

CONTENTS

Subjects	Page No.
Title Page	i
Certificate of Approval	ii
Certificate	iii
Declaration	iv
Acknowledgements	v
List of Symbols	vi
List of Abbreviations	vii
Abstract	viii
Contents	ix
 Chapter 1 Introduction	
1.1 General	1
1.2 Motivation of the present work	1
1.3 Objectives of the work	4
1.4 Layout of the work	5
 Chapter 2 Literature Review	
2.1 Introduction	7
2.2 Strength of spot-welded joints	7
2.2.1 Procedure to determine strength of spot-welded joints	7
2.2.2 Earlier works on strength of spot-welds	11
2.2.3 Failure mode of spot-welded joints	15
2.2.4 Strength of spot-welds under combined mode loading	15
2.3 Performance of spot-welds in corrosive environment	21
2.4 Fatigue strength of spot-welded joints	22
2.5 Toughness of spot-welded joints	27
2.5.1 Stress intensities and forces at spot-welded joints	27
2.5.2 Determination of impact toughness and fracture toughness of spot-welds	31
2.6 Appraisal of the present problem	33

Chapter 3	Characterization of the Selected Interstitial Free Steel Sheets	
3.1	Introduction	35
3.2	Experimental procedure	35
3.2.1	Materials	35
3.2.2	Metallographic examinations of the steel sheets	36
3.2.2.1	Microstructure	36
3.2.2.2	Grain size measurement	37
3.2.2.3	Inclusion characterization	37
3.2.3	Hardness measurement	38
3.2.4	Tensile tests	38
3.3	Results and discussion	39
3.3.1	Characterization of selected steels	39
3.3.1.1	Microstructural Characterization	39
3.3.1.2	Mechanical Properties	42
3.3.2	On the nature of the selected steels	45
3.4	Summary	49
Chapter 4	Strength and Fracture Behaviour of Spot Welds on Interstitial Free Steel Sheets	
4.1	Introduction	51
4.2	Experimental details	52
4.2.1	Spot welding procedure	52
4.2.2	Fabrication of specimens for measurement of strength	53
4.2.3	Macroscopic and microscopic examinations of the weld nuggets	55
4.2.4	Determination of hardness distribution along the spot-welds	56
4.2.5	Determination of strength of spot-welds	57
4.2.6	Post-failure examination of the spot-welds	57
4.3	Results and discussion	58
4.3.1	Structural characteristics of the spot-welds	58
4.3.2	Hardness profile along the spot-welds	62
4.3.3	Failure loads and failure stresses	64
4.3.4	Fracture toughness values of the spot-welded joints	75
4.3.5	Post failure examination of the spot-welds	78
4.4	Conclusions	82

Chapter 5	Effect of Pre-strain on the Strength of Spot Welds	
5.1	Introduction	85
5.2	Experimental details	86
5.2.1	Pre-straining of specimen blanks	86
5.2.2	Transmission electron microscopy (TEM) of spot-welds	87
5.3	Results	88
5.3.1	Tensile behaviour of pre-strained sheets	88
5.3.2	Characteristics of the spot-welds	89
5.3.3	Hardness profile along the spot-welds	91
5.3.4	Effect of pre-strain on the strength of spot-welds	93
5.3.5	Post failure examinations	96
5.3.6	TEM observations at the weld nugget	98
5.4	General comments	98
5.5	Conclusions	101
 Chapter 6	 Effect of Bake Hardening on the Strength of Spot Welded Joints	
6.1	Introduction	103
6.2	Experimental procedure	104
6.2.1	Bake hardening of selected steel sheets and determination of their tensile behaviour	104
6.2.2	Preparation of spot-welded samples and subsequent baking treatment	104
6.3	Results and discussion	105
6.3.1	Tensile properties of as-received, pre-strained, and bake hardened steel sheets	105
6.3.2	Characteristics of the spot-welds	107
6.3.3	Strength of spot-welds on the selected ultra low carbon bake hardening steels	111
6.3.4	Post failure examinations	115
6.4	Conclusions	116
 Chapter 7	 Effect of Corrosive Environment on the Strength of Spot Welds	
7.1	Introduction	119
7.2	Experimental procedure	120
7.2.1	Determination of strength of spot-welds in corrosive	121

	environment	
	7.2.1.1 Determination of strength after immersion in 3.5% sodium chloride solution	121
	7.2.1.2 Slow strain rate tensile test in 3.5% sodium chloride solution	122
	7.2.1.3 Slow strain rate tests under cathodic hydrogen charging	122
7.3	Results and discussion	123
	7.3.1 Characterization of the spot-welds	123
	7.3.2 Strength and ductility of spot-welds	124
	7.3.3 Failure of spot-welds after immersion in 3.5% sodium chloride solution	125
	7.3.4 Slow strain rate tensile test in 3.5% sodium chloride solution	128
	7.3.5 Slow strain rate tests under cathodic hydrogen charging	131
7.4	Conclusions	135
Chapter 8	Toughness of Spot Welds on Interstitial Free Steel Sheets under Impact Loading Condition and the Effect of Pre-strain	
8.1	Introduction	137
8.2	Experimental procedure	138
	8.2.1 Determination of impact tensile toughness of spot-welded joints	138
8.3	Results and discussion	141
	8.3.1 Impact energy of spot-welds	141
	8.3.2 Effect of pre-strain on impact energy of spot-welds	142
	8.3.3 Comparison of impact energies of spot-welds with their quasi-static energies	145
	8.3.4 Post-impact test examinations of spot-welds	149
8.4	Conclusions	151
Chapter 9	General Conclusions and Suggestions for Future Work	153
References		159
Appendix-I		171
Curriculum Vita		