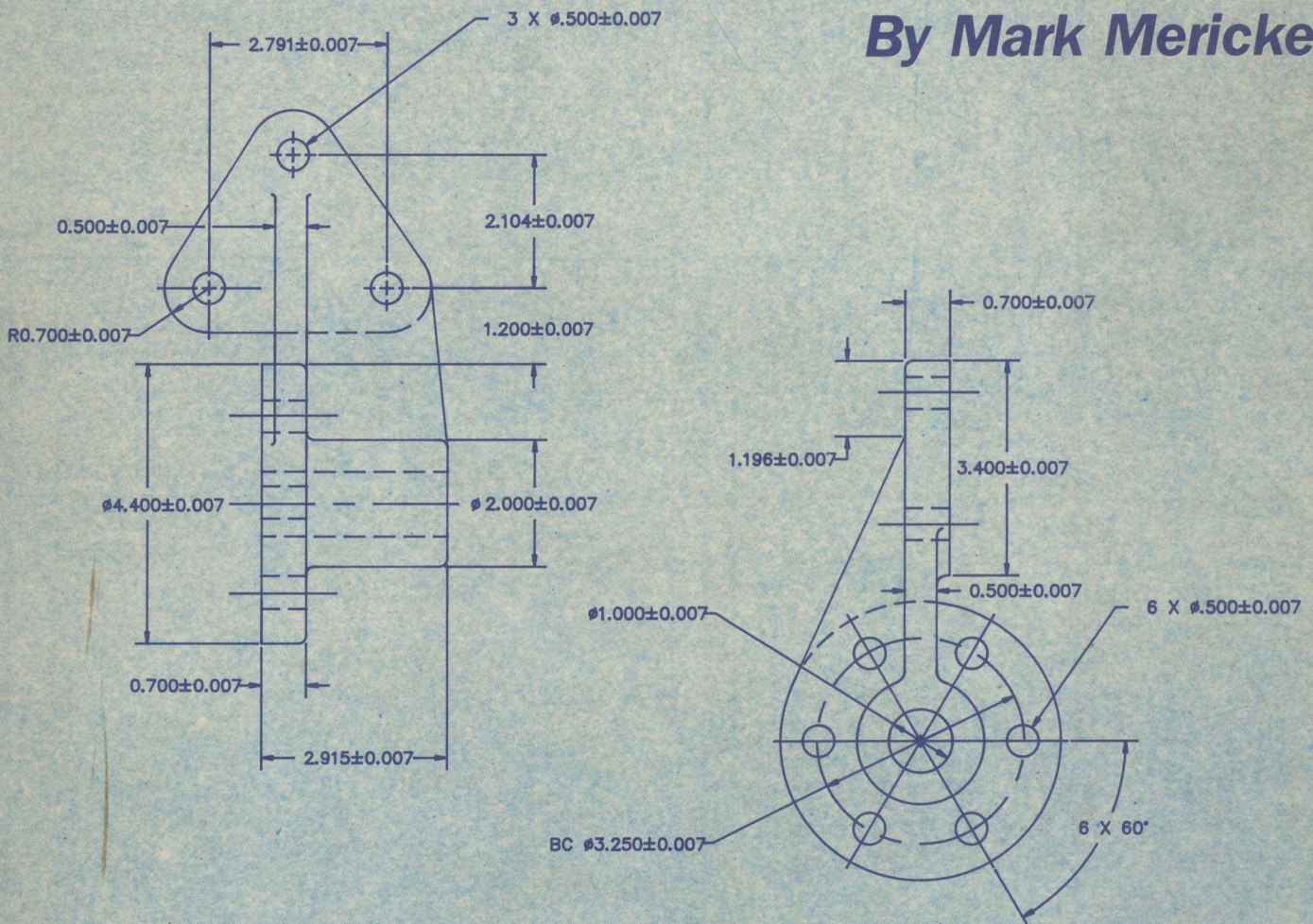


# STEPPING INTO CAD

By Mark Merickel



A TECHNICAL DRAFTING WORKBOOK USING  
THE AutoCAD<sup>®</sup> MICROCOMPUTER PROGRAM



New Riders Publishing



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A Technical Drafting Workbook  
Using The AutoCAD™ Microcomputer Program



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By Mark L. Merickel

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## ABOUT THE AUTHOR

MARK MERICKEL is Drafting Technology Instructor at Calaveras High School, Calaveras, California. He also is Computer Consultant to the Calaveras Unified School District, and serves as Chairman of the California State CAD Advisory Site and Steering Committee.

