

RESISTANCE WELDING SAFETY FOR OPERATORS

**By
Bob Szabo**

**Edited by
Beth Szabo**

Copyright © 2004, by Bob Szabo

All Rights Reserved

Acknowledgment

Special thanks to Letty Szabo, assistant editor; Jennifer Szabo, web design; and to Bill Roden, Dr. David Dickinson, Gerry Burchard, and Tom Croucher (PE) for their reviews. And to all of the people that we worked with who provided valuable input to this book.

Library of Congress Control Number: 2004091731
ISBN: 0-9749956-0-6

No part of this publication can be reproduced in any way, shape, or form, copied, or distributed as electronic media, or any other form of reproduction without the express, written permission of Szabo Publishing. International copyright protection is provided for this publication by existing treaties between the US and most countries throughout the world. The Copyright Act imposes severe financial liability and penalties on the infringer.

WARNING:

This is a special information book for readers who already have resistance welding experience. It is not a technical how-to book or a specification for resistance welding safety, arc, gas, or any other kind of welding. Due to the variety of resistance welding environments and changes to safety practices and equipment designs, the correctness of the book cannot be guaranteed. Safety is a broad subject and cannot be completely covered in any one source such as this. Therefore the purchaser or reader of the book is hereby notified that the author cannot guarantee or make any claim of accuracy of the book or that it covers all possible safety perils around resistance welding. A table of contents for disclaimers and warnings is on p. xvi. If these warnings, disclaimers, or other items in the book are unacceptable, you may return this book for a refund. Please enclose proof of purchase.

Published by Szabo Publishing
<http://www.szabopublishing.com>

Table of Contents

Chapter 1

INTRODUCTION 17

1-1.	What if it happened to you?	17
1-2.	Odds of making a mistake	18
1-3.	Safety dysmorphic disorder	18
1-4.	Resistance welding background	19
1-5.	Scope of the book	19
	Our sincere condolences	20
1-6.	Summary of what to expect	20
1-7.	Disclaimer	21
	Warning	21

Chapter 2

GENERAL SAFETY 23

2-1.	Overview	23
2-2.	Weld sparks	24
	Why weld sparks?	25
2-3.	Eye protection from weld sparks	26
	Broken safety glasses	26

	Cup over injured eye	27
	Generally no shaded glasses	27
2-4.	Protection from burn injuries caused by weld sparks	28
	Sparks ignite clothing	28
	Smoldering hair	29
2-5.	Burning injury from overheated components	30
2-6.	Molten copper from blown transformer	30
	Blown transformer	31
	Note to the electrician or maintenance person	31
2-7.	Substance abuse	32
	Amazing production rate	32
2-8.	Alcohol or drug use and welding	34
2-9.	What is it like to be at fault?	34
2-10.	Sheet metal cut	35
	Serious sheet metal cut injury	35
2-11.	Welding electrical power disconnect	36
	Welding machine hung up!	37
	Stand to the side of a weld power disconnect device	37
	Weld control automatic provisions	38
	Disconnect device does not always work	38

Chapter 3

PINCH POINT SAFETY 39

3-1.	Overview	39
3-2.	Weld cycle starts	40
3-3.	Inhibiting false or random initiation	40
	Pinch point weld control risk	40
	Warning about older weld controls	41
	Note to maintenance	41
3-4.	Pinch from power up or down	42
	Stored energy immediate risk	43
	Stored energy delayed risk	43
3-5.	Pinch from hang up after initiation	45

	Weld gun closer injury	45
	What to do in this emergency?	45
	Hang up initiation test	46
3-6.	Out-of-reach safety controls require two people to be present	47
3-7.	Getting bumped or pinned	47
3-8.	Lockout or lockout/tagout	47
	Lockout helps to puts you in control	48
	Lockout/tagout	48
	Machine started with employee inside	49
3-9.	Escape route	49
	Operator jumps from weld tool	50
	Press crushes operator	51
3-10.	Broken air pressure hose	52

Chapter 4

TYPES OF OPERATOR PROTECTION 53

4-1.	Overview	53
	Resistance welding evolution	54
4-2.	Types of load/weld/unload setups	54
	Load/unload separate from weld station	54
	Load/unload same as weld station	55
4-3.	Types of initiation	56
	Hand trigger initiation	56
	Other hand at risk	57
	Trigger guard	57
	Foot pedal initiation	57
	Operator hands at risk with foot pedal initiation	58
	Added protection to foot pedal initiation	58
	Single stage foot pedal	59
	Dual stage foot pedal	59
4-4.	Retraction	59
	Pinch risk from retraction	60
	Momentary or sustained retraction control	61
	Pinch risk both ways	61

