical path=No
Slack time=3 Weeks

Earliest start=2/16/83
Earliest finish=2/23/83
Latest start=3/9/83
Latest finish=3/16/83

Prerequisites=Job #6, Fill 1st part of trench

Manpower skills=none

Total effort=none
Manpower cost=\$0
Direct cost=\$5000

First Street Water Main
Revision 10, 1/1/83

Job #11, Project completed

***** CRITICAL *****

Duration=0 Weeks
Completed=No
On critical path=Yes
Slack time=none

Earliest start=3/16/83
Earliest finish=3/16/83
Latest start=3/16/83
Latest finish=3/16/83

Prerequisites=Job #9, Repave street
Job #10, Repair sidewalk

Manpower skills=none

Total effort=none
Manpower cost=\$0
Direct cost=\$0

First Street Water Main, Revision 10, 1/1/83
 Prepared by Mike Posehn

Job Description	Jan				Feb				Mar
	5	12	19	26	2	9	16	23	2
	0	1	2	3	4	5	6	7	8
1 Purchase the pipe	0----->				.	.	.	.	.
2 Dig 1st part of trench	0----->				.	.	.	.	.
3 Purchase fittings	0=====>				.	.	.	.	.
4 Lay 1st part of pipe	.	.	.	>=====					
5 Dig 2nd part of trench	.	.	>----->						
6 Fill 1st part of trench	.	.	.	.	.	>----->
7 Lay 2nd part of pipe	.	.	.	.	.	>=====
8 Fill 2nd part of trench	.	.	.	.	.	.	.	>=====
9 Repave street	.	.	.	.	.	.	.	.	>=====
10 Repair sidewalk	.	.	.	.	.	.	>----->
11 Project completed	.	.	.	.	.	.	.	.	.
Operating Engineer=1	1	1	0	0	1	0	2	3	
Laborer=3	3	3	4	4	6	4	2	0	
Welder=0	0	0	2	2	2	2	0	0	
Total manpower level=4	4	4	6	6	9	6	4	3	
Manpower cost=2.5K	2.5K	2.5K	3.5K	3.5K	5.5K	3.5K	3K	3K	
Direct cost=75K	0	5K	13K	0	10K	5K	10K	30K	
Total cost=77K	2.5K	7.5K	16K	3.5K	15K	8.5K	13K	33K	

- Symbol - Explanation
- >----> Duration of a normal job
 - >....> Slack time for a normal job
 - >====> Duration of a critical path job
 - >:::~> Duration of a completed job
 - * Job with zero duration
 - 0----> Job with no prerequisites
 - >----X Job with no successors

COLUMNAR JOB REPORT

First Street Water Main
Revision 10, 1/1/83
Prepared by Mike Posehn

JOB NAME	EARLY START	EARLY FINISH	LATE START	LATE FINISH
1 Purchase the pipe	0	2	1	3
2 Dig 1st part of trench	0	2	1	3
3 Purchase fittings	0	3	0	3
4 Lay 1st part of pipe	3	5	3	5
5 Dig 2nd part of trench	2	3	4	5
6 Fill 1st part of trench	5	6	6	7
7 Lay 2nd part of pipe	5	7	5	7
8 Fill 2nd part of trench	7	8	7	8
9 Repave street	8	10	8	10
10 Repair sidewalk	6	7	9	10
11 Project completed	10	10	10	10