Mr. Merickel has taught drafting at the secondary and community college level for fifteen years. He has industrial training and hands-on experience with both mainframe and microcomputer-based drafting and design systems. For the last 10 years he has been a pioneer and leader in bringing CAD/CAM curriculum into public education. He has created a CAD course built around a laboratory with hands-on micromputers. His classroom laboratory is visited by state and local educators seeking insight in developing CAD curriculum. His program has been selected as a State Model Program for California.

Mr. Merickel is a frequent guest lecturer and speaker on CAD/CAM in industrial and educational forums. He has presented seminars and classes to the California Industrial Arts Association (CIAA), the California Industrial Education Association (CIEA), and the California Department of Education, Industrial Education.

Mr. Merickel holds a B.A. in Drafting and Design and an M.A. in Industrial Technology from California State University at Fresno. He holds California Secondary, Vocational, and Community College Teaching Credentials.

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## INTRODUCTION

### ON PURPOSE . . . THE INTENTIONS OF THIS WORKBOOK

**This Workbook is your guide to learning CAD!!**

The *STEPPING INTO CAD WORKBOOK* provides you with a program of sequential, self-guided exercises which have been developed to assist you in understanding and developing Computer Aided Drafting skills -- CAD skills. These skills include using and maintaining a CAD workstation, drafting on "electronic" sheets, managing drawing files, creating and managing CAD symbol libraries, and creating 3-dimensional CAD drawings.

CAD presents you with a new way of thinking about drafting. Imagine never having to use an eraser to correct mistakes, or being able to insert standard symbols on a drawing by simply "pointing" to a location on your drawing.

Often, when a student is given the opportunity to learn CAD, various hurdles exist which must be overcome. These hurdles may include limited CAD stations, lack of CAD instructional materials, and a lack of well-planned drafting exercises. This Workbook has taken these factors, and more, into account and provides you with the vehicle to successfully learn CAD TECHNICAL DRAFTING SKILLS.

At the present time many employment positions for drafters still require manual drafting skills, but the transition to CAD is upon us. You must prepare yourself for the changing times. The time is coming when drafters and designers will carry their own CAD tools to the job on a floppy disk, just as they might carry their pencils today. This WORKBOOK will teach you the skills of CAD drafting.

### THE AutoCAD™ PROGRAM

This Workbook uses the AutoCAD microcomputer program. AutoCAD is widely accepted as the industry standard for CAD drafting. AutoCAD is a command driven computer program which allows you to develop computer-aided drawings with relative ease. AutoCAD is designed for use by anyone who draws in their work. As a student of CAD, AutoCAD offers you the opportunity to work with the leading microcomputer-based CAD program.

Once you have learned the techniques of using AutoCAD, you will find that this "drafting tool" will enhance your drafting abilities and productivity. AutoCAD is a sophisticated CAD program, and once you have learned to operate it "properly" you will find its capabilities are virtually unlimited.

The AutoCAD program provides you with a tool chest filled with very special drafting "tools". Lines, circles and arcs may be drawn by your command and then easily deleted, copied, or moved. AutoCAD also allows you to work in a "full scale drawing medium". This means you may set AutoCAD to draw a 100-foot long space shuttle or a simple 6-inch diameter flange in "full scale units". You no longer need to draw in reduced or enlarged scales.

AutoCAD records all the geometric information in a drawing. Therefore, it is an easy process for you to semi-automatically provide the "size description" of a drawing. You can signal AutoCAD where you want to locate the "starting point of a dimension" and where you want to locate the "ending point of a dimension". Then by "pointing" to where you want the dimension text located, AutoCAD will draw the completed dimension. All the drafting techniques mentioned above, and more, will become part of your CAD drafting skills.

