

3G Handy Guide:

Welding

2nd Edition

Features:

- ► Full Color Book plus DVD
- Over 100 hours Interactive
 E-lectures, Quiz and Videos in DVD
- DVD has many useful features for teachers to teach with digital resources in classroom





3G HANDY GUIDE: WELDING

2nd Edition



G HANDY GUIDE: WELDING

DEDITION



© 2023 3G E-learning LLC 90 Church Street FL 1 #3514 New York, NY 10008 United States of America www.3ge-learning.com email: info@3ge-learning.com

Authored and Edited by 3G E-learning LLC, USA

ISBN: 978-1-98468-083-9

All rights reserved. No part of this publication maybe reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning or otherwise without prior written permission of the publisher.

This book contains information obtained from highly regarded resources. A wide variety of references are listed. Reasonable efforts have been made to publish reliable data and information, but the authors, editors, and the publisher cannot assume responsibility for the legality of all materials or the consequences of their use. The authors, editors, and the publisher have attempted to trace the copyright holders of all material in this publication and express regret to copyright holders if permission to publish has not been obtained. If any copyright material has not been acknowledged, let us know so we may rectify in any future reprint.

Notice: Registered trademark of products or corporate names are used only for explanation and identification without intent of infringement. Case Studies and/or Images presented in the book are the proprietary information of the respective organizations, and have been used here specifically and only for educational purposes. Although care has been taken to check accuracy of formulas and procedures, the detailed methods should be tested further on a small scale before being adopted commercially.

For more information visit about 3G E-Learning LLC and its products, visit www.3ge-learning.com

TABLE OF CONTENTS



Preface
Chapter 1 Welding 3
Overview of Welding5
Need for Welding6
Advantage of Welding7
O.sadvantage of Welding8
Application of Welding8
Welding Equipment9
Classification of Welding Processes11
Types of Welding
The History of Welding14
Weld Joints
Welding Symbols29
Reference Line29
Arrow and Other Side30
Weld Symbols30
Dimensions and Other Data30
Supplementary Symbols30
Finish Symbols30
Tail31
Specifications, Process, or Other Information31
References32
Chapter 2 Physics of Arc Welding 35
Fundamentals of Arc Welding36
Structure and Characteristics of Welding Arc37
The Cathode Spot:

	ix
Electron Emission Mechanisms	3
The Cathode Drop Zone	
The Arc Column	
The Anode and the Anode Drop Zone:	
Types of Welding Arcs	
Methods of Initiating and Maintenance of the Welding Arc	e
Arc Initiation	47
Maintenance of Arc	49
Arc Characteristic	50
Temperature of the Arc	52
References	54
ReferencesChapter 3 Laser Welding	54 57
	57
Chapter 3 Laser Welding	57
Chapter 3 Laser Welding Principle and Mechanism of Laser Welding Ruby Laser Equipment and Setup of Laser	57 59
Chapter 3 Laser Welding Principle and Mechanism of Laser Welding Ruby Laser Equipment and Setup of Laser Welding	57 59
Chapter 3 Laser Welding Principle and Mechanism of Laser Welding Ruby Laser Equipment and Setup of Laser Welding Process Parameters for Laser Welding	57 596166
Chapter 3 Laser Welding Principle and Mechanism of Laser Welding Ruby Laser Equipment and Setup of Laser Welding Process Parameters for Laser Welding Weld Characteristics for Laser Welding	57 59 61 66 67
Chapter 3 Laser Welding Principle and Mechanism of Laser Welding Ruby Laser Equipment and Setup of Laser Welding Process Parameters for Laser Welding Weld Characteristics for Laser Welding Weld Joint Design for Laser Welding	57 59 61 66 67 68
Chapter 3 Laser Welding Principle and Mechanism of Laser Welding Ruby Laser Equipment and Setup of Laser Welding Process Parameters for Laser Welding Weld Characteristics for Laser Welding Weld Joint Design for Laser Welding Applications of Laser Welding	57 59 61 66 68 69 70
Chapter 3 Laser Welding Principle and Mechanism of Laser Welding Ruby Laser Equipment and Setup of Laser Welding Process Parameters for Laser Welding Weld Characteristics for Laser Welding Weld Joint Design for Laser Welding Applications of Laser Welding Variants of Laser Beam Welding:	57 59 61 66 67 69 70
Chapter 3 Laser Welding Principle and Mechanism of Laser Welding Ruby Laser Equipment and Setup of Laser Welding Process Parameters for Laser Welding Weld Characteristics for Laser Welding Weld Joint Design for Laser Welding Applications of Laser Welding Variants of Laser Beam Welding: Automation in Laser Beam Welding:	57 61 66 67 69 70 71
Chapter 3 Laser Welding Principle and Mechanism of Laser Welding Ruby Laser Equipment and Setup of Laser Welding Process Parameters for Laser Welding Weld Characteristics for Laser Welding Weld Joint Design for Laser Welding Applications of Laser Welding Variants of Laser Beam Welding: Automation in Laser Beam Welding: Safety Aspects of Laser Welding:	57 59 66 67 68 69 70 70