COLUMNAR JOB REPORT

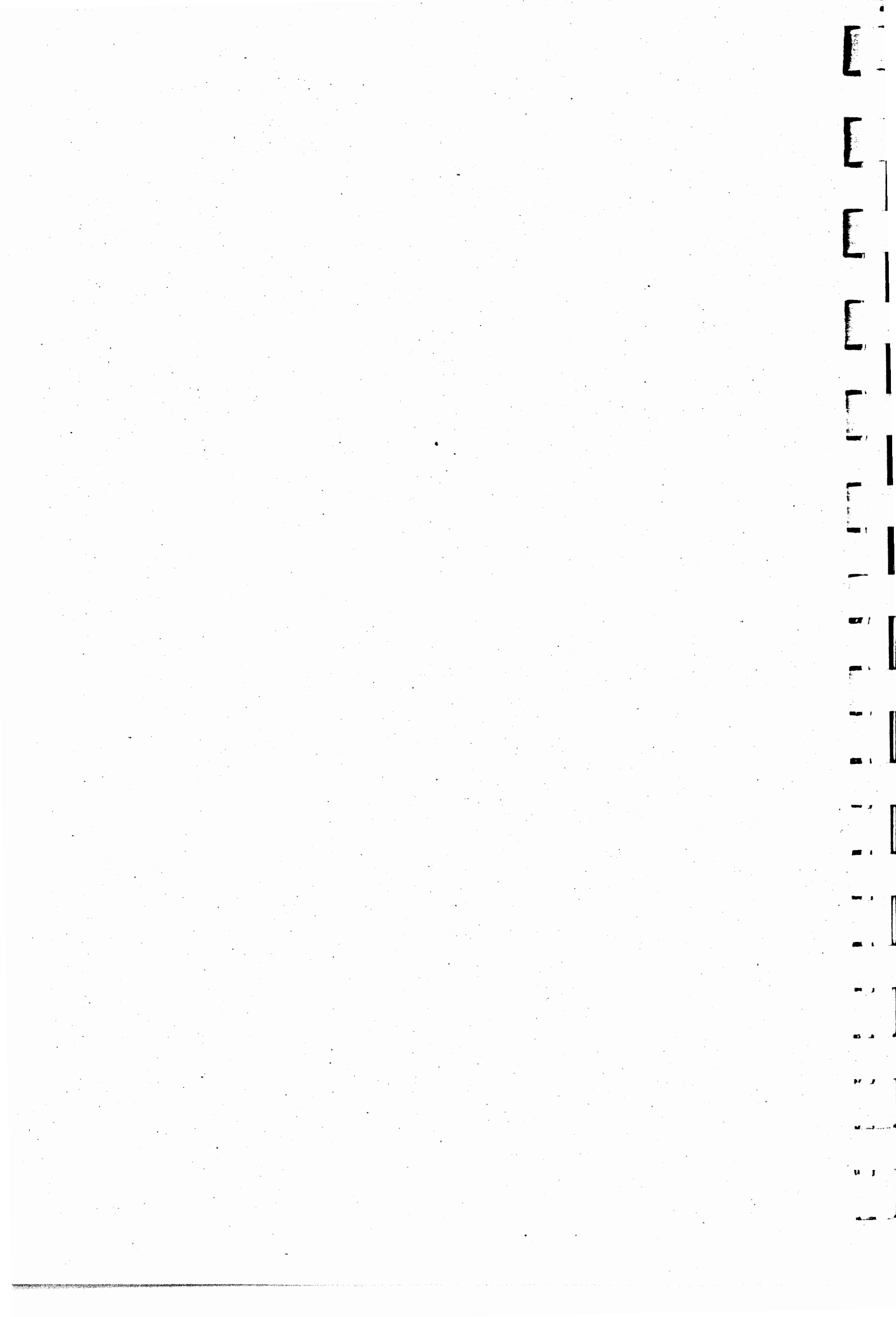
First Street Water Main
Revision 10, 1/1/83
Prepared by Mike Posehn

JOB NAME	DURATION	COMPLETE	SLACK TIME
1 Purchase the pipe	2	No	1
2 Dig 1st part of trench	2	No	1
3 Purchase fittings	3	No	0
4 Lay 1st part of pipe	2	No	0
5 Dig 2nd part of trench	1	No	2
6 Fill 1st part of trench	1	No	1
7 Lay 2nd part of pipe	2	No	0
8 Fill 2nd part of trench	1	No	0
9 Repave street	2	No	0
10 Repair sidewalk	1	No	3
11 Project completed	0	No	0

