

90th ANNIVERSARY EDITION

4 2013
7531

MARKS'
STANDARD HANDBOOK
FOR
MECHANICAL
ENGINEERS

11th EDITION

EUGENE A. AVALLONE
THEODORE BAUMEISTER III

Contents

For the detailed contents of any section consult the title page of that section.

Contributors	ix
The Editors	xiii
Preface to the Eleventh Edition	xv
Preface to the First Edition	xvii
Symbols and Abbreviations	xix

1. Mathematical Tables and Measuring Units	1-1
1.1 Mathematical Tables	1-1
1.2 Measuring Units	1-16
2. Mathematics	2-1
2.1 Mathematics	2-2
2.2 Computers	2-40
3. Mechanics of Solids and Fluids	3-1
3.1 Mechanics of Solids	3-2
3.2 Friction	3-20
3.3 Mechanics of Fluids	3-29
3.4 Vibration	3-61
4. Heat	4-1
4.1 Thermodynamics	4-2
4.2 Thermodynamic Properties of Substances	4-32
4.3 Radiant Heat Transfer	4-63
4.4 Transmission of Heat by Conduction and Convection	4-79
5. Strength of Materials	5-1
5.1 Mechanical Properties of Materials	5-2
5.2 Mechanics of Materials	5-14
5.3 Pipeline Flexure Stresses	5-51
5.4 Nondestructive Testing	5-57
5.5 Experimental Stress and Strain Analysis	5-63
5.6 Mechanics of Composite Materials	5-71
6. Materials of Engineering	6-1
6.1 General Properties of Materials	6-3
6.2 Iron and Steel	6-12
6.3 Iron and Steel Castings	6-34
6.4 Nonferrous Metals and Alloys; Metallic Specialties	6-46
6.5 Corrosion	6-92
6.6 Paints and Protective Coatings	6-111
6.7 Wood	6-115
6.8 Nonmetallic Materials	6-131
6.9 Cement, Mortar, and Concrete	6-162

6.10	Water	6-171
6.11	Lubricants and Lubrication	6-180
6.12	Plastics	6-189
6.13	Fiber Composite Materials	6-206
7.	Fuels and Furnaces	7-1
7.1	Fuels	7-2
7.2	Carbonization of Coal and Gas Making	7-30
7.3	Combustion Furnaces	7-43
7.4	Municipal Waste Combustion	7-48
7.5	Electric Furnaces and Ovens	7-54
8.	Machine Elements	8-1
8.1	Mechanism	8-3
8.2	Machine Elements	8-10
8.3	Gearing	8-83
8.4	Fluid-Film Bearings	8-111
8.5	Bearings with Rolling Contact	8-127
8.6	Packings, Gaskets, and Seals	8-133
8.7	Pipe, Pipe Fittings, and Valves	8-138
9.	Power Generation	9-1
9.1	Sources of Energy	9-3
9.2	Steam Boilers	9-29
9.3	Steam Engines	9-56
9.4	Steam Turbines	9-58
9.5	Power-Plant Heat Exchangers	9-78
9.6	Internal-Combustion Engines	9-93
9.7	Gas Turbines	9-127
9.8	Nuclear Power	9-138
9.9	Hydraulic Turbines	9-154
10.	Materials Handling	10-1
10.1	Materials Holding, Feeding, and Metering	10-2
10.2	Lifting, Hoisting, and Elevating	10-4
10.3	Dragging, Pulling, and Pushing	10-22
10.4	Loading, Carrying, and Excavating	10-26
10.5	Conveyor Moving and Handling	10-42
10.6	Automatic Guided Vehicles and Robots	10-63
10.7	Material Storage and Warehousing	10-69
11.	Transportation	11-1
11.1	Automotive Engineering	11-3
11.2	Railway Engineering	11-18
11.3	Marine Engineering	11-40
11.4	Aeronautics	11-58
11.5	Jet Propulsion and Aircraft Propellers	11-83
11.6	Astronautics	11-104
11.7	Pipeline Transmission	11-139
11.8	Containerization	11-149
12.	Building Construction and Equipment	12-1
12.1	Industrial Plants	12-2
12.2	Structural Design of Buildings	12-19
12.3	Reinforced Concrete Design and Construction	12-37
12.4	Air Conditioning, Heating, and Ventilating	12-49
12.5	Illumination	12-98
12.6	Sound, Noise, and Ultrasonics	12-98
13.	Manufacturing Processes	13-1
13.1	Foundry Practice and Equipment	13-3

13.2	Plastic Working of Metals	13-9
13.3	Welding and Cutting	13-29
13.4	Machining Processes and Machine Tools	13-50
13.5	Surface Texture Designation, Production, and Quality Control	13-72
13.6	Woodcutting Tools and Machines	13-77
13.7	Precision Cleaning	13-80
14.	Fans, Pumps, and Compressors	14-1
14.1	Displacement Pumps	14-2
14.2	Centrifugal Pumps	14-15
14.3	Compressors	14-26
14.4	High-Vacuum Pumps	14-39
14.5	Fans	14-46
15.	Electrical and Electronics Engineering	15-1
15.1	Electrical Engineering	15-2
15.2	Electronics	15-68
16.	Instruments and Controls	16-1
16.1	Instruments	16-2
16.2	Automatic Controls	16-21
16.3	Surveying	16-52
17.	Industrial Engineering	17-1
17.1	Operations Management	17-3
17.2	Cost Accounting	17-11
17.3	Engineering Statistics and Quality Control	17-18
17.4	Methods Engineering	17-25
17.5	Cost of Electric Power	17-31
17.6	Human Factors and Ergonomics	17-39
17.7	Automatic Manufacturing	17-43
18.	The Regulatory Environment	18-1
18.1	Environmental Control	18-2
18.2	Occupational Safety and Health	18-18
18.3	Fire Protection	18-22
18.4	Patents, Trademarks, and Copyrights	18-27
19.	Refrigeration, Cryogenics, and Optics	19-1
19.1	Mechanical Refrigeration	19-2
19.2	Cryogenics	19-26
19.3	Optics	19-41
20.	Emerging Technologies	20-1
20.1	An Introduction to Microelectromechanical Systems (MEMS)	20-3
20.2	Introduction to Nanotechnology	20-13
20.3	Ferroelectrics/Piezoelectrics and Shape Memory Alloys	20-20
20.4	Introduction to the Finite-Element Method	20-28
20.5	Computer-Aided Design, Computer-Aided Engineering, and Variational Design	20-44
20.6	Introduction to Computational Fluid Dynamics	20-51
20.7	Experimental Fluid Dynamics	20-63
20.8	Introduction to Biomechanics	20-79
20.9	Human Injury Tolerance and Anthropometric Test Devices	20-104
20.10	Air-Inflated Fabric Structures	20-108
20.11	Robotics, Mechatronics, and Intelligent Automation	20-118
20.12	Rapid Prototyping	20-132
20.13	Miscellany	20-135