## THE WORKBOOK'S ASSUMPTIONS

*STEPPING INTO CAD* assumes that you have little or no experience in the use of the AutoCAD program. If you have previous experience, but that experience has been unstructured, you will profit by following the Exercises in the Workbook. Each Exercise will teach you new CAD skills. By completing all the Exercises you will develop a high level of CAD proficiency.

We recommend that you use the book entitled *INSIDE AutoCAD* as your primary reading reference. Reading references for each Exercise are provided for *INSIDE AutoCAD* and *The AutoCAD USER REFERENCE MANUAL* under the heading "Exercise References".

Once you have learned to use AutoCAD, you will find that the savings in your drafting time are enormous. Using this *STEPPING INTO CAD WORKBOOK*, you will learn how to operate the AutoCAD program. You will learn how to make AutoCAD work for you, and you will learn how to apply AutoCAD to your future CAD applications.



## **STEP ONE . . . GETTING STARTED**

### **HOW THE WORKBOOK IS ORGANIZED**

The *STEPPING INTO CAD WORKBOOK* is organized to teach CAD skills through a systematic learning progression. The Workbook does not contain any programming and keeps the barriers of computer language as low as possible.

The Workbook is organized in seven steps. The steps take you from a description of CAD HARDWARE through the completion of 23 CAD EXERCISES.

**STEP ONE . . . GETTING STARTED** presents you with an overview of the Workbook. This overview will introduce you to the organization of the seven steps you will take on your "road" to learning technical drafting using CAD.

**STEP TWO . . . LEARNING ABOUT THE CAD WORKSTATION** illustrates and describes the typical components of a CAD workstation. It describes the hardware terms and applications you need to know to complete the Workbook Exercises.

**STEP THREE . . . STARTING AutoCAD AND MAKING A DRAWING DISK** will teach you how to start up the AutoCAD program. You will learn how to enter and exit the drawing editor and how to manage your CAD drawings using AutoCAD's file utilities. **STEP THREE** will show you how to prepare and label the floppy disk you will use as your CAD Exercise "drawing disk".

**STEP FOUR . . . HOW TO USE AutoCAD** provides a general overview of how to use AutoCAD to create or delete drawing elements. **STEP FOUR** introduces you to the way AutoCAD displays your drawing on the screen. You will learn about AutoCAD's graphic display and where key drawing information is found. You will learn about AutoCAD's coordinate system which is used to draw lines and position entities.

**STEP FIVE . . . LEARNING** AutoCAD's COORDINATE SYSTEM contains five paper-based drawing Exercises which will assist you in understanding AutoCAD's coordinate drafting structure. You will learn AutoCAD's absolute, relative, and polar coordinate modes used to generate lines and position entities. These drawing Exercises use paper representations of AutoCAD's graphic screen.

**STEP SIX . . . DRAFTING WITH** AutoCAD teaches you how to draft with the AutoCAD program using a planned tutorial sequence. STEP SIX presents fourteen AutoCAD Exercises for you to work out and complete. Each Exercise is preceded by an "Exercise Planner". Complete the Exercise Planner prior to using AutoCAD. The Planner will allow you to pre-plan the Exercises and will make your time spent using the CAD system more efficient.

Each Exercise adds new CAD drafting skills. The fourteen Exercises include the development of a "prototype" drawing, border/titleblock, and five components of a robot arm. Additional Exercises dimension the five components, and place all the component drawings on one sub-assembly working drawing. The final Exercise presents a 3-dimensional CAD (wireframe and hidden line removal) drawing.

**STEP SEVEN . . . ADVANCED DRAFTING** provides three additional drawing Exercises. These advanced drafting drawings use the skills and procedures you acquire in completing the STEP SIX Exercises.

### APPENDICES

**APPENDIX A . . . MENU TREE** describes AutoCAD's menu structure in a flow diagram form. This flow diagram will help you remember which AutoCAD ROOT MENU Command leads to the sub-menu you need to use.

**APPENDIX B . . . EXERCISE PLANNER** provides you with the vehicle to pre-plan CAD drawings. Use the Exercise Planner as a reference while developing your CAD drawings. It will help you think through your drawing and will make your CAD time more efficient.

**APPENDIX C . . . EXAMPLE EXERCISE PLANNER** provides you with a completed Exercise Planner. This completed Exercise Planner illustrates how to fill out the Planner for an Exercise. Use the Example Planner as a model for the other Exercises.