COLUMNAR JOB REPORT

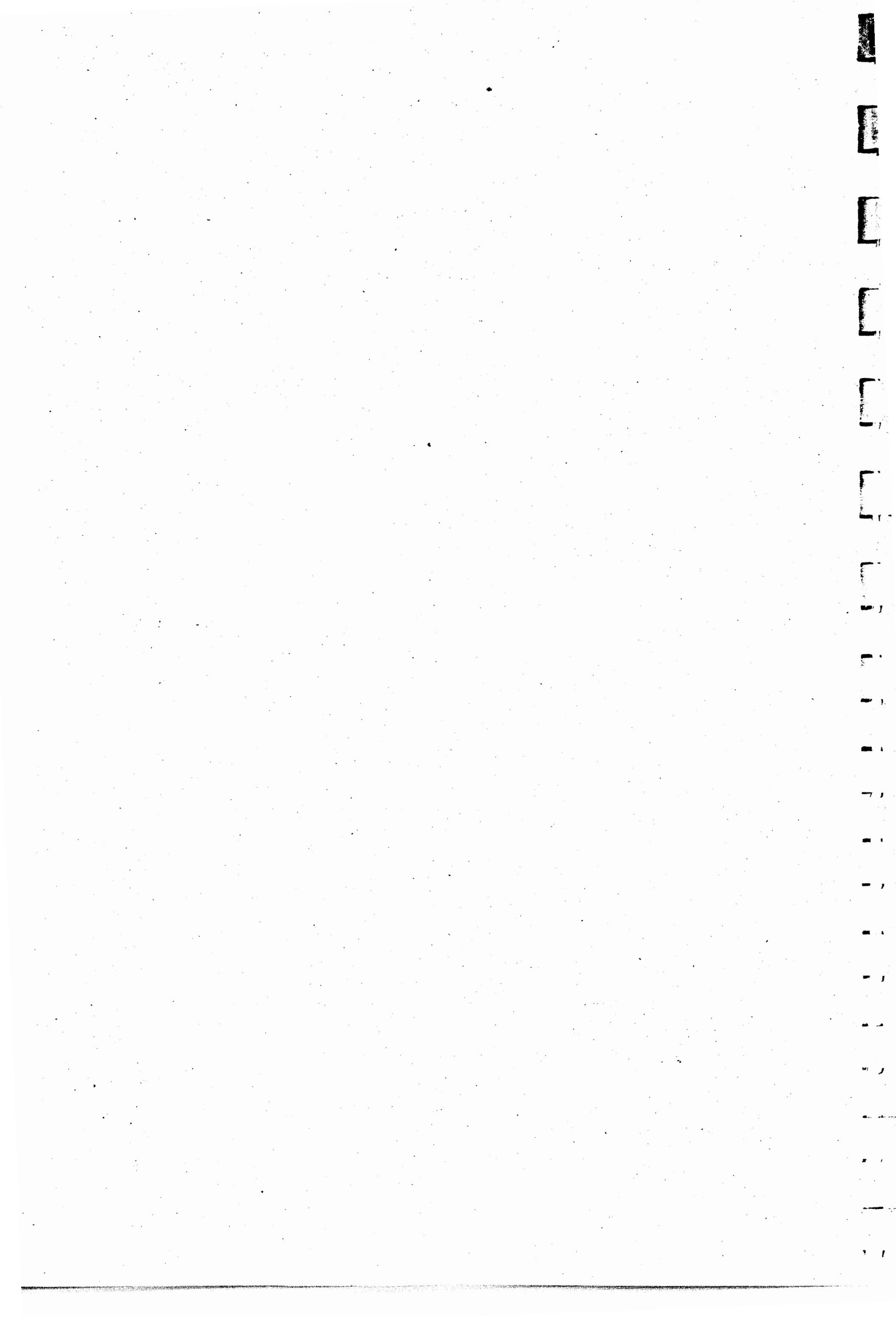
First Street Water Main
Revision 10, 1/1/83
Prepared by Mike Posehn

