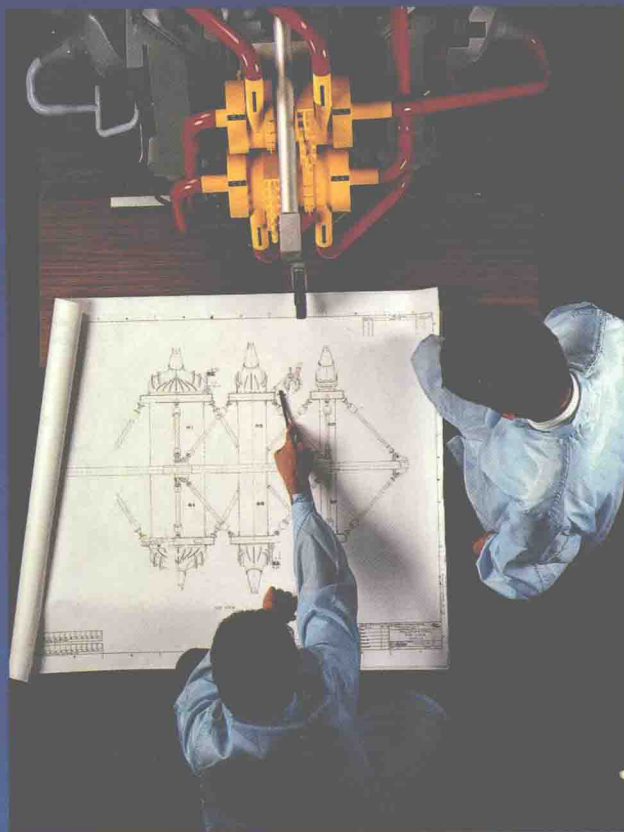


ENGINEERING DRAWING AND DESIGN

FIFTH
EDITION



CECIL JENSEN • JAY D. HELSEL

Engineering Drawing and Design

Fifth Edition

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McGraw-Hill

New York, New York Columbus, Ohio Mission Hills, California Peoria, Illinois

Photo Credit: Cover photo courtesy of Wayne Eastep

Jensen, Cecil Howard

[Engineering drawing and design / Cecil Jensen, Jay D. Helsel.
5th ed.

p. cm.

Includes index.

ISBN 0-02-801795-1

1. Mechanical drawing. 2. Engineering design. I. Helsel, Jay D.

II. Title.

T353.J47 1996

604.2—dc20

94-11373

CIP

Photo credits for part and chapter openers: Part One, Comstock, Inc. Part Two, Charly Franklin/FPG International. Part Three, Andrew Sacks/Tony Stone Images. Part Four, Earl Zubkoff Photography. Part Five, Martin Rogers/Tony Stone Images. Chapters 1-27, Aaron Haupt. Other credits: Photos 27-7-1 and 27-7-5 by OrCAD, Inc.

Imprint 1997

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This printing includes references to ASME Y14.5M-1994.

Printed in the United States of America.

Send all inquiries to:

Glencoe/McGraw-Hill
936 Eastwind Drive
Westerville, OH 43081

ISBN 0-02-801795-1

5 6 7 8 9 10 11 12 13 14 15 004/043 03 02 01 00 99 98 97

ABOUT THE AUTHORS

CECIL JENSEN is the author or coauthor of many successful technical books, including *Engineering Drawing and Design*, *Fundamentals of Engineering Drawing*, *Fundamentals of Engineering Graphics* (formerly called *Drafting Fundamentals*), *Interpreting Engineering Drawings*, *Geometric Dimensioning and Tolerancing for Engineering and Manufacturing Technology*, *Architectural Drawing and Design for Residential Construction*, *Home Planning and Design*, and *Interior Design*. Some of these books are printed in three languages and are used in many countries.

He has 27 years of teaching experience in mechanical and architectural drafting, and was a technical director for a large vocational school in Canada. He has also been responsible for the supervision of the teaching of technical courses for General Motors apprentices in Oshawa, Canada. Before entering the teaching profession, Mr. Jensen gained several years of design experience in the industry.

Mr. Jensen is a member of the Canadian Standards Committee (CSA) on Technical Drawings (which includes both mechanical and architectural drawing), and is chairman of the Committee on Dimensioning and Tolerancing. Mr. Jensen is Canada's representative on the American (ANSI) Standards for Dimensioning and Tolerancing, and has represented Canada at two world (ISO) conferences in Oslo (Norway) and Paris on the standardization of technical drawings.

He took an early retirement from the teaching profession in order to devote his full attention to writing.

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He has worked in industry and has taught drafting, metalworking, woodworking, and a variety of laboratory and professional courses at both the secondary and college levels. During the past 25 years, he has also worked as a free-lance artist and illustrator. His work appears in many technical publications.