4-5.	Dual palm buttons initiation	62
4-6.	Anti-tie-down	63
	Anti-tie-down defeated	63
	When anti-tie-down is defeated and it should not be	64
4-7.	Anti-repeat	64
4-8.	Portable weld gun with aggressive personality	65
4-9.	Operator presence-sensing safety devices	65
	Safety light curtain (photo-electric presence-sensing device)	66
	Safety mat (pressure-sensitive surface)	66
	Other devices	66
4-10.	Fail-safe operation	67
	Non-operative safety devices that are not fail-safe	68
	Safety device dependency	68
	Presence-sensing devices are even more complicated	69

Chapter 5

SAFETY AND INITIATION 71

5-1.	Inhibit initiation not interrupt the weld cycle!	71
	Operator injury from not stopping initiation	72
	Note to management and maintenance	72
	Presence sensing safety devices that interrupt a sequence	73
	Yet another problem with safety interrupts	73
	16 hrs. setup after emergency stop	74
5-2.	Stored energy sources	74
	Hidden stored energy	75

Chapter 6

SAFETY FROM EXCESSIVE NOISE 77

	Disclaimer:	77
6-1.	Loud noise effect on hearing loss	77
	Noise measurement	78
	Hearing loss now or later	78
	Hearing loss is more than a personal problem	79
6-2.	Loud noise can cause ringing in the ears	79
6-3.	Summary	80

Chapter 7

ELECTRICAL SAFETY DISCUSSION 83

7-1.	Nature of electrical shock	84
	Examples of voltage values	84
	Risk from inside a weld control cabinet	85
	Unknown shock hazards	85
7-2.	Consider the current pathway in your body	86
	Voltage contact points	86
7-3.	Resistance welding electrode voltage levels	87
	Note to the electricians	88
	Please take note of high voltage machines	89
	Those big monstrous machines	89
	Disclaimer for specific higher voltage machines	
	with capacitive discharge power supplies	89
	Small bench type resistance welding machines	90
	Valves, positioners, and motors	90
	Welding transformer voltage levels	90
7-4.	Electrical grounding	92
	Car electrical ground	93
	Welding machine ground	93
	Grounded machine frame	93
	Ground connection not fail-safe	96
	Shock from a weld control box	96
	Electrical risk possible but infrequent	97

	Ungrounded weld guns	98
7-5.	Electrical risk involving the weld power supply	99
	Grounding reactor	99
	Isolation contactor	100
	Isolation contactor timing	101
	Isolation contactor on all the time	102
	Machine build shop safety oversight	102
	Isolation contactor operation is music to an operator's ears	102
	The operator is a good symphony critic	103
7-6.	Wet concrete	104
	I have rubber-soled shoes. So no shock risk.	
	Maybe yes. Maybe no!	105
	I stand on a rubber safety mat. So no shock risk.	
	Maybe yes. Maybe no!	106
7-7.	Firing too soon	106
7-8.	Weld gun misses the part	107
7-9.	Summary	108

Chapter 8

AIRBORNE CONTAMINATE DISCUSSION 109

	Disclaimer	109
8-1.	Introduction	109
8-2.	Resistance welding electrode air contaminates	111
	Copper story	111
	Arthritis and copper machining	111
	Copper air contaminates	112
8-3.	Copper alloys	112
	Chrome and zirconium copper alloys	112
	Cadmium copper alloy	113
	Beryllium copper alloy	113
	Grinding beryllium copper in-place	114
	Grinding copper tooling	114
8-4.	Galvanized metal airborne contaminates	115
	Galvanize odor	116
8-5.	Oil mist from air cylinders	116

	Dry lube cylinders	116
8-6.	Weld-through sealants (and adhesives)	117
8-7.	Airborne contamination from burned sealants (and adhesives)	118
8-8.	Combinations of air contaminants	118
	Bad combination of fumes	119
	Peculiar symptoms	119
8-9.	Effects of other compounds	120
8-10.	Weld metal dust	120
8-11.	Air contamination problem can be mobile	121
8-12.	Skin contact or ingestion warning	121

Chapter 9

MAGNETIC FIELD DISCUSSION 123

9-1.	Introduction	123
	Warning	123
9-2.	Resistance welding magnetic field	124
	Cannot feel large magnetic field	124
	Insect in a large magnetic field	124
	Magnetic metals	125
	Non-magnetic metals	126
9-3.	Implanted heart defibrillator or pacemaker	126
	Disclaimer	126
	Introduction	126
	Defibrillator or pacemaker problem in an industrial environment	127
	Risks from other machines	128
	Medical community can help	129
	A consideration for both	129
	Higher current and magnetic field from current surge	130
	AC and DC machines	131
	Determine a safe distance	132
	Once the decision for testing has been made	132
9-4.	Other electric medical devices	133
9-5.	Conclusions	133