JOB	PREREQUISITES								
	1	2	3	4	5	6	7	8	9
1									
2									
3									
4	1	2	3						
5	2								
6	4								
7	5	4							
8	7	6							
9	8								
10	6								
11	9	10							



Terminal Control Codes

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Terminal Control Codes

Terminal Selection

If your terminal does not appear in the "TERMINAL SELECTION" list, you must enter its control codes manually. This will certainly require that you read and understand the technical manual for your terminal and may require the assistance of a programmer.

If you cannot find a programmer to help you, consult your computer dealer or software distributor.

After selecting the "terminal not shown" option in the "TERMINAL SELECTION" list, the following display appears.

TERMINAL SELECTION

Since your terminal is not shown on the menu, you must specify its control codes for cursor positioning, clearing the screen, and other functions. Please consult your terminal manual before continuing.

The mandatory control codes are:

- Clear the screen and home the cursor
- Position the cursor to a specific row and column

Optional control codes are:

- Erase from the cursor to the end of the screen
- Erase from the cursor to the end of the line
- Turn on screen highlighting
- Turn off screen highlighting

You will be asked a series of questions. To answer, enter a decimal number and then press RETURN.

To continue, press RETURN
To quit, press ESC

This display is intended to remind you of the complexity of the information that is required. The following sections of this appendix discuss each of these six control code functions in more detail.

There is a blank control code form at the end of this Appendix. You should read your terminal manual along with this Appendix and record each of the control sequences as you discover them. After you have installed your program and tested the codes, we would appreciate receiving a copy of the completed form so that we can include your terminal in the TERMINAL SELECTION menu and thereby eliminate this chore for others in the future.

Clear Screen and Home Cursor

This is a mandatory function that is used very frequently.

CLEAR THE SCREEN AND HOME THE CURSOR (mandatory)

This character, or sequence of characters, should entirely blank the screen and leave the cursor in the upper left hand corner.

For example, an ADM3A terminal requires,

Number of characters in the sequence = 1
first character = 26 (an ASCII Control/Z)

To answer each question, enter a decimal number followed by RETURN
To quit, press ESC

The sequence that you enter here, and anywhere else for that matter, is limited to seven characters at most. This should be sufficient for any terminal.

The example given above is the ADM3A, a very common terminal. Looking in an ADM3A manual you might see the home and clear function defined in any one of the following ways:

By its ASCII name → SUB
As a hexadecimal number → 1A
As a control character → CONTROL/Z
As an octal number → 32
As a decimal number → 26

Whatever is given in your manual, you must convert it into a decimal number before you can enter it. This should not be a problem, because most terminal manuals have conversion tables in the back.

The home and clear sequence may be a combination of two functions for your terminal (one to clear the screen and one to home the cursor). In that case, just combine the two sequences into one long sequence and enter in the decimal values.

Other terminals list a “lead-in” character that must follow each control code. If yours does, remember to include the lead-in character in the sequence.

As an example, specification of the ADM3A control codes is shown below with operator’s entries shown in bold face.

How many characters are in the home and clear sequence?	1
What is the decimal value of character #1?	26

Position the Cursor

Positioning the cursor is probably the most complicated function that your terminal can perform. Because of the obscure way in which most terminal manuals are written, it may take you several tries before you successfully discover the proper control sequence. Don’t despair, most people have difficulty with this one.

POSITION THE CURSOR (mandatory)

This is a complex sequence of characters used to move the cursor to a specific row and column of the terminal screen. The sequence required by most terminals can be generalized into five parts.

The general sequence is.