Dr. Helsel is coauthor of *Engineering Drawing and Design*, *Fundamentals of Engineering Drawing*, *Programmed Blueprint Reading*, *Mechanical Drawing*, and *Computer-Aided Engineering Drawing*.

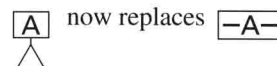
DRAWING STANDARDS UPDATE

The recently published standard *ASME Y14.5M—1994 Dimensioning and Tolerancing*, a revision of *ANSI Y14.5M—1982*, contains additions and modifications to improve national and international drawing communications. This was accomplished by adopting many of the International Organization for Standardization (ISO) drawing standards.

The publication of this standard came at a time when *Engineering Drawing and Design*, 5th edition was ready for publication. In order that the fifth edition of *Engineering Drawing and Design* reflect the current standards adopted by the ISO, the United States, and Canada, this section of the text was introduced to provide current drawing standards to the user. This second printing includes changes in Chapter 16 to be consistent with *ASME Y14.5M—1994*. This will ensure that the students and teaching staff using this text will be informed of the latest drawing requirements.

Significant changes found in *ASME Y14.5M—1994* are:

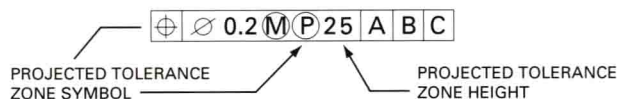
- Adoption of the universal (ISO) datum feature symbol.



The drawing and placement of this symbol is explained in Unit 16–5.

- Discontinuance of the use of the RFS symbol (Ⓢ). The “regardless of feature size” condition now applies where the symbol for MMC and LMC are not stated on size features. This now conforms with ISO practices and is explained in Unit 16–4.

- Placement of the projected tolerance zone symbol and its height in the feature control frame, following the stated tolerance and any modifier. The dimension indicating the minimum height of the projected tolerance zone is placed after the projected tolerance zone symbol. See Unit 16–10.



- Revision of the designation from ANSI to ASME to reflect The American Society of Mechanical Engineers as the preparing organization.
- Reinstatement of the symmetry symbol \equiv , to be applied only on an RFS basis. See Unit 16–14.

ACKNOWLEDGMENTS

The authors are indebted to the members of ASME Y14.5M–1994 Dimensioning and Tolerancing, and the members of the CAN/CSA–B78.2–M91 Dimensioning and Tolerancing of Technical Drawings for the countless hours they have contributed to making such a successful standard.

We also wish to thank Donald Voisin, Professor of Engineering Technology and Coordinator of Design and Drafting at the Niagara County Community College, for his assistance in developing Chapter 2 Computer-Aided Drafting (CAD); Sherwood Davis, Professor at Salt Lake Community College, for his revision of Chapter 27 Electrical and Electronic Drawings; and Dennis Short, Associate Professor in the

Technical Graphics Department of the School of Technology at Purdue University, for his development of the *Instructor's Wraparound Edition* and the instructional material to be included in *Instructor's Management System*.

The authors thank the many people who helped in the preparation of this edition including John Beck, the executive editor, Freida O'Neil-Robinson, the editor, and Jennifer King, the senior production editor.

The authors and staff of Glencoe/McGraw-Hill wish to express their appreciation to the following individuals for their professional review of the text and sample design.

Kenneth Arnold
Tulsa Equipment Manufacturing Co.

Michael Holler
Paragon Films, Inc.

Deb Rosenweig
York Technical Institute

Tom Brennan
ITT Technical Institute

Stanley Hopkins
New England Institute of Technology

M. Peter Saxon, III
Porter and Chester Institute

Judith Dalton
ITT Technical Institute

Tommy Justice
John Patterson State Technical College

Dan Steinke
ITT Technical Institute

Thomas Eddins
Clayton State College

Hamid Khan
Ball State University

Mostafa Tossi
Penn State Worthington Scranton

Melvin Freeman
Houston Community College

Harold Lott
Calhoun Community College

George Voll
ITT Technical Institute

Joseph Greenfield
Sunny College of Technology

Walter Reed
Oregon Polytechnic Institute

David Webb
Salt Lake Community College

Mel Hartley
Bessmer State Technical

PREFACE

Engineering Drawing and Design is written as an introductory course to prepare students for drafting careers in a modern, technology-intensive industry. Technical drafting, like all technical areas, is constantly changing. The computer has revolutionized the way in which drawings and parts are made. Thus, in this new edition, the authors have made every effort to translate the most current technical information available into the most useful form from the standpoint of both instructor and student. The latest developments and current practices in all areas of graphic communication, CAD, functional drafting, material representation, shop processes, geometric tolerancing, true positioning, numerical control, electronic drafting, and metrication have been incorporated into this edition. The approach used synthesizes, simplifies, and converts complex drafting standards and procedures into understandable instructional units.