## READING REFERENCES AND THE CAD WORKSTATION

This Workbook assumes that you have little or no experience in the use of the AutoCAD program. If you have previous experience, but that experience has been unstructured, you will profit by following the Workbook Exercises in their entirety. Each Exercise will teach you new CAD skills. By completing all the Exercises you will develop a high level of CAD proficiency.

### INSIDE AutoCAD

We recommend that you use the book entitled *INSIDE AutoCAD* as a primary reference. References to *INSIDE AutoCAD* and the *AutoCAD USER REFERENCE MANUAL* are provided for each Exercise under the heading "Exercise References". The reference listings are given by "Command Names" and "Page Numbers". If questions regarding the Exercises are left unanswered by *INSIDE AutoCAD*, you should consider the *AutoCAD USER REFERENCE MANUAL* as the master reference.

### The CAD Workstation

The AutoCAD program operates on over thirty different microcomputers. *STEPPING INTO CAD* references to the "CAD systems microcomputer" refer to the IBM-PC/XT/AT. The Workbook assumes you will be using an IBM-PC or MS-DOS work-alike microcomputer. The Workbook also assumes that you will be using a "pointing device" to control AutoCAD's cursor movement when "picking" drawing locations or entities and making menu command "Selections". If your CAD Workstation is different from the example given, consult with your instructor for guidance.

## HOW TO USE THIS WORKBOOK

Read all the information contained within a Workbook Exercise to prepare for the Exercise.

Each Workbook Exercise is numbered. Do each Exercise in sequence. The skills developed in each Exercise build on each other and are used in succeeding assignments. A goal of the Workbook is to have you develop CAD drawings of robot arm parts, and then to place each of these individual components on one sub-assembly drawing.



## HOW THE WORKBOOK EXERCISES ARE ORGANIZED

Each Exercise is numbered at the top of the Exercise sheets.

The Exercises are titled according to the CAD skills emphasized in the Exercise. These titles include "Drafting Geometry, Dimensioning, 3-D Drawing, and Advanced Drafting".

### Key Elements in the Exercise

There are seven key instructional elements in the drawing Exercises. These are:

- o The Disk Drawing Name.
- o The Exercise Objectives.
- o The Exercise References.
- o The Exercise Introduction.
- o The Exercise Setup.
- o The Exercise AutoCAD Menu and Command List.
- o The Exercise Drawing Size Description.

### The Disk Drawing Name

The CAD Exercises are saved on your "drawing disk" by the name given under the Exercise heading "Save Drawing As:". The drawing names, like "MOUNT" and "PIN", usually describe the drawing component. Use the exact name to insure that you can retrieve the drawings for future Exercises.

### Exercise Objectives

Each Exercise lists drawing objectives for the Exercise. These are given to assist you in understanding the Exercise goals.

### Exercise References

The "Exercise References" for each Exercise are listed for both *INSIDE AutoCAD* and the *AutoCAD USER REFERENCE MANUAL* by AutoCAD command names and by page numbers. Although the Exercises are designed to "stand-alone", we recommend that you read the *INSIDE AutoCAD* references before starting the Exercise, and the *AutoCAD MANUAL* if additional referencing is required during the Exercise.

### Exercise Introduction

Each Exercise "Introduction" will provide you with a description of the Exercise. The Exercise Introduction summarizes the steps you need to take to complete each Exercise. You should read the introduction carefully to gain an understanding of where the Exercise is going and just how you will get there.

### Exercise Setup

The Exercise "Setup" tells you when it is necessary to "set" certain AutoCAD drawing parameters. The Setup also may instruct you to "call up" an existing drawing. Follow the Setup drawing settings to insure that you get accurate drawings.

### AutoCAD Menu and Command Sequence

Each Exercise lists the AutoCAD command menu sequence used to develop a drawing. The menus are listed in the form of a "menu flow sequence" which gives the AutoCAD menus you will use when you select AutoCAD drawing and editing commands. The menu list also provides "Comments" to highlight specific AutoCAD commands used in the drawing. The menu list will assist you in making the menu selections for each Exercise.

