

*Chapter 41—Air Duct Design.* New tables giving circular equivalents of rectangular ducts are based upon formulas developed in latest ASHVE research. The treatment of losses occurring in systems has been enlarged and includes a detailed discussion of losses due to area changes. Under the subject of sizing ducts, three methods are outlined and examples are included.

*Chapter 46—Industrial Exhaust Systems.* Numerous revisions in fundamental design data have been added to keep this chapter in agreement with the latest knowledge on the subject.

*Chapter 47—Drying Systems.* New illustrations of dryers and new diagrams of drying operations are included in the rewritten and enlarged chapter. Problems in drying have been amplified. An example is given in the solution of a typical drying problem and the selection of a belt-type of dryer.

*Chapter 48—Transportation Air Conditioning.* This chapter has been rewritten in order to present current practice in design and control of heating, cooling and air conditioning systems in modern railway passenger cars, street cars, trolley coaches, passenger buses and aircraft. Special requirements for various types of planes are discussed.

*Chapter 52—Codes and Standards.* The record of codes and standards applicable to heating, ventilating and air conditioning has been reviewed, and references to the latest editions of the codes have been brought up to date. In addition, a reference column indicates where the codes may be obtained, and a list of addresses of the sponsoring organizations has been added.

The cross index of the Technical Data Section has been enlarged to facilitate reference to the technical text.

The high standard established by The Guide has been made possible by the contributions of many members, organizations and individual authorities in the past, as well as those who have devoted considerable time and effort to the improvement of the present edition. It is a pleasure to acknowledge this valuable service of the following contributors to the 27th edition:

|                  |                |                  |
|------------------|----------------|------------------|
| D. K. ADAMS      | A. A. GIANNINI | R. A. MILLER     |
| C. M. ASHLEY     | N. A. HALL     | M. M. MONTGOMERY |
| H. S. BEAN       | H. B. HEDGES   | H. B. NOTTAGE    |
| MERRILL BERNARD  | W. E. HEIBEL   | H. N. OSTBORG    |
| A. D. BRANDT     | F. K. HICK     | B. P. POSTMAN    |
| W. G. BROMBACHER | W. O. HUEBNER  | F. J. REED       |
| S. D. BROWNE     | E. F. HYDE     | R. W. ROOSE      |
| L. F. COLLINS    | W. C. JACOBS   | F. B. ROWLEY     |
| O. C. DAVIDSON   | R. C. JORDAN   | H. J. RYAN       |
| H. E. DEGLER     | J. M. KANE     | B. R. SMALL      |
| R. S. DILL       | A. J. KEATING  | L. A. STEVENS    |
| E. F. DU BOIS    | J. S. LOCKE    | J. P. STEWART    |
| M. R. EASTIN     | J. W. MILLER   | R. P. WARREN     |
| K. H. FLINT      |                | W. E. ZIEBER     |

The reader's attention is directed to the Catalog Data Section which provides concise information on the up-to-date products of 249 manufacturers. A cross index of manufactured products facilitates the finding of sources of supply for equipment needed in heating, ventilating and air conditioning installations.

The 1949 edition of The Guide is presented with the hope that the many improvements incorporated will make this volume increasingly valuable to the manufacturer, student, teacher and practicing engineer.

#### GUIDE PUBLICATION COMMITTEE

R. C. CROSS, *Chairman*

|              |                                           |                                 |
|--------------|-------------------------------------------|---------------------------------|
| A. B. ALGREN | NATHANIEL GLICKMAN                        | W. M. WALLACE, II               |
| R. L. BYERS  | B. H. JENNINGS                            | W. N. WITHERIDGE                |
| R. P. COOK   | H. R. LIMBACHER                           | CYRIL TASKER, <i>Ex-officio</i> |
|              | CARL H. FLINK, <i>Technical Secretary</i> |                                 |

