620.00222 RAS 2d ed.

CONTENTS

1 **DRAFTING PROCEDURES** 1

1.1 Drawing Types 3, 1.2 Technical Sketching 10, 1.3 Drafting Tools 12, 1.4 Drawing Details 20, Questions 36, Exercises 37

2 **DRAWING PRACTICES** 38

2.1 Pencil Work 38, 2.2 Ink Work 39, 2.3 Lettering Techniques 40, 2.4 Dimensioning Methods 44, 2.5 Dimensioning of Holes 46, 2.6 Tolerances and Limits 52, 2.7 Simplified Drafting 55, 2.8 Drafting Self-Aids 57, Questions 58, Exercises 59

3 **DRAFTING ROOM ROUTINE** 62

3.1 Numbering and Filing Drawings 62, 3.2 Drafting Room Engineering Standards 63, 3.3 Abbreviations 63, 3.4 Letter Symbols 71, 3.5 Index Systems 73, 3.6 Catalogues 73, 3.7 Reference Books and Magazines 74, 3.8 Engineering Information Sources 74, 3.9 Government Standards, Specifications, and Drawings 75, 3.10 Drawing Reproduction 75, Questions 76, Exercises 77

4 **COMPONENTS IN ELECTRONICS** 78

4.1 Preferred Values System 78, 4.2 Color-code System 79, 4.3 Capacitors 80, 4.4 Connection Devices 90, 4.5 Electron Tubes 94, 4.6 Indicating Devices 100, 4.7 Inductors 101, 4.8 Interconnection Components 103, 4.9 Relays 105,

4.10 Resistors 108, **4.11** Semiconductor Devices 117, **4.12** Switches 131, **4.13** Synchros 132, **4.14** Transformers 136, Questions 139, Exercises 141

5 **FASTENING AND DRIVING COMPONENTS** 143

5.1 Machine Screws 144, **5.2** Other Fastening Components 147, **5.3** Bonding with Adhesives 151, **5.4** Mechanical Driving Components 154, Questions 157, Exercises 158

6 **MATERIALS AND FINISHES** 159

6.1 Metals 159, **6.2** Plastics 164, **6.3** Ceramics 168, **6.4** Potting and Encapsulating Compounds 168, **6.5** Finishes 171, **6.6** Semiconductor Processes 173, Questions 173

7 **GENERAL ELECTRONIC DESIGN** 175

7.1 Tasks of the Designer 175, **7.2** Design Factors and Tasks 177, **7.3** Space Planning 183, **7.4** Panel Mounting Racks 184, **7.5** Types of Equipment 191, **7.6** Modular Construction 196, **7.7** Multilayer Boards 208, **7.8** Other Design Elements 215, **7.9** Design Techniques 219, Questions 225, Exercises 226

8 **CHASSIS AND THEIR COMPONENTS** 228

8.1 Types of Chassis 229, **8.2** Chassis Fabrication 233, **8.3** Chassis Sizes 240, **8.4** Chassis and Panel Design 241, **8.5** Component Boards 254, **8.6** Semiconductor Device Packaging 262, **8.7** Typical Component Dimensions 266, **8.8** Miniature and Subminiature Components 269, Questions 269, Exercises 270

9 **GRAPHIC SYMBOLS** 274

9.1 Graphic Standards 274, **9.2** Symbol Composition 275, **9.3** Graphic Symbols 277, **9.4** Details of Symbol Drawing 311, Questions 313, Exercises 315

10 **REFERENCE DESIGNATIONS** 320

10.1 Reference Designations for Consumer Equipment 324, **10.2** Electrical and Electronic Reference Designations for Military and Complex Equipment 328, Questions 336, Exercises 337

11 **GOVERNMENTAL REQUIREMENTS** 338

11.1 Government Specifications and Drawings 338, **11.2** Identification of Military Electronic Equipment 341, **11.3** General Specifications

for Military Electronic Equipment **341,** **11.4** General Requirements for Ground Electronic Equipment, MIL-E-4158 **343,** **11.5** General Requirements for Aircraft Electronic Equipment, MIL-E-5400 **345,** **11.6** General Requirements for Naval Ship and Shore Electronic Equipment, MIL-E-16400 **346,** Questions **351**