Before beginning to work on this edition, a questionnaire was mailed to a number of users and non-users of the text requesting their input on text material and format. In response to the reviewers' suggestions and recommendations, we have incorporated major changes in the fifth edition. The suggestions and changes are:

1. Using a two-column format, rather than a three-column format, which is easier for students to read.
2. Updating the photographs of drafting and CAD equipment. The first three chapters of this edition provide up-to-date color photographs of drafting equipment. In addition, two eight-page color inserts are included as photo essays covering various engineering areas.
3. A greater selection of drawing and design projects. For this edition, we have added over three hundred projects throughout the text.
4. More information on geometric tolerancing and how to apply it to various drawings. This edition has three to four times more information and assignments on this subject than any other current text.
5. Deleting CAD icons and applications throughout the existing text. The reviewers felt that the CAD reference manuals which accompany CAD software packages provide adequate coverage of CAD usage.
6. Continuing to use the unit approach to teach the subject matter. Reviewers find this approach to be a real bonus. It allows them to readily put together a customized program that suits the needs of their students and local industry by choosing the appropriate units. This edition continues to divide chapters into mini-teaching units.
7. Supporting the design concepts covered in the text through drawing practice. While time constraints often limit the use of design units in the instructional program, graduates often find these concepts to be extremely useful in drafting and design experience. Instructors can choose those units they feel appropriate to their program.
8. Continuing to cover current ANSI and ISO drawing practices better than every other text. It is a basic requirement of any engineering drawing text to keep the instructors aware of the latest drawing standards and practices. In this edition, we again included the latest drawing standards on:
 - Methods of representation (Unit 6–1)
 - Symbols representation for installed rivets used in aerospace equipment (Unit 11–5)
 - Simplified representation on drawing (Unit 14–1), a new standard being prepared by ISO and ANSI

These simplified representations have been used for years by American industries as a cost-saving feature. They are covered in this edition of *Engineering Drawing and Design* as they have been since the second edition.

In addition to the major changes incorporated from the reviewers' recommendations, this edition also provides other new features including key terms and a new two-color design. Each chapter begins with the important terms and their definitions. The new two-color design is used to highlight the text's features and enhance its appearance.

Engineering Drawing and Design, 5th edition is supported by ancillary products including some which are new to this edition. The following summarizes the major changes in the instructor and student support material:

- *Instructor's Wraparound Edition of the Textbook.* For the first time, the drafting instructor has a comprehensive teaching guide. This unique and innovative two-color teaching guide combines the student edition with the instructor's edition to provide a wealth of teaching support. Chapter and part overviews, unit objectives, teaching tips, and critical thinking exercises specifically focus on major concepts. Real world engineering drawing facts and technical references provide an interesting learning link. Pop quizzes, evaluation standards, and reteaching strategies are combined into this unprecedented publication.
- *Instructor's Management System.* This comprehensive solutions manual details solutions to many of the end-of-chapter drawing problems. It also provides instructors with course objectives, instructional tips, teaching transparencies, and chapter tests.
- *Instructor's CD-ROM Program.* The CD-ROM includes all of the drawing solutions from the Instructor's Management System. It also provides tutorial drawings which are excellent for instructional use.

- *Problems Workbook for Engineering Drawing and Design.* Many reviewers suggested that we include a problems workbook to enable their students to have more practice. A correlated problems workbook is now available.
- *Text-Workbook for Geometric Tolerancing.* Many of the reviewers also suggested that we include additional coverage of geometric tolerancing in a separate book. This up-to-date text is intended for those instructors who emphasize geometric tolerancing in their program.

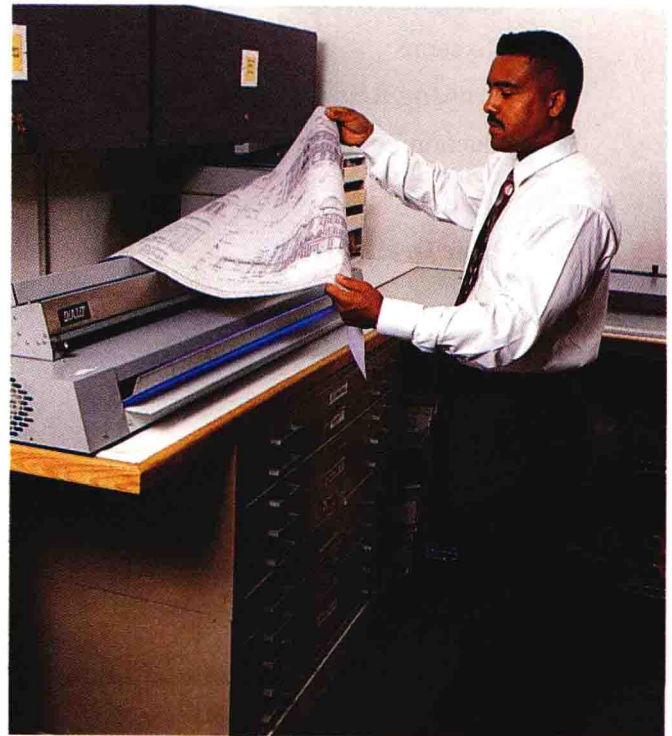
Comments and suggestions concerning this and future editions of the text are most welcomed.