## CONTENTS

| TITLE PAGE                                                      | PAGE      |
|-----------------------------------------------------------------|-----------|
| PREFACE                                                         | iii       |
| CODE OF ETHICS FOR ENGINEERS                                    | v         |
| INDEX TO TECHNICAL DATA                                         | viii      |
| INDEX TO ADVERTISERS                                            | ix        |
| INDEX TO MODERN EQUIPMENT                                       | ix        |
| MANUFACTURERS' CATALOG DATA                                     | 1025-1384 |
| <b>SECTION I. PRINCIPLES</b>                                    |           |
| Chapter 1. Terminology                                          | 1         |
| 2. Abbreviations and Symbols                                    | 11        |
| 3. Thermodynamics                                               | 23        |
| 4. Fluid Flow                                                   | 75        |
| 5. Fundamentals of Heat Transfer                                | 101       |
| 6. Heat Transmission Coefficients of Building Materials         | 115       |
| 7. Performance of Air Heating and Cooling Coils                 | 151       |
| 8. Air Leakage                                                  | 161       |
| 9. Natural Ventilation                                          | 169       |
| 10. Air Contaminants                                            | 179       |
| 11. Instruments and Measurements                                | 193       |
| <b>SECTION II. HUMAN REACTION TO ATMOSPHERIC ENVIRONMENT</b>    |           |
| Chapter 12. Physiological Principles                            | 213       |
| 13. Air Conditioning in the Prevention and Treatment of Disease | 233       |
| <b>SECTION III. HEATING AND COOLING LOADS</b>                   |           |
| Chapter 14. Heating Load                                        | 249       |
| 15. Cooling Load                                                | 271       |
| <b>SECTION IV. COMBUSTION AND CONSUMPTION OF FUELS</b>          |           |
| Chapter 16. Fuels and Combustion                                | 325       |
| 17. Automatic Fuel Burning Equipment                            | 349       |
| 18. Heating Boilers, Furnaces, Space Heaters                    | 373       |
| 19. Chimneys and Draft Calculations                             | 399       |
| 20. Estimating Fuel Consumption for Space Heating               | 417       |
| <b>SECTION V. HEATING SYSTEMS AND EQUIPMENT</b>                 |           |
| Chapter 21. Gravity Warm Air Systems                            | 433       |
| 22. Mechanical Warm Air Systems                                 | 443       |
| 23. Steam Heating Systems and Piping                            | 461       |
| 24. Hot Water Heating Systems and Piping                        | 503       |
| 25. Radiators, Convectors, Coils                                | 521       |
| 26. Unit Heaters, Unit Ventilators, Unit Humidifiers            | 545       |
| 27. Pipe, Fittings, Welding                                     | 561       |
| 28. Pipe Insulation                                             | 579       |
| 29. District Heating                                            | 595       |
| 30. Electric Heating                                            | 607       |
| 31. Panel Heating and Radiant Heating                           | 615       |
| 32. Fans                                                        | 631       |
| 33. Air Cleaning Devices                                        | 647       |
| 34. Automatic Control                                           | 663       |
| 35. Motors and Motor Controls                                   | 677       |
| <b>SECTION VI. AIR CONDITIONING</b>                             |           |
| Chapter 36. Unit Air Conditioners, Unit Air Coolers             | 697       |
| 37. Spray Apparatus                                             | 709       |
| 38. Dehumidification by Sorbent Materials                       | 735       |
| 39. Refrigeration                                               | 745       |
| 40. Air Distribution                                            | 783       |
| 41. Air Duct Design                                             | 807       |
| 42. Sound Control                                               | 837       |
| 43. Central Systems for Air Conditioning                        | 857       |
| 44. Owning and Operating Costs                                  | 873       |
| <b>SECTION VII. SPECIAL APPLICATIONS</b>                        |           |
| Chapter 45. Industrial Air Conditioning                         | 885       |
| 46. Industrial Exhaust Systems                                  | 895       |
| 47. Drying Systems                                              | 909       |
| 48. Transportation Air Conditioning                             | 927       |
| 49. Marine Heating, Ventilation, Air Conditioning               | 937       |
| 50. Water Services                                              | 947       |
| 51. Corrosion and Water Formed Deposits, Causes and Prevention  | 965       |
| <b>SECTION VIII. INSTALLATION AND TESTING CODES</b>             |           |
| Chapter 52. Codes and Standards                                 | 987       |
| <b>CATALOG DATA SECTION</b>                                     |           |
| Index to Advertisers                                            | 993       |
| Index to Modern Equipment                                       | 995       |
| Manufacturers' Catalog Data                                     | 1001      |