For example, for an ADM3A.

part 1 = a lead-in sequence	2 characters, 27 and 61
part 2 = the row number plus an offset	row number + 32
part 3 = a separator sequence	none required
part 4 = the column number plus an offset	column + 32
part 5 = an ending sequence	none required

By generalizing the sequence into five parts almost all terminals can be controlled. If your terminal's cursor positioning is simple you won't need to use all five parts. But if your terminal is more complicated, all five may be necessary.

There is one complication: some terminals want the column number first, not the row number. Make sure to check your manual for this odd behavior.

The lead-in sequence is a set of characters that tells your terminal to be on the look out for a cursor address.

The row number is sent with an optional offset. It is a conventional practice for computer programs to refer to rows of the terminal screen using the numbers 0 through 23, but some terminals refer to rows using the numbers 32 through 55 (these are just the same numbers but with an offset of 32). They do this so that they won't confuse a row number with some other control code. Because a row offset is so common, you will be asked to enter the offset used by your terminal.

Some terminals require a separator sequence between the row and column, but most terminals don't. If one is required it is probably due to the fact that you can independently position the cursor row and column location.

As with the row number, the column number may require an offset and this offset may be different from the row offset. For example, a Microterm ACT-V terminal uses a row offset of 32 and a column offset of 80 but most programs refer to terminal screen columns with numbers from 0 through 79. If the column offset is 32, then the numbers 32 through 112 are used instead. If a column offset is used that would make the column number greater than 126, then the numbers wrap back around to 0.

The fifth part of this general sequence is included for those terminals that require something to follow both the row and column numbers.

As an example, the following entries could be used for an ADM3A:

How many characters are in the lead-in sequence?	2
What is the decimal value of character #1?	27
What is the decimal value of character #2?	61
Is the row first for your terminal? Enter "Y" or "N"?	Y
What offset, in decimal, is added to the row number?	32
How many characters are in the separator sequence?	0
What offset, in decimal, is added to the column number?	32
How many characters are in the ending sequence?	0

Erase to End of Screen

This is the first of the optional control codes. If your terminal does not perform this function, it will be simulated in software. Simulation in software will, of course, be noticeably slower.

ERASE TO END OF SCREEN (optional)

This sequence blanks the screen from the cursor position to the bottom. If your terminal does not provide this function, it will be simulated in software.

Since this control sequence is used very frequently, it is highly desirable that your terminal have it. Although the ADM3A we have been using does not perform this function, most newer terminals do.

Does your terminal provide this function? Enter "Y" or "N"? N

Erase to End of Line

This is the second of the optional control codes. If your terminal does not perform this function, it will be simulated in software. Simulation in software will, of course, be noticeably slower.

ERASE TO END OF LINE (optional)

This sequence blanks the screen from the cursor position to end of line. If your terminal does not provide this function, it will be simulated in software.

Since this control sequence is used very frequently, it is highly desirable that your terminal have it. Although the ADM3A we have been using does not perform this function, most newer terminals do.

Does your terminal provide this function? Enter "Y" or "N"? N

Turn On Highlighting

Highlighting is intended to be a function such as inverse video, a change in intensity, or any other function that calls attention to some area of the terminal screen. It is normally used by the program to accent one or more data fields in a screen display.

If your terminal is not capable of such a function, there will be no noticeable performance sacrifice.

The highlighting displays and the responses for an ADM3A terminal are shown below.

TURN ON HIGHLIGHTING (optional)

This sequence turns on screen highlighting such as inverse video or a change in screen intensity. On some terminals the highlighting attribute applies to fields and must be treated specially to prevent a distracting flashing of the screen. Sometimes the attribute itself uses a blank space on the screen.

If your terminal does not provide highlighting, it will not be used.

Does your terminal provide this function? Enter "Y" or "N"? N

TURN OFF HIGHLIGHTING (optional)

This sequence turns off screen highlighting such as inverse video or a change in screen intensity. Since you have already specified a sequence to turn on highlighting, you must also enter this sequence.

How many characters are in the turn-off screen highlighting sequence?