Solid State LASER	76	Chapter 6	Design of Weld Joints	145
The Excimer LASER	76	Racics of Wel	d Joint	146
References	77		Failure of the Weld Joints	
			Weld Joints and Mechanical	
Chapter 4 Heat Flow in Welding	81		operties	147
Weld Thermal Cycle	82		fecting the Performance of the	
Factors Affecting Welding Thermal Cycle	83		eld Joints	148
Cooling Rate	84		Weld Joints and Loading	1/18
Peak Temperature and Heat Affected Zone	88		elding Symbols	
Solidification Rate	90		Veld Joints	
Residual Stresses	91		Velding Position	
References	98		e Preparation in Welding	
			eld	
Chapter 5 Gas Welding	101		fecting Selection of Suitable Gro	
Process of Gas Welding	102		cometry for Edge Preparation	
Inert Gas Welding			nd Weld Bead Geometry	
Gas Metal Arc Welding			ld Joints for Fatigue Loading	
Different Types of Flames in Gas Welding			of Weld Joint Design for Fatigu	
Use of Gas in MIG Welding		Lo	ading	163
Need of Welding Torch		Factors Af	fecting Fatigue Life	
Types of Gas Welding		Material C	haracteristics	176
Gas Welding and Gas Cutting		Environme	ent	178
Thermochemical Processes		References		181
Progression in Weld Pass	117			
Gas Welding in Carbon Steel Plates and Tub		Chapter 7	Development and	405
Perform Surface Preparation	129		Safety in Welding	185
Gas Welding Equipment and Accessories	131	Developmen	t in Welding	186
The Principle of Pressure Regulator	133	Benefits of	Welding	187
Importance of Personal Protective		The Tools	of the Trade	188
Equipment (PPE)		Misconcep	otions and Lack of Information.	189
Tanks or Cylinders Secured in a proper pla		The Weldi	ng Industry and Its Future	190
References	142	Safety Precau	itions During Welding	196
		Confined	Space Working	202
			g Fire and Explosion	
		Electrical	Hazards	204
		Controllin	g the Risks from Welding	206

LEV for the most common types of Manual	Personal Protective Equipment (PPE)	211
Welding Processes208	References	
Respiratory Protective Equipment (RPE)209		
Other Workers in the Area210	Glossary	215
	Index	219

NDEX

A

Arc plasma 81 Arc welding 35, 36, 45, 46 Automated welding system 7, 8 Automobile industry 8, 17

B

Blacksmith 5 Butt joint 146, 150, 154

C

Carburization 3, 5
Chemical composition 6
Coalescence 102
Control system 107
Cooling rate 82, 83, 84, 85, 86, 87, 88, 90, 91, 94, 95
Corner joint 146, 150, 151, 154

E

Economic health 187 Edge joint 146, 150, 152, 155 Elastic deformation 147 Electric arc 35, 36, 47, 49 Electric arc welding 145 Electrode holder 186, 204 Electron emission 39 Energy density process 83 Excitation energy 40

F

Fabrication process 3, 145
Fatigue loading 148, 149, 158, 163, 167, 170, 173, 176
Filler material 101, 105, 115, 118, 127
Fuel gas 101, 102, 103, 112, 115, 126, 132

G

Gaseous region 41
Gas metal arc welding (GMAW) 189
Gas tungsten arc welding (GTAW) 189
Gas welding 101, 102, 103, 110, 115, 116, 127, 134

H

Hazardous workplace activity 185 Heat affected zone (HAZ) 146 Heat source 82, 84, 94 High energy density 83 Hypo-eutectoid steel 85

I

Inert gas welding 105, 106 Iron-making techniques 5

welding

J

Join metal 101, 111, 114

K

Kinetic energy 39 Kitchen utensil 5

L

Laser welding 57, 58, 67, 73 Load resistor 37

M

Mechanical performance 148
Mechanical strength 7
Metal inert-gas/metal active-gas (MIG/MAG)
welding 81
Metal inert gas welding (MIG) 105
Metallurgical notch 9
Microstructure 8, 10
Mobile cathode spot 38, 46
Molten metal 81, 82, 92, 102, 106, 107, 116, 127

0

Ordinary light 59 Oxide film 38 Oxyacetylene welding 102, 118 Oxy-fuel welding 103, 116

P

Power density 57, 58, 61, 66 Pulsed spray transfer 108

BOOK

Q

Quantum energy 59

S

Safety measure 104
Shielded metal arc welding (SMAW) 189
Shielding gas 35, 36, 44, 47, 52, 53
Solidification 81, 84, 90, 91, 96
Spectral range 59
Static loading 147, 162, 165
Submerged arc welding (SAW) 189
Surface preparation 146
Surface tension 58
Synergic control 108

T

Thermal conductivity 84, 87, 90, 91 Thermal cycle 82, 83, 84, 85, 88, 92, 93 Thermoplastics 57 Tungsten inert-gas (TIG) welding 81

W

Welded blades 3, 5
Welding industry 186, 189, 190, 191, 194, 196
Welding joint 145, 146, 152
Welding process 3, 7, 11, 12, 15, 18, 19, 20, 21, 22, 31
Welding safety 185
Welding speed 57
Welding technician 188
Weld metal deposition 106
Wire electrode 106, 112