Warning: patient may not fit in	134
Some environments could be a problem	134

Chapter 10

SAFETY AND THE TYPE OF WELDING MACHINE

135

10-1. Operator held portable weld gun	135
Pinch point	135
Weld gun jerking	136
10-2. Electrical risk with portable weld guns	137
Low voltage trigger and valves	137
Higher voltage welding power supplies	138
When a safety ground should be there and it is missing	139
No ground	139
Note to the electrician	140
Wrong transformer	140
The right transformer is not always evident	140
Footnote to electrician	141
Ground cable not connected	141
Note to the electrician	141
Portable weld gun arm arc outs	142
10-3. Counterbalance cable	142
Counterbalance cable insulation requirement	142
Good-by weld gun	143
Alarm! Alarm! Alarm!	144
An afterthought	144
10-4. Stationary press type and rocker arm welding machines	145
Pinch point risk	145
Electrical risk	145
High powered press type and rocker arm welding machines	146
Welding machine blows electrodes	146
Preoccupied	147

	Big power	147
	Welding machine trips city power	148
10-5.	Seam welding	148
	Pinch point	149
	Electrical safety	149
10-6.	Projection welding	150
	Pinch point	150
	Electrical safety	150
	Weld sparks	150
	Projection weld sparks	151

Chapter 11

WELDING AUTOMATION SAFETY 153

11-1.	Operator load station with an industrial robot	153
	Pinch and pinning risk	154
	Non-routine automated robot movement	155
	How could this be a problem?	156
	The problem with a warning	156
	Enabling switch	157
	Spotter	158
	Cowboys	158
	Robot run-away	158
	When safety devices are defeated	158
	Electrical risk	159
	Robot Summary	159
11-2.	Operator load multi-electrode welding machines	160
	Pinch or pinning risks	160
	Electrical risk involving the weld tool	161
	Ungrounded weld guns or part locators	162
	Risk from welding machine stop	163
	Cycle end stop	163
	Emergency stop	163
	Breakdown stop	164
	Recognizable breakdown stop	165
	Unrecognizable breakdown stop	165

End of the shift	166
Operator leaves line in breakdown stop	166
11-3. Operator load multi-station weld line	167
Pinch, pinning, or bump risk	167
Delayed start	168
Cycle interrupt	168
The moment before eternity	169

Chapter 12

SAFE WORK HABITS 171

12-1. Assuming that it is safe	171
Assumed it was safe	171
12-2. Conditioned response and habits	172
Foreman touches 277 volts	172
Analysis	172
12-3. Imaginary wall of safety	173
Two step safety wall	173
Mind control	174
12-4. Personal responsibility	175
Asleep at the wheel	175
12-5. General safety inspection	175

Chapter 13

SAFETY COMMUNICATION 177

13-1. The beginning of a shift	177
Operator starts the shift on a line	
in breakdown stop	177
Management/shift competition	178
13-2. Knowledge and encouragement	179
Operator's unique knowledge	180
Operator/supervisor safety encouragement	180
13-3. Almost-accident or near-accident reports	180
Hard time with accident reports	181
Good applications for almost accident reports	181
13-4. On-line safety logbook	182

Chapter 14

WHAT HAPPENS WHEN YOU GET INJURED ON THE JOB? 183

Disclaimer	183
14-1. Some important information regarding workers' comp.	184
14-2. Injury leads to unforeseen outcome	185
14-3. Additional unforeseen outcomes	186

Chapter 15

CLOSING REMARKS 189

SUMMARY CHECKLIST 191

• INTRODUCTION	191
Now and in the future	191
• DISCLAIMER	192
Safety and productivity disclaimer	192
• ABOUT THE CHECKLIST	193
Note	193
• GENERAL RISKS	194
• MACHINE CONFIGURATION SAFETY	205
• SAFETY WITH THE WELDING AUTOM. TYPE	211
• SAFE WORK HABITS	217
• SAFETY COMMUNICATION	218