Special Terminal Options

SPECIAL TERMINAL OPTIONS

There are several special options that are required by a few terminals. Use the normal answer unless you are absolutely sure your terminal is different

How many NULLS are required after erasing the screen?
(Normally 0) 0

Are cursor addresses sent as strings?
(Normally NO) Enter "Y" or "N" N

What is the cursor origin? (Normally 0) 0

TERMINAL CONTROL CODE FORM

Terminal Manufacturer _____

Model Number _____

CLEAR SCREEN AND HOME CURSOR

Decimal values of the characters = _____

POSITION THE CURSOR

Decimal values of lead-in sequence = _____

Is the row value sent first? (circle one) = Y N

Row offset = _____

Decimal values of separator sequence = _____

Column offset = _____

Decimal values of ending sequence = _____

ERASE TO END OF SCREEN

Decimal values of the characters = _____

ERASE TO END OF LINE

Decimal values of the characters = _____

TURN ON HIGHLIGHTING

Decimal values of the characters = _____

Do attributes apply to fields? (circle one) = Y N

Do attributes occupy a space? (circle one) = Y N

TURN OFF HIGHLIGHTING

Decimal values of the characters = _____

SPECIAL OPTIONS

Number of NULLS after home and clear = _____

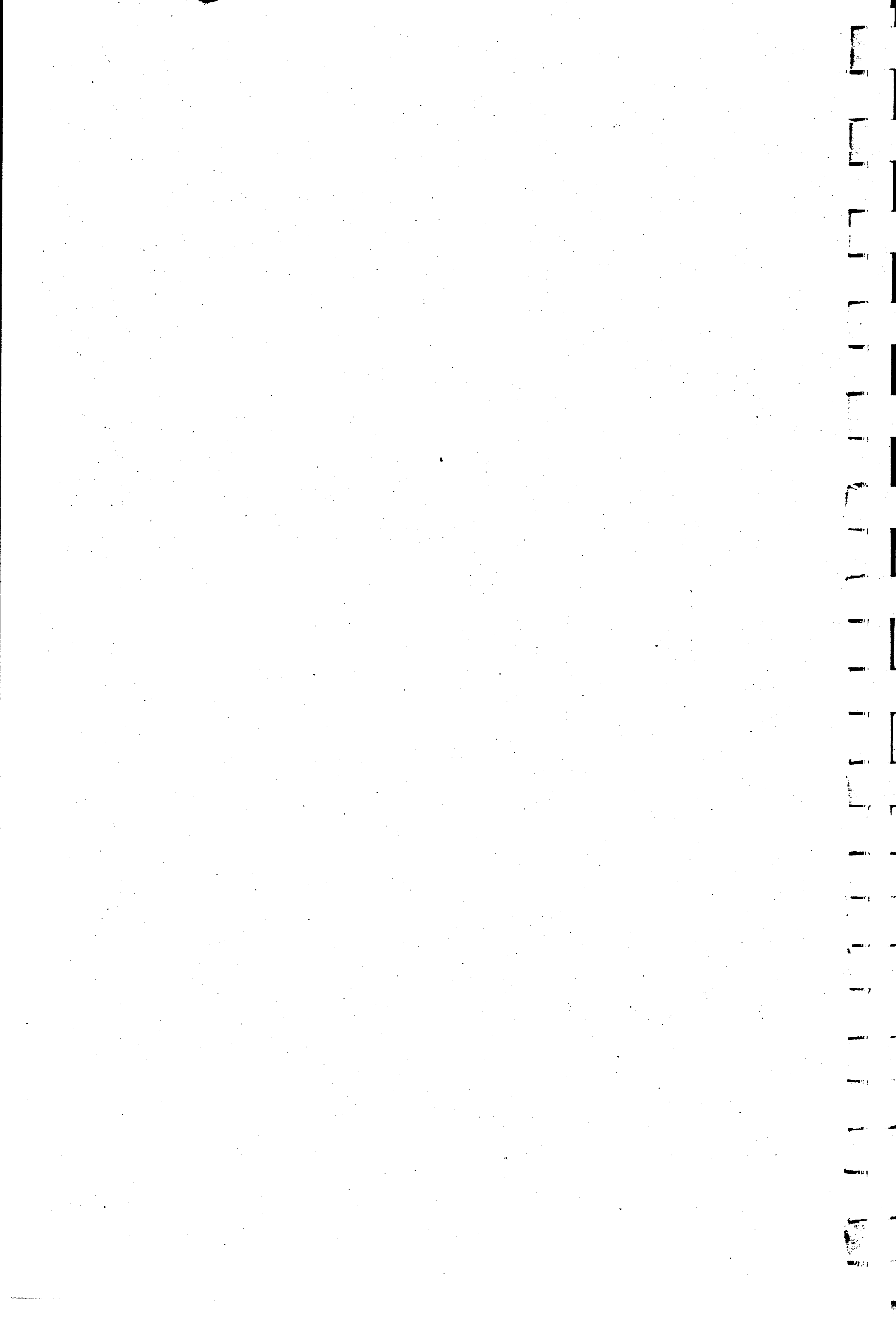
Send Cursor Addresses in ASCII (Normally No) = _____