Cecil Jensen and Jay Helsel

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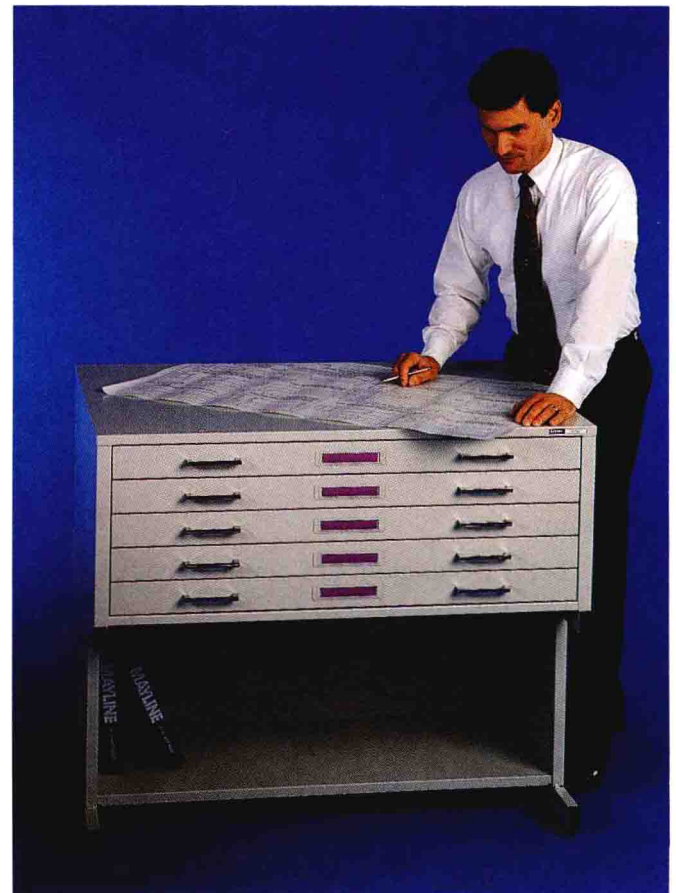
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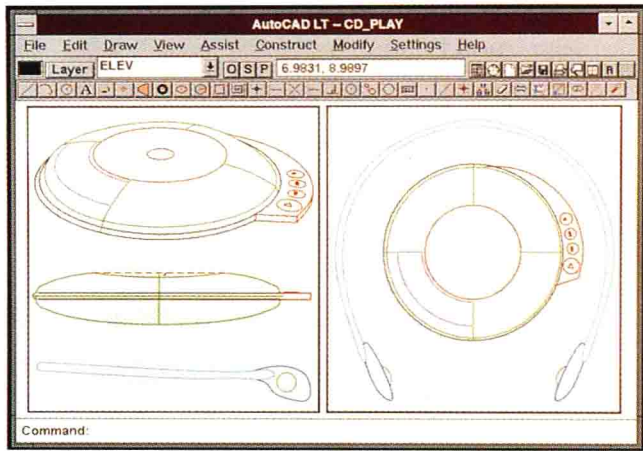
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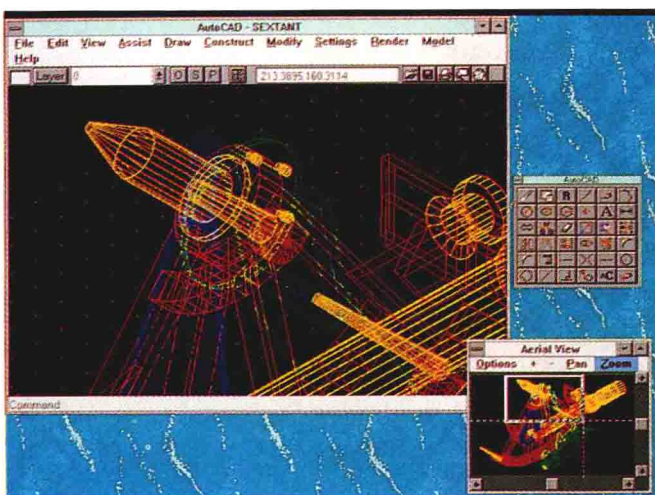
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