### Exercise Size Description

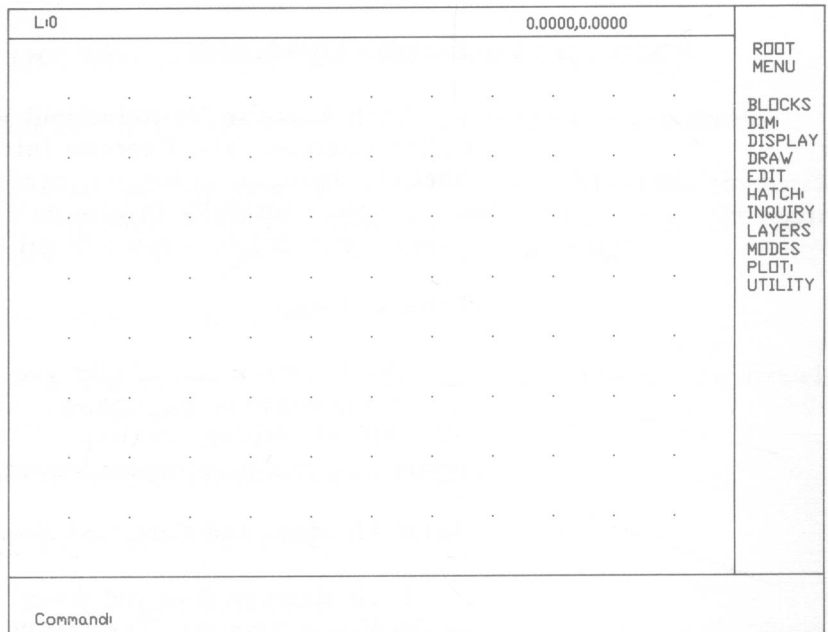
The Exercises include an "Exercise Size Description". This is a drawing that illustrates the orthographic views and the dimensions of the objects which you will draw in the Exercise. Study the Exercise Size Description drawings carefully before starting your Exercises.

## THE EXERCISE PLANNER

Each of the AutoCAD drafting Exercises requires that you complete an "Exercise Planner" prior to using the CAD system. The Exercise Planner is designed to assist you with the development of the CAD Exercises by helping you pre-plan your CAD drawing.

To use the Planner you check off and fill in pertinent information about the AutoCAD drawing sequences and commands used in the Exercise. A drawing of the AutoCAD graphics screen is located at the back of the Planner in APPENDIX B. This "paper screen" lets you develop a drawing of the Exercise and record notations which you can refer to when you use the CAD workstation. The paper screen is shown below. The area to the right of the *gridded drawing area is where AutoCAD's drawing menu commands appear.*

GETTING STARTED



AutoCAD's Drawing Screen

HOW THE WORKBOOK SHOWS DRAWING ACTIONS

Each Exercise gives drawing Instructions to complete the Exercises. Throughout the Exercises you will be asked to "Select" an AutoCAD menu command. For example, you will be asked to "Select LINE:", the command for drawing lines. This type of instruction means you are to "highlight" a specific drawing command choice by using your CAD system's "pointing device" to point to the command you wish to select. Pushing the pointing device's "selection button" will signal AutoCAD to display the "highlighted" command and enact the command or initiate a command sequence.

Picking Points

Throughout the Exercises example drawings are used to describe the Exercise drawing's shape and size. Many of the example drawings show specific points or entities which you are to "Pick" using the CAD system's "pointing device". Each "Pick" point is indicated in the text.

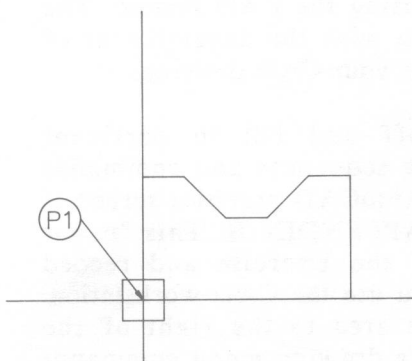


Illustration Screen Action When "Picking" Point

For example, the Exercise Instructions will say "Pick 1". The point "P1" will be shown on the corresponding example drawing with an arrow pointing to the specific "Pick" point. An example of this procedure is shown below.

Pick ①