Is Zero The Cursor Origin (Normally Yes) = _____

Table of ASCII Characters

Use this table to find the decimal equivalent of ASCII characters used to control your terminal.

CHAR	CTRL	HEX	DEC	CHAR	HEX	DEC	CHAR	HEX	DEC
NUL		00	00	+	2B	43	V	56	86
SOH	^A	01	01	,	2C	44	W	57	87
STX	^B	02	02	-	2D	45	X	58	88
ETX	^C	03	03	.	2E	46	Y	59	89
EOT	^D	04	04	/	2F	47	Z	5A	90
ENQ	^E	05	05	0	30	48	[	5B	91
ACK	^F	06	06	1	31	49	\	5C	92
BEL	^G	07	07	2	32	50	]	5D	93
BS	^H	08	08	3	33	51	^	5E	94
HT	^I	09	09	4	34	52	_	5F	95
LF	^J	0A	10	5	35	53	`	60	96
VT	^K	0B	11	6	36	54	a	61	97
FF	^L	0C	12	7	37	55	b	62	98
CR	^M	0D	13	8	38	56	c	63	99
SO	^N	0E	14	9	39	57	d	64	100
SI	^O	0F	15	:	3A	58	e	65	101
DLE	^P	10	16	;	3B	59	f	66	102
DC1	^Q	11	17	<	3C	60	g	67	103
DC2	^R	12	18	=	3D	61	h	68	104
DC3	^S	13	19	>	3E	62	i	69	105
DC4	^T	14	20	?	3F	63	j	6A	106
NAK	^U	15	21	@	40	64	k	6B	107
SYN	^V	16	22	A	41	65	l	6C	108
ETB	^W	17	23	B	42	66	m	6D	109
CAN	^X	18	24	C	43	67	n	6E	110
EM	^Y	19	25	D	44	68	o	6F	111
SUB	^Z	1A	26	E	45	69	p	70	112
ESC	^[	1B	27	F	46	70	q	71	113
FS	^^	1C	28	G	47	71	r	72	114
GS	^]	1D	29	H	48	72	s	73	115
RS	^^	1E	30	I	49	73	t	74	116
US	^_	1F	31	J	4A	74	u	75	117
SP		20	32	K	4B	75	v	76	118
!		21	33	L	4C	76	w	77	119
"		22	34	M	4D	77	x	78	120
#		23	35	N	4E	78	y	79	121
\$		24	36	O	4F	79	z	7A	122
%		25	37	P	50	80	{	7B	123
&		26	38	Q	51	81		7C	124
'		27	39	R	52	82	}	7D	125
(28	40	S	53	83	~	7E	126
)		29	41	T	54	84	DEL	7F	127
*		2A	42	U	55	85			



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