About the Author 221

Common Terms 225

References 233

Table of Contents

Disclaimers & Warnings

1. INTRODUCTION	
Our sincere condolences	20
1-7. Disclaimer	21
Warning	21
6. SAFETY FROM EXCESSIVE NOISE	
Disclaimer:	77
7. ELECTRICAL SAFETY DISCUSSION	
7-3. Resistance welding electrode voltage levels	
Please take note of high voltage machines	89
Disclaimer for specific higher voltage machines	
with capacitive discharge power supplies	89
8. AIRBORNE CONTAMINATE DISCUSSION	
Disclaimer	109
8-12 Skin contact or ingestion warning	121
9. MAGNETIC FIELD DISCUSSION	
9-1. Introduction	
Warning	123
9-3. Implanted heart defibrillator or pacemaker	
Disclaimer	126
<u>No info. ... capacitance/electromag./medical</u>	132
10. SAFETY AND THE TYPE OF WELD MACHINE	
10-2. Electrical risk with portable weld guns	
<u>No info. ... portable transgun</u>	137
14. WHAT HAPPENS WHEN YOU GET INJURED ...	
Disclaimer	183
CHECKLIST	
Disclaimer	192

CHAPTER 1

INTRODUCTION

This book is all about operator safety around resistance welding. It contains information for resistance welding operators, maintenance people, supervisors, engineers, consultants, contractors, and machine builders. Some of it is technical, but most of it is discussed in layman terms.

1-1. What if it happened to you?

Assume that you are a spot weld operator. Imagine yourself at work. You look down at your watch; it is the beginning of the shift. You have the rest of your shift ahead of you. You walk across a damp factory floor to the weld tool. The light above your head flickers, the sound of your steel toed shoes creak with every step. In the background you can hear the sound of the machines starting up and workers pouring in, chatting amongst themselves. You reach for a part that was left in the weld tool, and suddenly you feel your body tense with excruciating pain, then you black out into oblivion. You're dead.

If this were to ever happen to you or someone you knew there would always be the question "did this have to happen?" The

answer is no. The cause of this mishap is an electrical fault in the machine, together, with an absence or breakdown of an electrical protection device and a failure in shift-to-shift communication. It is not complex and is in the many subjects to be discussed in this book.

1-2. Odds of making a mistake

Many situation comedies on TV and in movies have depicted people making mistakes for entertainment purposes. For every 100 moves that you make in real life, how many times do you make a mistake? Drop something, bump your head, trip, or forget something? Think of 100 people that you know. How many have been in an auto accident? How many have been injured or died from one of these accidents?

Now imagine the next 100 moves that you do around an industrial work environment like resistance welding. What are the chances of a mistake as frequent as an auto accident? How about the next set of 100 moves? What can be the cost of that mistake; a minor or serious injury, someone's life, or your life?

1-3. Safety dysmorphic disorder

Body dysmorphic disorder (BDD) is a mental ailment. It is when a person sees himself in some unusual manner such as too skinny no matter how overweight he is, or too fat no matter how skinny he is. A person can have safety dysmorphic disorder (SDD, a term made up in this book; see p. 230). An ailment where his work area is dangerous and he sees it as safe, or even the alternate where his work area is safe, and he sees it as dangerous.

Much of the information is presented as a discussion of known safe practices around resistance welding machines to reinforce safety. A lot of information is provided so that a work environment can be re-evaluated to maintain safety. Hopefully, an unrealistic SDD is not developed in a worker from misunderstandings, and a realistic attitude about safety is instead maintained.

1-4. Resistance welding background

Resistance welding is a low cost process used to join sheet metal. A lot of jobs have been made possible by the low cost characteristics of resistance welding to make strong and reliable products. It has many cost saving benefits over other joining methods, such as no extra filler metal or fasteners, and it is easy to do. The world has enjoyed many resistance welded products. Automobile bodies, appliances, computer chassis, furniture, and many aerospace frames are examples. With proper provisions resistance welding is also a relatively safe process.

1-5. Scope of the book

It is applicable to many environments:

- production plants that use resistance welding
- resistance welding machine and automation builders
- resistance welding component suppliers
- job shops that do resistance welding
- resistance welding research and development facilities
- education, library, government, and information facilities.

Several subjects about operator safety are discussed. They are about resistance spot, seam, and projection welding for industrial sheet metal. Some of the discussion may apply to other forms of resistance welding as well (such as flash and upset butt welding).

This book is written around manufacturing in the USA, although much of the discussion applies to manufacturing in other countries that use similar utilities and machines.

Technical information is based on common industry specifications, standards, and work practices. In the event that your situation deviates from common practices, you should keep this in mind when reading this book as the information may or may not apply. Narratives are stories taken from experience and in some cases second hand information.

Buy this book
from
T. J. Snow Company

insidesales@tjsnow.com

(423) 894-6234