12 **ENGINEERING STANDARDS AND SPECIFICATIONS** **352**

12.1 Military Standards and Specifications **353,** **12.2** American National Standards Institute Standards **355,** **12.3** Electronic Industries Association Standards **355,** **12.4** Institute of Electrical and Electronics Engineers Standards **356,** **12.5** National Machine Tool Builders' Association Standards **356,** **12.6** Standards Issued by Other Organizations **356,** **12.7** Sources of Federal Government Standards **357,** Questions **357**

13 **SCHEMATIC DIAGRAMS** **358**

13.1 Basic Composition of Diagrams **358,** **13.2** Basic Stage Elements **362,** **13.3** Filter and Tuned Circuits **366,** **13.4** Semiconductor Circuits **368,** **13.5** Switch Circuitry **373,** **13.6** Microwave Circuit Diagrams **374,** **13.7** Logic Diagrams **374,** **13.8** Simplified Layouts **379,** Questions **382,** Exercises **383**

14 **DRAWING SCHEMATIC DIAGRAMS** **386**

14.1 Estimating Space Requirements **388,** **14.2** Individual Stage Layout **390,** **14.3** Switch Layout Details **394,** **14.4** Relay Circuits **397,** **14.5** Circuit Separation **399,** **14.6** Diamond and Angular Layouts **405,** **14.7** Microwave Diagram Practices **407,** **14.8** Logic Diagram Details **408,** **14.9** Miscellaneous Schematic Diagram Practices **412,** **14.10** Reference Designations **413,** **14.11** Diagram Layout **413,** Questions **426,** Exercises **428**

15 **CONNECTION OR WIRING DIAGRAMS** **439**

15.1 Component Details **439,** **15.2** Equipment Views **445,** **15.3** Conductors **446,** **15.4** Conductor Identification **452,** **15.5** Cable and Wiring Drawings **457,** **15.6** Connection Diagram Layout **459,** **15.7** Connection Diagram Types **468,** Questions **478,** Exercises **479**

16 **INDUSTRIAL ELECTRONIC DIAGRAMS** **483**

16.1 Diagram Definitions **484,** **16.2** Elementary Diagram Practices **485,** **16.3** Connection Diagram Practices **495,** Questions 500, Exercises 500

17 BLOCK DIAGRAMS 505

17.1 Symbols 505, **17.2** Blocks 506, **17.3** Line Details 508, **17.4** Lettering Details 512, **17.5** A Typical Block Layout 513, **17.6** Block Diagrams in Circuit Layout 515, **17.7** Miscellaneous Practices 515, Questions 517, Exercises 517

18 WIRING HARNESSES 522

18.1 Conductors 523, **18.2** Harness Drawing Development 524, **18.3** Harness Problems 528, **18.4** Harness Manufacturing Details 531, Questions 536, Exercises 537

19 PRINTED CIRCUITRY 539

19.1 Printed Wiring Processes 540, **19.2** Materials 541, **19.3** Board Assemblies 542, **19.4** Military Specifications for Printed Circuitry 542, **19.5** Conductors and Components 544, **19.6** Printed Board Design 554, **19.7** Printed Wiring Board Drawings 564, **19.8** Flexible Printed Cables 566, **19.9** Multilayer Printed Wiring Boards 574, Questions 577, Exercises 578

20 GRAPHIC DRAWINGS 582

20.1 Charts 582, **20.2** Graph Papers 583, **20.3** Scale Layout and Lettering 587, **20.4** Graph Layout 591, **20.5** Rectilinear Graphs 595, **20.6** Logarithmic Graph Layout 596, **20.7** Characteristic Curves 600, **20.8** Polar Graphs 600, **20.9** Graphs for Projection Slides 602, **20.10** Nornographs 604, Questions 606, Exercises 607

21 CHECKING ELECTRONIC DRAWINGS 610

21.1 Checking Drawings 611, **21.2** Checking Mechanical Drawings 611, **21.3** Checking Circuit Drawings 613, **21.4** Checking Harness Drawings 615, **21.5** Checking Printed Circuit Artwork 616, Questions 616

SELECTED BIBLIOGRAPHY 618

APPENDIX

INDEX 647